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Frank Weiß

Consumerization: Enabling the Introduction of IT Services for Mobile Consumer Devices

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Frank Weiß

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Frank Weiß

Zusammenfassung

Problemstellung IT-Innovationen, die für den Privatgebrauch entworfen wurden, dringen verstärkt ins betriebliche Umfeld ein. Dieser Trend, der als „Consumerization of IT“ bezeichnet wird, wird einen nachhaltigen Einfluss auf das Informationsmanagement haben und IT-Verantwortliche in den nächsten Jahren fortlaufend vor neue Herausforderungen stellen. Im Zuge dieses Trends bahnen sich mobile Endgeräte des Verbrauchermarktes (sogenannte „mobile Konsumentenmarkt-Endgeräte“), wie etwa auf iOS oder Android basierende Smartphones und Tablets, ihren Weg in die Unternehmen. Die betriebliche Nutzung von Technologien, die ursprünglich für die Privatnutzung vorgesehen waren, bietet Unternehmen diverse Vorteile, erzeugt für IT-Entscheider weltweit aber auch Problemstellungen. Insbesondere, die Bewertung des hierbei zu erwartenden Mehrwerts stellt eine Forschungslücke und eine entscheidende Herausforderung dar, welche die betriebliche Einführung von IT-Dienstleistungen auf mobilen Konsumentenmarkt-Endgeräten bremst.

Lösungsansatz Es ist zum einen das Ziel dieser Arbeit die mit der Nutzung von mobilen Konsumentenmarkt-Endgeräten einhergehenden Auswirkungen auf betriebliche IT-Abteilungen zu untersuchen – Herausforderungen die erzeugt und Gegenmaßnahmen die angewandt werden. Zweitens zielt diese Arbeit insbesondere darauf ab einen strukturierten Ansatz für die Bewertung des Mehrwerts der Nutzung von IT-Dienstleistungen auf mobilen Konsumentenmarkt-Endgeräten bereitzustellen, um deren betriebliche Einführung zu ermöglichen. Diese Herausforderung wird in der Literatur diskutiert und durch Erkenntnisse aus der Praxis gestützt. In der vorliegenden Arbeit ist eine Methode erstellt worden, die IT-Abteilungen in die Lage versetzt nicht nur mehrwertstiftende Ideen für IT-Dienstleistungen zu definieren, sondern auch deren vielfältigen Produktivitäts-Mehrwert vorab zu bestimmen, darzustellen und auf einer abstrakten Ebene zu quantifizieren.

Forschungsmethodik Es sind Fallstudien durchgeführt worden, um die Auswirkungen der Nutzung von mobilen Konsumentenmarkt-Endgeräten auf IT-Abteilungen zu erforschen. Die Basis für die Identifikation von Herausforderungen der Geräte- bzw. IT-Service-Nutzung und für die Extraktion von möglichen Gegenmaßnahmen bilden vier Fallstudien mit multinationalen Unternehmen, unterschiedlicher Industrien. Die Fallstudienuntersuchung basiert auf einer Analyse von Dokumenten und einer Auswertung von Interviews, die mit 27 Experten über die vier Unternehmen hinweg durchgeführt wurden.

Zusätzlich ist Aktionsforschung und Design Science angewandt worden, um eine Methode zu entwerfen und zu evaluieren, für die Bewertung des erwarteten Mehrwerts der Nutzung von IT-Dienstleistungen auf mobilen Konsumentenmarkt-Endgeräten. Zuerst wurde ein Prototyp der Methode im Rahmen von Aktionsforschung, in einem Projekt gemeinsam mit einem großen multinationalen Unternehmen, in einer Reihe von Workshops konstruiert und evaluiert. Dieser Prototyp wurde basierend auf einer Anwendung der Methode in einer Feldstudie mit einer Vertriebsabteilung des Unternehmens nochmals bewertet. Anschließend ist der Prototyp der Methode überarbeitet und durch Experteninterviews, eine wiederholte Anwendung in besagter Vertriebsabteilung sowie bezüglich der Attribute und Elemente die eine Methode beinhalten soll getestet und bewertet worden.

Ergebnisse In Summe sind acht Herausforderungen der betrieblichen Nutzung von IT-Dienstleistungen auf mobilen Konsumentenmarkt-Endgeräten und fünfzehn Gegenmaßnahmen extrahiert worden. Diese Herausforderungen betreffen das IT-Applikationsmanagement, die IT-Architektur, die IT-Sicherheit, den IT-Support, das IT-Wissensmanagement, die IT-Steuerung, und den Bereich der Generierung von Mehrwert durch IT – in der Phase der Service-Analyse, des Service-Designs, der Service-Implementierung oder des Service-Betriebs.

Die entworfene Methode, welche die Einführung von mehrwertstiftenden IT-Dienstleistungen auf mobilen Konsumentenmarkt-Endgeräten ermöglicht wird als „IDA-Methode“ bezeichnet. Sie umfasst ein Vorgehensmodell, Rollenbeschreibungen, Techniken zur Operationalisierung der wesentlichen Prozessschritte, vordefinierte Vorlagen zur Dokumentation der Ergebnisse der Anwendung sowie Tool-Unterstützung. Die Methode wird als IDA-Methode abgekürzt, da sie folgende Prozesse unterstützt: 1) Identifikation von Aufgaben, die von einer Unterstützung durch mobile Konsumentenmarkt-Endgeräte profitieren; 2) Definition von mehrwertstiftenden Service-Ideen für die Nutzung von IT-Dienstleistungen auf mobilen Konsumentenmarkt-Endgeräten, für die identifizierten Aufgaben; 3) Bewertung (im Englischen „Assessment“) des Produktivitäts-Mehrwerts, der durch die definierten Service-Ideen der IT-Dienstleistungsnutzung auf mobilen Konsumentenmarkt-Endgeräten zu erwarten ist.

Theoretischer Beitrag Ein erster Beitrag dieser Arbeit liegt in der Generierung von Theorie im Themenfeld Consumerization of IT – insbesondere bezüglich der Nutzung von IT-Dienstleistungen auf mobilen Konsumentenmarkt-Endgeräten. Die Fallstudienuntersuchung trägt hierzu bei indem Implikationen des Consumerization-Trends und der resultierenden Geräte-Nutzung entlang des Service-Lebenszyklus für IT-Abteilungen erforscht und erklärt werden.

Der wesentliche theoretische Beitrag der Arbeit liegt darüber hinaus in der Erstellung der IDA-Methode. Durch Aktionsforschung und Design Science ist ein Methoden-Artefakt entworfen worden, das präskriptives Wissen bezüglich der Bewertung von Mehrwert der IT-Dienstleistungsnutzung auf mobilen Konsumentenmarkt-Endgeräten in der Service-Analyse-Phase erzeugt. Zudem stellt das generierte deskriptive Wissen, bezüglich der Bewertung von IT-Mehrwert für Unternehmen und der Implementierung der Methode in einer Vertriebsabteilung, einen theoretischen Beitrag dar.

Praktischer Beitrag Diese Arbeit gibt Experten aus dem IT-Bereich einen detaillierten Überblick der Herausforderungen, die durch die betriebliche Nutzung von IT-Dienstleistungen auf mobilen Konsumentenmarkt-Endgeräten, in den unterschiedlichen Phasen des Service-Lebenszyklus zu erwarten sind – für das IT-Applikationsmanagement, die IT-Architektur, die IT-Sicherheit, den IT-Support, das IT-Wissensmanagement, die IT-Steuerung, und den Bereich der Generierung von Mehrwert durch IT. Zudem werden Gegenmaßnahmen aufgezeigt, die wiedergenutzt oder angepasst werden können, zur Milderung oder Überwindung von Herausforderungen.

Die IDA-Methode ist entworfen worden, um IT-Abteilungen als Best Practice-Ansatz zur Bewertung von Mehrwert zu dienen, um so die Einführung von mehrwertstiftenden IT-Dienstleistungen auf mobilen Konsumentenmarkt-Endgeräten zu ermöglichen. Sie bietet Experten aus dem IT-Bereich ein Vorgehensmodell um die Anwendung der Methode zu steuern, Techniken und ein Tool um sie zu operationalisieren und Vorlagen um die Ergebnisse der Anwendung zu dokumentieren. Die IDA-Methode befähigt IT-Abteilung Service-Ideen für die Nutzung von mobilen Endgeräten die „Quick Wins“ darstellen zu identifizieren und, in einem nächsten Schritt, einen sogenannten Business Case zur Beurteilung der finanziellen Vorteilhaftigkeit ausgewählter Service-Ideen zu berechnen. Für Vertriebsabteilungen stellen insbesondere die Ergebnisse der durchgeführten Feldstudien einen wertvollen Beitrag dar. Die gesammelten Informationen und das Feedback sowie die erstellten und bewerteten Service-Ideen können ausgewertet und wiederverwandt werden, um die Bewertung von Mehrwert und die Service-Einführung zu optimieren.

Ausblick Bezogen auf die Analyse der Auswirkungen der betrieblichen Nutzung mobiler Konsumentenmarkt-Endgeräte und möglicher Gegenmaßnahmen, kann zukünftige Forschung in die unterschiedlichen Forschungsfelder eintauchen, die im Rahmen der Fallstudienuntersuchung gestreift wurden. Die vorliegende Arbeit konzentriert sich überwiegend auf die Herausforderung der Bewertung von IT-Mehrwert für Unternehmen, durch die Anwendung von Aktionsforschung und Design Science. Andere extrahierte Problemstellungen und deren zugrundeliegende Dynamiken sind durch zukünftige Forschung zu adressieren. Gegenmaßnahmen, die in der Fallstudienuntersuchung identifiziert wurden, sollten bezüglich ihrer Geeignetheit zur Überwindung der Herausforderungen geprüft werden und, falls notwendig, verfeinert oder erweitert werden.

Weiteres Forschungspotential liegt in der IDA-Methode und der ihr zugrundeliegenden Herausforderung der Mehrwertsbewertung. Speziell die enthaltenen Möglichkeiten zur Quantifizierung von Mehrwert sollten hier weiter vertieft werden. Die Quantifizierungsschritte, die in der IDA-Methode enthalten sind, stellen eine Ausgangsbasis dar. Zukünftige Forschung sollte hier Wege der Vereinfachung und Automatisierung der finanziellen Mehrwert-Quantifizierung, ex ante, in der Service-Analyse-Phase untersuchen. Darüber hinaus würde die Reduzierung der Subjektivität die der Methode innewohnt eine Erweiterung darstellen. Die IDA-Methode greift zu einem gewissen Grad auf das Feedback und die Einschätzung von Experten zurück. Insbesondere würde eine Standardisierung der Produktivitäts- und Total-Cost-of-Ownership-Bewertungen, ohne einen Verlust ihrer Gültigkeit, eine Erhöhung der Effizienz und Vergleichbarkeit der Methodenanwendung und ihrer Ergebnisse bedeuten.

Stichworte: Consumerization, Mobile IT, Mobiles Endgerät, Fallstudien, Action Research, Design Science, Methodenentwicklung, IT-Wertbeitrag.

Abstract

Problem Statement IT innovations originating in the consumer sector have increasingly been infiltrating business companies. This trend, referred to as "consumerization of IT", will impact corporate information management and confront IT managers with new challenges in coming years. As part of this trend, mobile devices from the consumer market (so-called mobile consumer devices) such as iOS- or Android-based smartphones and tablets are starting to force their way into business companies. The corporate use of consumer technology provides several benefits for business companies but also creates problems for CIOs around the globe. In particular, the assessment of related value added turns out to be a research gap and crucial challenge slowing down the corporate introduction of IT services used on mobile consumer devices.

Solution Statement First, the objective of this thesis is to research the impact mobile consumer device use constitutes for corporate IT departments – challenges created and countermeasures applied. Secondly, this thesis particularly aims to provide a structured approach, in particular, to tackle the challenge of assessing the value added of corporate IT service use on mobile consumer devices to enable service introduction. This problem is discussed in the related body of literature but also supported by findings from practice. In this thesis, a method has been built to enable IT departments not only to define value-adding service ideas, but also to determine, illustrate, and on an abstract level quantify the multidimensional productivity-related value added of the service use on consumer devices ex ante.

Research Method For analyzing the impact of the mobile consumer device use on IT departments, case study research has been conducted. Four in-depth case studies at multinational companies from different industries lay the foundation to identify challenges of the device, respectively, IT service use and to extract possible measures for mitigation. The case study research comprises document analysis and interviews with 27 experts.

In addition, action design research has been applied to build and evaluate a method to assess value added of the IT service use on mobile consumer devices. First, a prototype of the method was constructed and evaluated in a series of workshops, in an action research project with a large multinational company. This prototype was then evaluated based on its application in a field study at a selected sales department of the corporation.

The method prototype has been reworked and evaluated based on expert interviews, a second application at the sales department, and a feature-based evaluation.

Results In total, eight challenges of the corporate use of IT services on mobile consumer devices and fifteen countermeasures have been extracted. These challenges affect IT application management, IT architecture, IT security, IT support, IT knowledge, IT governance, or IT business value during the service analysis, design, implementation, or operation phase.

The constructed method, which enables the introduction of value-adding IT services on mobile consumer devices, is referred to as the "IDA method". It comprises a procedure model, role assignments, techniques to enable the major process steps, predefined templates to document the results of its application, and a tool to support it. The method is abbreviated as IDA method because it supports the following processes: 1) Identification of tasks that benefit from mobile consumer device support; 2) Definition of value-adding service ideas for IT service use on mobile consumer devices for the identified tasks; 3) Assessment of the productivity-related value added potentially provided through the defined service ideas of IT service use on mobile consumer devices.

Theoretical Contribution A first contribution of this doctoral thesis is the generation of theory of explanation on consumerization of IT and particularly on the use of IT services on mobile consumer devices on a top-level. The case study analysis contributes to this field by exploring and explaining the implications the consumerization trend and the resulting consumer device use have for IT departments along the service lifecycle.

Second, the major theoretical contribution of this thesis, the constructed IDA method, can be classified as theory of design and action. By applying design and action research to build a method artifact, a contribution in the form of nascent design theory is constituted. It generates prescriptive knowledge, particularly on how to assess the value added of IT service use on mobile consumer devices in the service analysis stage. Moreover, descriptive knowledge on IS business value assessments and situated implementations of the IDA method at a sales department constitute theoretical contributions.

Practical Contribution This thesis gives IT practitioners a detailed picture on what challenges to expect from the corporate use of IT services on mobile consumer devices in different service lifecycle phases – for IT application management, IT architecture, IT security, IT support, IT knowledge, IT governance, or IT business value. Moreover, countermeasures which can be reused or adopted to mitigate challenges are listed.

The IDA method has been designed to act as a best practice approach for IT departments to assess value added for enabling the introduction of value-adding IT services on mobile consumer devices. It offers practitioners a procedure model to guide its application, techniques and a tool to operationalize it, and templates to document the results of its application. The IDA method enables IT departments to identify mobile enterprise service ideas that constitute "quick wins" and, in a next step, to calculate a business case for selected service ideas. In particular for sales departments, the results of the conducted field studies at the action research partner depict valuable findings. The information and feedback gathered as well as the service ideas compiled and assessed can be evaluated and reused to optimize the assessment of value added and introduction of service ideas.

Future Research Regarding the analysis of the impacts of the corporate mobile consumer device use and possible mitigation measures, future research will have to dig into the various potential research fields explored through the case study analysis. This doctoral thesis focuses mainly on the challenge of assessing IT business value, addressed through action and design research. Other topics extracted and the underlying dynamics are subject to future research. Countermeasures identified in the case study analysis should be tested for their suitability to tackle these challenges, and if necessary, refined or extended.

In the focus of the IDA method and the underlying challenge to assess value added, future research potential lies especially in enhancing the quantification capabilities of the value assessment technique. The quantification steps included in the IDA method depict a baseline. Future research will have to figure out ways to simplify and automate monetary value added quantification, ex ante, in the service analysis stage. Apart from improving the quantification abilities of the IDA method, a further enhancement would be provided by reducing the subjectivity the method inherits. The IDA method relies to a certain degree on expert feedbacks and ratings. In particular, ways to standardize the productivity and total-cost-of-ownership ratings without losing validity would improve the efficiency and comparability of the method application and its results.

Key words: consumerization of IT, mobile enterprise, mobile IT, mobile consumer device, case studies, action research, design science, method, IS business value, value of IT.

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List of Abbreviations

ACM	Association for Computing Machinery
ADR	Action Design Research
AIS	Association for Information Systems
An.	Analysis
API	Application Programming Interface
APN	Access Point Name
app	Mobile Application
AR	Action Research
ARPR	Action Research Project Requirements
B2B	Business-to-Business
B2C	Business-to-Commerce
B2E	Business-to-Employee
BC	Business Case
BD	Business Department (role name in IDA method prototype)
BE	Business Department Executive (role name in IDA method)
BIE	Building, Intervention, and Evaluation
BPI	Business Process Improvement
BPR	Business Process Reengineering
BYOD	Bring-Your-Own-Device
CAPEX	Capital Expenditure
CAR	Canonical Action Research
CBA	Cost / Benefit Analysis
CEO	Chief Executive Officer
CIO	Chief Information Officer
CIP	Continuous Improvement Process (of IDA method prototype)
CISO	Chief Information Security Officer
CPO	Chief Procurement Officer
CRM	Customer Relationship Management
CSR	Case Study Research
De.	Design

DG	Design Goal
DR	Design Research
DSR	Design Science Research
ECIS	European Conference on Information Systems
EJIS	European Journal of Information Systems
ERP	Enterprise Resource Planning
ext.	extended
FTPP	Functional Task Productivity Potential (of IDA method)
GPS	Global Positioning System
HR	Human Resources
HTML	Hypertext Markup Language
IAV	Informational Added Values
ICIS	International Conference on Information Systems
ICT	Information and Communication Technology
ID	Identifier
IDA	Identification, Definition, and Assessment
IEEE	Institute of Electrical and Electronics Engineers
IM	Information Management
Im.	Implementation
IMEI	International Mobile Station Equipment Identity
impl.	Implementation
IMSI	International Mobile Subscriber Identity
IS	Information Systems
ISJ	Information Systems Journal
ISR	Information Systems Research
IT	Information Technology
ITE	Internal IT Expert (role name in IDA method)
ITIL	IT Infrastructure Library
JAIS	Journal of the Association of Information Systems
JIT	Journal of Information Technology
JMIS	Journal of Management Information Systems

JSIS	Journal of Strategic Information Systems
JSTOR	Journal STORage
KM	Knowledge Management
KPI	Key Performance Indicator
LitRev	Literature Review
LTE	Long Term Evolution
MAV	Mobile Added Values
MB	Megabyte(s)
MDM	Mobile Device Management
MEE	Mobile Enterprise Expert (role name in IDA method)
MIBP	Mobile-Integrated Business Processes
MISQ	Management Information Systems Quarterly
MoBiSUML	Mobile Business Service - Unified Modeling Language
ODI	Outcome-Driven Innovation
OL	Obstacle Level (of IDA method)
Op.	Operation
OPEX	Operational Expenditure
OS	Operating System(s)
PCS	Pilot Case Study
PDA	Personal Digital Assistant
PIM	Personal Information Management
PM	IT Project Manager (role name in IDA method)
PoC	Proof of Concept
Pu.	Publishing
QR	Quick Response
Re.	Retirement
reprint.	reprinted
RFID	Radio-Frequency Identification
RFP	Request for Proposal
RPP	Role Productivity Potential (of IDA method)
RQ	Research Question

RR	Role Representative (role name in IDA method)
SAT	Service Assessment Tool (of IDA method prototype)
SCM	Supply Chain Management
SD	Service Designer (role name in IDA method)
SIM	Subscriber Identity Module
SLA	Service Level Agreement
STPP	Structural Task Productivity Potential (of IDA method)
SV	Service Idea
TCO	Total-Cost-of-Ownership
TPPI	Task Process Productivity Impact (of IDA method)
TTF	Task-Technology Fit
UC	Use Case
UCST	Use Case Screening Tool (of IDA method prototype)
UML	Unified Modeling Language
UMTS	Universal Mobile Telecommunications System
VLAN	Virtual Local Area Network
VPN	Virtual Private Network
WLAN	Wireless Local Area Network

0 List of Publications

Bitzer, P.; Weiß, F. & Leimeister, J. M. (2013): Towards a Reference Model for a Productivity-Optimized Delivery of Technology Mediated Learning Services. In: 8th International Conference on Design Science Research in Information Systems and Technology (DESRIST), Helsinki, Finland 2013.

Bitzer, P.; Weiß, F.; Leimeister, J. M. (2013): Towards a Reference Model for a Productivity-Optimized Delivery of Technology Mediated Learning Services. In: Design Science at the Intersection of Physical and Virtual Design. Springer, Berlin 2013, pp. 471-478.

Weiß, F.; Leimeister, J. M. (2013): Consumerization: Herausforderungen für das betriebliche Informationsmanagement durch iPhone und Co. 11th International Conference on Wirtschaftsinformatik, Leipzig, Germany 2013a.

Weiß, F.; Leimeister, J. M. (2013): Why Can't I Use My iPhone at Work? – Managing Consumerization of IT at a Multi-National Organization. 21st European Conference on Information Systems, Utrecht, The Netherlands 2013b.

Weiß, F.; Leimeister, J. M. (2013): Why Can’t I Use My iPhone at Work?: Managing Consumerization of IT at a Multi-National Organization. In: Journal of Information Technology Teaching Cases, Vol. 4 (2013c), pp. 11-19.

Weiß, F.; Leimeister, J. M. (2012): Consumerization. IT Innovations from the Consumer Market as a Challenge for Corporate IT. In: Business & Information Systems Engineering, Vol. 4 (2012) No. 6, pp. 363-366.

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Weiß, F.; Söllner, M. (2012): Technologische und Marktseitige Unsicherheit bei der Neuentwicklung von Mobile Enterprise Services. In: Smart Mobile Apps. Ed.: Verclas, S.; Linnhoff-Popien, C., Springer, Berlin 2012, pp. 177-190.

1 Introduction

A case study is initially presented in section 1.1 to introduce the basic problem statement guiding the research presented in this thesis, described in section 1.2. How the problem statement is addressed, namely by means of which research questions and methods, is outlined in section 1.3, followed by an overview of the thesis structure in section 1.4.

1.1 Research Context

Seven o'clock in the morning, the alarm clock application on John[1] Smith's iPhone is ringing. He gets up, takes a shower, and has a cup of coffee with Mary and the kids in the kitchen. To get the latest news, he opens the New York Times application on his iPhone and takes five minutes to screen the headlines. "John, have you seen the pictures of Grandma's birthday?" asks his wife Mary. "No, just upload them to Dropbox, I will flip through them on my iPhone this afternoon," answers John. "I never remember what time the train leaves in the morning," says John and launches his community train application, "Oh, I am late, sorry, need to hurry." John packs his stuff and tries to catch the next underground train. Sitting in the train, reading the latest employee posts through the mobile application of an enterprise social network used within his company called "Yammer" John thinks, "The iPhone is a great tool, wherever I am I can stay current on the latest news, manage my private data, collaborate with others, stay in touch with our employees through social media, and these location-based services are really fantastic. Why shouldn't this device be used for business purposes? It is more intuitive than my work BlackBerry. And why do I need to keep carrying around two devices?"

Mobile devices, smartphones and tablets, from the consumer market (so-called "mobile consumer devices") are spreading into companies around the world (Ingalsbe/Shoemaker/Mead 2011; Holtsnider/Jaffe 2012a). BlackBerrys, the legacy mobile enterprise devices, are still widely spread within companies, but lose ground in employees' appreciation as devices based on consumer market operating systems, such as iOS and Android, gain more popularity (see Figure 1).

The trend that IT innovations (e.g., mobile devices and applications) originating in the consumer market are infiltrating enterprises is called "consumerization of IT[2]"

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[1] Names (e.g., of case company, persons, consulting firm) have been disguised for confidentiality reasons and are fictional.
[2] IT = information technology

(Ingalsbe/Shoemaker/Mead 2011; Holtsnider/Jaffe 2012a). This trend poses several challenges to CIOs[3] around the world, such as "How will corporate use of mobile consumer devices affect IT management?" and "How can an IT service be introduced for corporate as well as personal mobile consumer devices?". These topics have to be addressed by John Smith, the CIO of OMEGA Group, if he decides to leverage the benefits of consumer devices like the iPhone within his company.

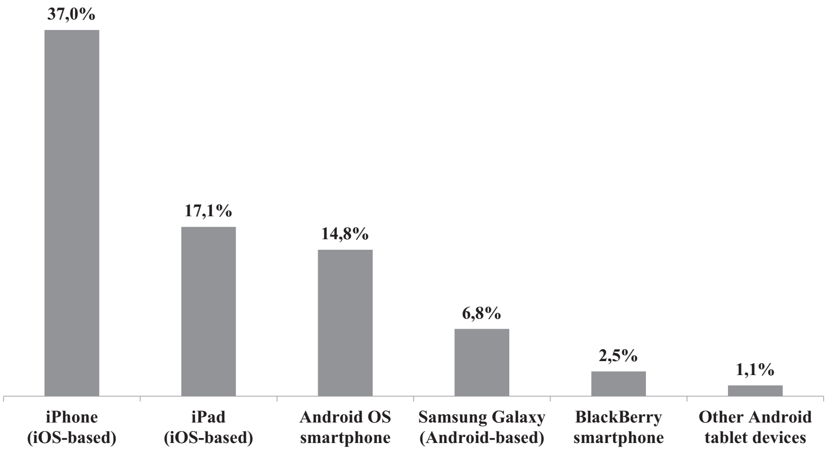

Figure 1: Mobile workers' preferred primary device choices
Source: Adapted from iPass (2013, 12), excerpt of iOS, Android, and BlackBerry survey data (base: global survey of 1,625 mobile workers)

What drives consumer technology adoption?

Following his normal routine, upon arrival at OMEGA Group's headquarters, John grabs a cup of coffee at the company's coffee shop. Just next to him, a group of junior and senior employees are in a lively discussion about mobile devices. As John is interested, he joins the group. The group, without noticing who is following the conversation, is discussing the mobile phones available through OMEGA Group's IT department. A young lady says, "I think our personal phones like the iPhone or Android phones are much better than the Nokias we get from OMEGA Group. I really wish we could use these phones for work. Don't you?" A senior colleague supports her argument, "Yes, me too! My personal iPhone is much easier to use than my corporate BlackBerry. I like its touch screen, intuitive menu and great design. It's got way more style." Everybody is laughing. Just after they stop laughing, he adds, "All the apps available for the iPhone

[3] CIO = chief information officer

would also be great for business, if we could use them. In particular, the context-sensitivity provided by the integrated sensors and exploited by these apps is great. And I would only need to carry one device for personal and corporate use. Don't you think?" The lady nods her head and responds, "You're right. But don't forget that if the IT department made iPhones available, due to the pretty high device costs, they would likely only be available to a certain management level and select employees. Sooner or later iPhones could replace the BlackBerrys and be the new status symbols." She pauses, smiles, and continues, "But, I would like to have one to be more productive at work and, to be honest, the image and status associated with the iPhone would motivate me. Somebody should submit a request for the introduction of iPhones to our CIO." A colleague taps on her shoulder and whispers, "Hmm, actually you can just ask him right now." With a big smile on his face John says, "Interesting discussion, I will think about it. Have a nice day."

John leaves the group, walks down the floor, and takes the elevator to the 40th floor where his office is located. Jane, his secretary, welcomes him, "Hello John. How was your weekend?" John smiles, "Hi Jane. I had a great and relaxing weekend. I wish I could have more weekends like the last one," and continues, "I just followed an interesting discussion at our coffee shop about mobile consumer devices. I got some insight that might be helpful in our discussion in the IT Board right now." Before John can enter the IT Board meeting, Sally grabs his arm, "Oh sorry John, could you just approve these 20 iPhone orders for a group of executives. They ask almost daily if the orders have already been sent out by procurement." Being astonished John says, "Don't they know that no corporate data and no e-mails will be provided with these devices? Our IT security department hasn't approved the access to corporate data on iPhones yet." Sally replies, "Yes, they do, but they are not happy about it." Opening the door to the meeting room, John says, "I will have to deal with that after the IT Board meeting, sorry Sally. It's a good thing we are discussing this topic in the meeting this morning. We need to clarify if and how we can benefit from these devices."

What IT management challenges to solve?

Today, the company CEO[4] Richard Green and the CPO[5] Sarah Miller cannot attend the IT Board meeting. Therefore, it is headed by John Smith. The board meeting is complemented by the business units' CIOs Albert Austin, Brian Baldwin, Clara Cole, and Dave Dudley. This time, the round of the company's IT management executives is extended to include the Group CISO[6] Edmond Elias, who is responsible for all IT security-related topics (see Figure 2).

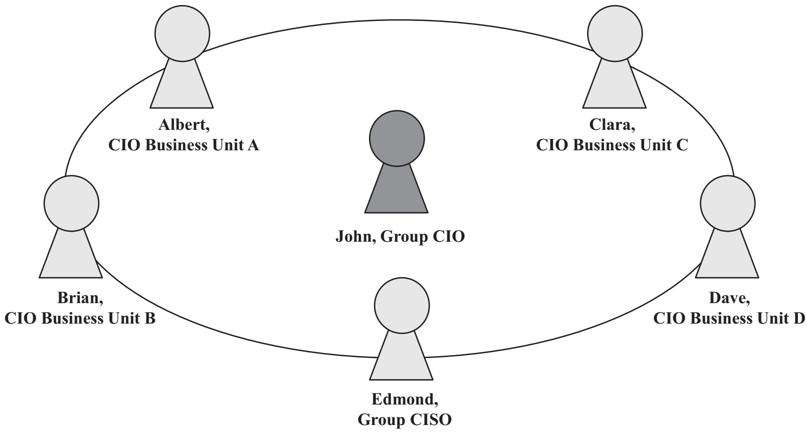

Figure 2: Participants of IT Board meeting
Source: Own illustration

As John enters the meeting, the IT Board members are already awaiting his arrival. John gives a short introduction and continues, "As some of you know, Sarah and Richard, on short notice, had to travel to London to attend a meeting with one of our key customers. So we are going to have to shift most of our agenda topics to the next meeting. I didn't cancel the meeting since we were able to have Edmond be here today to discuss with us the use of mobile consumer devices within our company. We will inform Sarah and Richard in our next meeting about the key outcome of our discussion and then align possible next steps. This topic is urgent because more and more employees, and in particular our executives, want to use such devices for business. Clara, I know that within your business unit you dug pretty much into this topic. And I know you attended this

[4] CEO = chief executive officer
[5] CPO = chief procurement officer
[6] CISO = chief information security officer

year's Mobile World Congress in Barcelona. What's your opinion on the corporate use of mobile consumer devices?"

Clara smiles and responds, "That's not an easy question. First of all, let me start by discussing the financial aspects. John and I discussed some months ago that iPhone devices are more expensive than our BlackBerrys, even if you compare the most expensive BlackBerry to the cheapest iPhone model. Not to mention that we would have to introduce an IT service for the mobile access of corporate PIM[7] data on these consumer devices, a so-called mobile PIM service. We would end up paying a service fee, just like we do for the BlackBerry. Finally, we would need to set up a financial model of the reoccurring mobile communication costs. Of course, we could provide iPhones based on our existing smartphone rate plan. To be honest, I doubt that this rate plan is appropriate for consumer devices. We obviously would have a different usage pattern on mobile consumer devices like the iPhone. A resulting increase in the volume of mobile data would lead to higher IT costs – unless we introduced countermeasures. I think that our employees would use the apps, which would include bandwidth-intensive streaming services. I know that we prohibit any application use on our BlackBerry devices. We would have to change this if we introduced iPhones or other mobile consumer devices. You know that even though not officially introduced, a lot of top management executives use iPhones. One reason for their interest in these phones is the number of available apps that can be used for private or business purposes. However, it would be ridiculous to provide these devices and lock out the apps. I believe that we could benefit from these devices, but it is hard to quantify the monetary benefits we would get by investing in it. This makes it hard to make a decision on pure financial data and to justify the introduction of these devices."

At OMEGA Group, provider-subsidized iPhone costs range from 100 to 300 Euro compared to 5 to 60 Euro for the purchase of BlackBerry smartphones. However, nearly 100% of the employees equipped with a corporate BlackBerry are using the expensive high-end model. In addition, as Clara mentioned, the company would have to pay a service fee as for the BlackBerry operations. ITSP, OMEGA Group's internal IT service provider, plans to introduce a mobile PIM service for consumer devices. The targeted fee of this service, including licensing and support costs, for the first year is twice as high as for the BlackBerry PIM service, which currently is priced at 10 Euro per device

[7] PIM data = personal information management data such as e-mail, contact, and calendar data (Wikipedia 2015)

per month. For years two and three, a monthly service fee of 5 Euro is targeted for the iPhone service by ITSP. The smartphone rate plan is priced at 20 Euro per month per SIM[8] card and includes 30 Megabytes (MB) of national and 10 MB of international mobile data usage. The 30 MB and respectively the 10 MB can be used in a pooling scenario across all business units and devices. This means that if some use more and some use less data volume, no extra costs occur – provided that the consumption stays in balance across all phones. Currently, the national pool is utilized by nearly 95% and the international pool only by 50%. If the data pools are exceeded, each additional MB will be charged. For mobile voice communications, the plan includes 400 minutes for international or national usage provided in a pooling scenario. This pool is utilized by 50%.

"I see your concern," Dave gets involved in the discussion and continues, "However, as other mobile consumer devices, mainly Android-based, are typically less expensive than the iPhone models, we could extend the availability to a broader range of consumer phones. This could be one option to lower device acquisition costs. In addition, by allowing our employees to use their personal phones for corporate purposes, we have another possibility to reduce the device costs. By the way, have you ever thought about the possibilities of the added business value these devices could provide? We could improve our business processes, for example, with a focused use of iPhones or iPads in the sales process." Clara answers, "Yes, I thought about it, but keep in mind Dave that the added value, resulting for example from efficiency increase or employee satisfaction, is hard to quantify. Nevertheless, on the one hand, the use of personal employee devices within the company would save investment costs. On the other hand, you have to consider that we have to pay a service fee for each device. If a huge number of employees uses this service, in particular employees that did not have a corporate phone before, our IT costs would go up. Moreover, we can't overlook that the data privacy issues have to be clarified before introducing such a service."

Reflecting awhile on Clara's and Dave's comments, John answers, "We definitely have to clarify this." Clara responds, "Yes, we should. You also have to think about further IT governance challenges we would face by using those devices for corporate purposes, especially the challenges that pop up by using these devices for more than PIM access. First of all, I think we can use a proxy server, placed in a separate network segment for the backend server access to provide the PIM data onto mobile consumer devices. But

[8] SIM = Subscriber Identity Module

if we want to provide more sensitive data in the mid-term, like ERP[9] or CRM[10] data, onto those devices, we will probably have to find a new IT architecture standard to make a secure core network access from these devices. One approach is to establish a certificate-based VPN[11] connection. Certificates are also required to implement a secure WLAN[12] authentication mechanism on mobile devices. I know the certificate support the iPhone is offering is quite good, but what about other mobile consumer devices, Android- or Phone 7-based? I don't think so." Edmond interjects, "You're right Clara," and continues, "Enterprise-grade certificate support is important to implement the required high level of secure authentication measures and is probably missing for many mobile consumer devices." John kindly interrupts, "Ok, you mentioned lots of technical details. Did I get it right? The technical limitations of the different mobile consumer devices, mainly the missing enterprise-grade support of certificate technology, would pose a problem since we simply cannot apply our network access standard to as many types of devices?" Nodding in agreement, Clara and Edmond simultaneously reply, "Yes!"

Clara adds, "Thinking one step further, how can we deploy and manage apps as a part of a shared infrastructure service for those devices? We would have to solve several issues. First of all, there are no license models offered by Apple or Google for applications within their application stores that are sufficient for corporate environments. If we reimbursed the purchase of apps for our employees, we could lose the license if the employee left the company. Take Apple for example, if an employee uses the iPhone with his personal Apple ID, the license is bound to this personal ID[13] and cannot be transferred to another ID. Second, if we want to develop our own apps for these devices, we have to deal with the heterogeneity of mobile devices and operating systems. Application development would be more complex as it has to be adapted and optimized for the different platforms. Even our corporate web applications like the intranet would need to be adjusted for mobile access. Currently, application access is only optimized for Internet Explorer and not Safari. This would also increase complexity in application development. Thirdly, application lifecycle management would be complicated due to the short release cycles of mobile consumer operating systems [see Figure 3]. Mobile applications developed internally or sourced at one of our IT service providers would

[9] ERP = enterprise resource planning
[10] CRM = customer relationship management
[11] VPN = virtual private network
[12] WLAN = wireless local area network
[13] ID = identifier

have to be regularly adapted in light of continued incremental changes. In particular, if we put our focus on more than one operating system, the update complexity would increase. Finally, it would be a great challenge to set up a process for the rapid introduction of mobile apps for these devices. Our internal processes and necessary alignment steps to introduce new IT services are too complex and time-consuming to effectively deploy apps on short notice – especially compared to the short app[14] development time. Moreover, in discussing this with other companies that have already integrated mobile consumer devices, it turned out to be a challenge for IT departments to not be excluded from screening and defining the needs for business applications by the business units."

iOS:	**• 1.0 (Jun. 07)** **• 1.1 (Sep. 07)**	**• 2.0 (Jul. 08)** **• 2.1 (Sep. 08)** **• 2.2 (Nov. 08)**	**• 3.0 (Jun. 09)** **• 3.1 (Sep. 09)**	**• 3.2 (Apr. 10)** **• 4.0 (Jun. 10)** **• 4.1 (Sep. 10)** **• 4.2 (Nov. 10)**	**• 4.3 (Mar. 11)** **• 5.0 (Oct. 11)**	**• 5.1 (Mar. 12)** **• 6.0 (Sep. 12)**
Android:		**• 1.0 (Sep. 08)**	**• 1.1 (Feb. 09)** **• 1.5 (Apr. 09)** **• 1.6 (Sep. 09)** **• 2.0 (Oct. 09)**	**• 2.1 (Jan. 10)** **• 2.2 (May 10)** **• 2.3 (Dec. 10)**	**• 3.0 (Feb. 11)** **• 3.1 (May 11)** **• 3.2 (Jul. 11)** **• 4.0 (Oct. 11)**	**• 4.1 (Jul. 12)** **• 4.2 (Nov. 12)**
Year:	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**

Figure 3: Release cycles of iOS and Android operating systems
Source: Adapted from Wikipedia (2013a; 2013b)

Everybody is looking at Clara and is surprised about her deep knowledge of mobile consumer technology. "Clara, you seem to know what you are talking about. I frequently use my iPhone, but to be honest I have not thought that deeply about the impact the corporate use would have for us. I would expect that this is true for all of us. Do you see any further impact?" John asks. Clara continues, "I think that we would need a standard service, probably cloud computing-based, to make corporate files which are centrally stored within the company network accessible on heterogeneous devices, such as laptops, smartphones, or tablets. If we didn't provide this kind of standard, we would run the risk that employees might use an unsecure consumer cloud service like Dropbox in order to access files seamlessly on their different corporate devices." Edmond nods and adds, "Cloud storage services like Dropbox are not secure from a corporate perspective. We would definitely have to prevent the use of these services by providing a viable alternative. Moreover, the use of mobile consumer devices would decrease the level of IT security we can provide by pure technical measures for mobile infrastructure services, compared to the level we currently have for our BlackBerry devices."

[14] app = mobile application

Not to be left out of the conversation, Brian remarks, “I am not an expert on this topic, but I read an interesting article on mobile consumer device security. It stated that technical limitations varying between the different mobile OS[15] make it hard to administrate consumer devices at an enterprise-grade security level. The article mentioned that a selective denial of application downloads is problematic. Additionally, they mentioned that checks done by public application stores are not thorough enough for enterprise IT security requirements.” Edmond replies, “You’re right Brian, those issues definitely would have to be addressed.”

After a short pause, John says, “Thanks everybody for shedding some light on this topic. You mentioned a bunch of issues we have to consider and clarify before we find out if we can use and operate mobile consumer devices like the iPhone within our corporate infrastructure. I guess there are still more issues we would need to tackle. What about IT support for heterogeneous mobile devices? Would it be more or less complex? Would we be able to control and dictate the mobile device portfolio used to access mobile infrastructure services? I would recommend we find external support to capture the full picture. Thanks for your contribution and the interesting comments. Nevertheless, we need to move on. Let’s continue with the next point on the agenda.”

As the discussion in OMEGA Group’s IT Board showed, the corporate use of mobile consumer devices and applications creates certain IT management challenges. Only for some, due to the newness of the consumerization topic, best practices do exist. Companies have implemented first measures to handle managerial issues, e.g., those related to IT support, IT security, or IT costs. To handle the device heterogeneity, IT support can be implemented in a self-service approach by the employee. Usage guidelines can mitigate the problem that, by pure technical measures, an enterprise-grade IT security level can hardly be provided. Increasing IT costs can be tackled by several measures, such as specific consumer smartphone rate plans or communication measures, creating awareness for a cost-efficient device usage. Thereby, usage guidelines can also help to create certain awareness and to influence employees’ usage patterns. However, even though not having solved all managerial challenges upfront, companies tend to integrate corporate as well as personal mobile consumer devices, in particular due to the high management interest in using these devices.

[15] OS = operating system(s); OS is used as abbreviation for singular and plural in this thesis

How can an IT service be introduced?

After attending the IT Board meeting, reflecting on the discussion about the impact of these mobile consumer devices, John thinks, “We discussed the challenges that might arise due to the device use, but not how we could introduce these consumer devices. Perhaps Clara has some ideas.” John takes his BlackBerry, opens his address book and calls Clara, “Hi Clara, this is John. Regarding our discussion about mobile consumer devices, I was wondering what the next steps would be if we want to start using these devices in our company. What do we need to do to set up IT services for this class of mobile devices, especially if we want to integrate personal devices?” Clara responds, “That’s not an easy question. There are not many best practices out there, especially for setting up IT services for personal mobile devices. First of all, to reduce the complexity, we should only integrate iPhones into our PIM infrastructure by setting up a mobile PIM service for those devices. iPhones are the most requested smartphones by our employees and, as you know, even more so by top management. Starting by only providing e-mail, calendar and contacts data, we could establish a mobile PIM service for personal and corporate consumer devices based on a sandbox approach.”

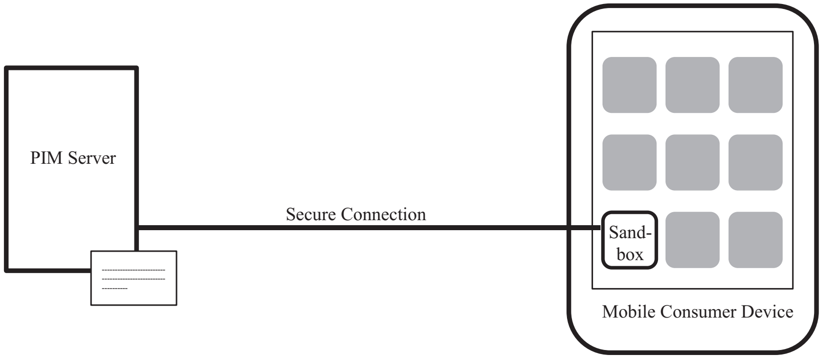

Figure 4: **Simplified illustration of the sandbox approach**
Source: Own illustration

A so-called sandbox approach is widely used to integrate personal mobile devices into corporate infrastructures. Thereby, based on strong encryption mechanisms, a separate container is created on the mobile device. The most widely deployed vendor solutions synchronize PIM data through an encrypted connection from the corporate backend servers into the sandbox application on the device (see Figure 4). Through the sandbox approach, both, data privacy regulations for corporate use of personal devices as well as company IT security requirements, can be considered.

John smiles, “Impressive. How do you know all these details?” Clara answers, “Of course I listened to many interesting presentations at the Mobile World Congress in Barcelona. I also had many conversations with vendors, service providers, and other companies. I have also been reading lots of interesting studies on the consumerization trend. The reports address topics such as the corporate use of consumer technology or employee satisfaction with the enterprise IT. If you are interested, I can send you a copy of the pdf files.”

Clara pauses and continues her explanation, “In Barcelona, I also met George Brown. George is a Managing Partner at Innocon, an international consulting company specialized on mobile devices and applications. He shared with me some of his experience about their latest projects. George said most of his customers lack know-how, mainly on the non-IT related issues of mobile consumer device integration and the set-up of so-called Bring-Your-Own-Device – abbreviated BYOD – programs, to enable employees to bring in their personal devices. He also sent me some presentations on this topic. As there are only a few best practices in this field, companies get in touch with Innocon. In particular, non-IT related requirements and questions regarding the corporate use of personal devices are coming from data privacy, legal, and tax. These questions concern the subsidy of private rate plans, corporate liability for personal devices, or the handling of private employee data. These questions definitely call for the alignment of the service design for a BYOD program HR[16], legal, IT security, and data privacy departments. But don’t forget, especially for the European business units, the workers’ council approval is important. Missing approvals of all these stakeholders, can delay the roll-out of such an IT service.”

Reflecting on Clara’s comments, John says, “Ok, the same lack of internal knowledge on mobile consumer devices and the corporate use of personal devices applies for us. I do not think that we have this knowledge in-house.” Clara agrees with John, “You might be right. But there are more aspects to consider. George mentioned that there is always high personal demand for these consumer devices coming from top management. This typically creates high time pressure for his customers. Standard processes for setting up a project are thrown overboard. It is not like any other IT service introduction. To speed up the process, there is typically no project budget requested and no dedicated project

[16] HR = human resources

team assigned. Not having an official project set up complicates the alignment with internal stakeholders from HR, legal, IT security, or data privacy departments."

John interrupts Clara, "Ok, I see that there are specific issues in particular when using personal devices within the company, but what now?" Clara smiles and continues with her explanations, "According to George, the high time pressure normally pushes IT departments to skip the first project phase, the strategic assessment of the mobile PIM service. Companies should initially assess the monetary impact of the service with a three-year focus. Thereby, projected device costs, licensing fees, support costs, mobile communication costs, and, if possible, the total value added should be addressed. In a second step, the service has to be designed. The design phase should always start with a thorough analysis of requirements. George mentioned that due to the high time pressure, this task is sometimes skipped or not carried out as detailed as necessary. Instead, companies tend to quickly screen some pre-selected vendor solutions. Vendor selection is crucial, but has to be carried out based on predefined requirements. In particular, business unit-specific requirements should be collected including international service requirements as those coming from local law. Without solid requirements analysis, there is a high risk that the selected solution won't provide the specific features required by the company. George mentioned that due to time pressure, companies tend to quickly decide for certain vendors, without thoroughly analyzing the market and existing solutions. In addition, according to George's experience, companies tend to skip the definition of necessary usage guidelines during the design step. This can later create a state of uncertainty for the users and operational departments about what employees are allowed to do with their corporate or personal devices. In particular in a BYOD program, clear usage guidelines are important."

Thinking about what Clara just mentioned, John asks, "Did George say anything about high management attention and the time pressure that influences testing and the final service implementation?" Clara waits for a moment and answers, "Hmm, yes, he did. He mentioned that his customers normally select two solutions initially tested by a small group of employees in a so-called proof of concept. Of course these solutions should be selected based on predefined service requirements. The most convincing solution is then further evaluated in a pilot test. George pointed out that high management interest in using mobile consumer devices can lead to a large group of executives participating in the pilot test phase, less likely in the proof of concept. These employees are typically less fault-tolerant, even during test phases. To avoid major complaints, top management test users should be made aware of performance limitations during testing by implementing specific communication measures. Not to forget, according to George, a fast increase of particularly top management pilot users is problematic. Therefore, even if desired, the IT management could hardly cancel the final roll-out of this IT service. As this normally is obvious to the IT service provider, this also restricts room to finally negotiate a good price for the official service roll-out."

Like for other IT services, the testing of a mobile PIM service for consumer devices, as described by Clara, is normally done in a two-phased approach: proof of concept and pilot test. To conduct a pilot test, the IT service provider builds up the necessary infrastructure at enterprise-grade standards, sets up a helpdesk, and negotiates a price per mobile client participating in the pilot.

John interrupts Clara, "Sorry Clara, did George elaborate specifically on the effects of high time pressure for the service implementation? I am stressing this point since I expect this to be a major issue." Clara smiles and continues, "As a result of high time pressure, there is often no final holistic cost calculation conducted. The business case[17] definitely should be updated based on the actual pricing figures negotiated with the IT service provider. If not, George mentioned that this sooner or later pops up, especially when device orders and mobile data costs rise quickly. If not controlled, this often leads to nervous behavior and the implementation of short-term measures. George also mentioned that one company wanted to be consistent on how it integrated the devices into its national and international business units. In the end, the company had to realize that one standardized set up does not fit all business units equally well. The requirements of the different units differed too much, so that specific regulations and processes had to be aligned with the business units."

John thanks Clara and adds, "We definitely need external support on this topic. We have to discuss this with Richard, Sarah, and the other IT Board members." Nodding her head Clara responds, "Definitely. We need a consulting company, maybe George and Innocon, to structure and analyze this topic for us."

1.2 Problem Statement

IT innovations originating in the consumer sector have increasingly been infiltrating business companies (see, e.g., Ingalsbe/Shoemaker/Mead 2011; Holtsnider/Jaffe

[17] A business case calculation is used in companies to quantify the monetary impact of IS investments and to justify them accordingly.

2012a). This trend is referred to as the "*consumerization of IT*" (see, e.g., Holtsnider/Jaffe 2012a) in this thesis. It will impact corporate information management, and confront IT managers with new challenges in coming years (Weiß/Leimeister 2013a). As part of this trend, mobile devices from the consumer market (so-called mobile consumer devices) such as iOS- or Android-based smartphones and tablets are starting to force their way into the corporate sector (Ingalsbe/Shoemaker/Mead 2011; Harris/Ives/Junglas 2012; Holtsnider/Jaffe 2012a; iPass 2013; Ortbach et al. 2013).

The corporate use of consumer technology is on the one hand discussed to provide several *benefits* such as an increase of employee satisfaction, acceleration of business growth, higher speed of adopting new technologies, or increase in productivity (Harris/Ives/Junglas 2012; Niehaves/Köffer/Ortbach 2012; Sen 2012). On the other hand, consumer technology creates specific *challenges* for CIOs around the globe related to, e.g., immaturity of the technology, regulatory obligations, support effort, loss of process control, or security concerns (Niehaves/Köffer/Ortbach 2012; Sen 2012). Considering the related body of literature on mobile consumer IT, no research-based articles that holistically analyze the information management challenges created by the corporate mobile consumer device use[18] could be gathered.

The specific challenges created for IT departments through the consumerization trend and the resulting corporate use of mobile consumer devices are illustrated in the case study presented in section 1.1. The *case study* was conducted at a multinational company. Slight adaptations of the extracted findings were applied to fit the case findings into an appealing teaching case format. The teaching case is published in Weiß and Leimeister (2013b; 2013c). It illustrates possible drivers and challenges of the consumerization trend and necessary tasks to introduce an IT service for mobile consumer devices. The main drivers for the introduction of mobile consumer devices in multinational corporations can be expected to result from a strong employee demand. As illustrated in the case study, a high level of user experience, new application areas offered through the plethora of existing apps, and the specific status associated with mobile consumer devices potentially drive employee demand and corporate adoption processes. Looking at the impact of the use of IT services on mobile consumer devices for multinational enterprises through the IT governance lens (Weill/Ross 2004), challenges in the area of IT infrastructure (e.g., support, security), IT architecture (e.g., network and data access),

[18] In this thesis, the term "mobile consumer device use" is used to refer to the IT service use on mobile consumer devices within companies.

business applications (e.g., IT business alignment) and IT investments (e.g., quantification of benefits) can be expected. Additionally, as described in the exemplary case study, introducing an IT service for mobile consumer devices can be expected to create fields of action for IT service management in the areas of service strategy, design, and transition (Office of Government Commerce 2007).

As part of this doctoral thesis, particularly the information management challenges of corporate IT service use on mobile consumer devices are analyzed along the service lifecycle (Kohlborn/Korthaus/Rosemann 2009). Therefore, a multi-case study analysis[19] has been carried out and evaluated for challenges and applied countermeasures. From this analysis, the *assessment of value added* of IT service use on mobile consumer devices has been finally extracted as a critical challenge for IT departments, which can pose an obstacle for service introductions. In all researched cases, there is evidence that value added (e.g., from productivity gains) is seen to be doubted or not taken into consideration when assessing the mobile consumer device use. Moreover, findings support the hypothesis that it is complex to quantify this value added. For this multifaceted challenge, no countermeasure is seen to be applied or planned to be applied among the case study companies. As supported by the case study findings, the use of consumer devices – particularly tablet devices such as the iPad – will most probably boost and enable the use of IT services on mobile devices, thereby bringing this issue on the agenda of many corporate IT departments.

Problems concerning the *value added of IT* for business companies have been discussed in the literature for several years. Schryen (2013) conducted a comprehensive literature review on the business value of information systems (IS). By examining selected research papers, he constitutes evidence of the strategic and operational relevance of IS (Schryen 2013). Nevertheless, he points out that causal relationships between investments and value of IT are mainly unexplored, and that economic relevance of IS has to still be fully identified and explained (Schryen 2013). Based on his very recent literature review, Schryen (2013) points out several existing research gaps on value of IT, e.g., in the fields of IS business value creation and assessment. Brynjolfsson and Yang (1996) elaborate on missing accurate quantitative methods to measure the value of IT and state that it is thus complex for managers to assess IT investments. An excerpt from Walter and Spitta (2004, 178) provides a comprehensive summary of business challenges regarding value of IT assessment:

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[19] Details on the multi-case study analysis are presented in chapter 4.

> "*Practitioners named the identification of benefits, the quantification of benefits, and the estimation of costs and returns as main problems associated with the appraisal of IS investments by means of evaluation approaches.*"

Not only in IS literature but as well in specific articles on *mobile IT* value added is a topic that has been elaborated intensively. Exploring the performance impacts of mobile technology use on corporate processes has long been discussed to be a specific challenge (see, e.g., van der Heijden/Valiente 2002b). There are several publications outlining the benefits of corporate mobile IT use such as an increase in efficiency and effectiveness (as summarized by Gruhn/Köhler/Klawes 2007). However, in most companies, the adoption of mobile technology did not come with the expected velocity (Basole 2004). Companies were reported to be hesitant to use mobile IT because of doubts of the constituted value added (Balocco/Mogre/Toletti 2009). Research findings show that companies, e.g., from the construction industry, rated mobile IT to be too expensive compared to the expected benefits from its use (Leskinen 2008). From a corporate perspective, it is crucial but also particularly challenging to analyze which processes do benefit from which mobile technology support and which factors determine the value added – before introducing mobile enterprise services[20] (Gebauer/Shaw/Zhao 2002; Deibert/Rothlauf 2006; Deibert/Heinzl/Rothlauf 2008; Picoto/Palma-dos-Reis/Bélanger 2010). Pousttchi and Becker (2012) not only describe the challenge of identifying the business processes that benefit from mobile IT use, but also outline the challenge of measuring and quantifying its use – particularly when there are more than financial benefits. Determining and measuring value added of mobile IT is complicated, since it results not only from quantitative / tangible but also qualitative / intangible benefits such as increased transparency or higher accuracy (Leskinen 2008). However, qualitative benefits might turn into quantitative benefits in the end (Leskinen 2008). But how to measure and quantify qualitative benefits (Pousttchi/Becker 2012) and how to take quantitative value assessments for mobile IT without reliable figures that can only be obtained through testing (Leskinen 2008)? Missing tangible and quantified figures of the value added offered by mobile IT make it difficult to calculate a valid business case and to get top management support for its introduction (Leskinen 2008). Furthermore, traditional methods for financial investment evaluations (such as the net present value or return on investment) are not adequate for the assessment of value of mobile IT, because they do not consider intangible qualitative benefits (Löfgren 2006).

[20] IT services used on mobile devices within business companies are referred to as "mobile enterprise services" in this thesis; details on the definition of this term are provided in section 3.2.1.

Conducting *value added assessments* of corporate mobile IT use before any service implementation is done (ex ante) is particularly challenging (see also Kadyte 2004; Balocco/Mogre/Toletti 2009). Kadyte (2004) outlines mobile IT specifics such as its rapid development to complicate ex ante investment decisions IT. As described by Leskinen (2008) and Peltomäki, Hallikainen, and Tuunainen (2009), value assessments of mobile IT have to consider the various specific intangible benefits resulting from its use. There are several publications which discuss specifics of mobile IT in comparison to stationary IT, e.g., on personal computers (Pousttchi/Thurnher 2006; Wigelius/Aula/Markova 2007; Fischer/Smolnik 2014; Picoto/Bélanger/Palma-dos-Reis 2014). These specifics, for instance, come from the offered ubiquity, instant connectivity, or personalization (Picoto/Bélanger/Palma-dos-Reis 2014). It can be summarized that there are specific characteristics and benefits of mobile IT which have to be considered when assessing its value added for corporations.

The need to provide instruments to assess the value added of mobile technology from an organizational point of view can also be derived from other, most recent publications, e.g., Falk and Leist (2014) and Fischer and Smolnik (2014). Both articles emphasize the need to evaluate the corporate benefits for business companies coming from mobile IT use and present research and details on possible performance impacts.

With the spread of mobile consumer devices, applications running on these devices (so-called apps) have been adopted by employees (Ortbach et al. 2013). The plethora of existing *apps* offers new possibilities to employees but also to organizations (Hess/Jung 2012; Perez 2014). If companies want to use corporate IT services on mobile consumer devices, they first have to decide which app should be introduced as a "mobile enterprise service" to support which specific corporate process and task (Gröger et al. 2013). Moreover, they must not only be able to identify the corporate task for which the mobile IT support provides value added, but they also need to be able to assess this added value in order to justify the necessary investments (Weiß/Leimeister 2013a). Companies have to be able to figure out which app is just a gimmick and which one really provides positive benefits to the company. Particularly, the ex ante assessment of this value added, considering mobile consumer IT specifics, is a challenge existing in practice that has not been addressed sufficiently by existing frameworks.

There are existing *frameworks* that aim to address the challenge of assessing value added of corporate mobile IT use ex ante and to enable the introduction of mobile enterprise services, such as the "Mobility-M" (Gumpp/Pousttchi 2005; Pousttchi/Thurnher 2006;

Pousttchi/Becker 2012) or "Mobile Process Landscaping" (Köhler/Gruhn 2004a; Gruhn/Köhler/Klawes 2005; Gruhn/Köhler/Klawes 2007) – to name just a few. A particular drawback of existing frameworks is that they neither provide detailed procedures (techniques) for determination and illustration of productivity-related value added of service ideas for the corporate mobile consumer device use, nor for quantifying it ex ante. Furthermore, no analyzed framework holistically considers consumer IT specifics for assessing the benefits of mobile IT use. As discussed in the body of literature[21], benefits of the mobile IT use such as context-sensitivity, user experience, innovation potential, and ease of learning technology use are specifically fostered by mobile consumer IT (Murdoch/Harris/Devore 2010; Unisys 2010; Pitt/Berthon/Robson 2011; Hess/Jung 2012; Niehaves/Köffer/Ortbach 2012; Junglas/Harris 2013). As mobile consumer IT and particularly consumer market tablets are increasingly infiltrating companies and due to their own characteristics and benefits, consumer IT specifics are crucial to be considered (Drew 2011; Harris/Ives/Junglas 2012; Hess/Jung 2012; Holtsnider/Jaffe 2012a; iPass 2013). The drawbacks illustrated above depict research gaps on business value of mobile IT with high relevance for practitioners.

1.3 Solution Statement and Research Questions

The goal of this doctoral thesis is twofold. On the one hand, the purpose of this thesis is to explore the rather untouched research field of "consumerization of IT" from a mobile enterprise perspective while outlining the challenges created through the mobile consumer device use for IT departments and possible countermeasures. On the other hand, it aims to address the specific challenge of assessing value added of IT service use on mobile consumer devices in order to enable service introduction. This challenge has not only been identified as an open issue for selected case study companies, but also as a field of research with existing research gaps in the related body of literature.

The research focus, summarized above and set to tackle the problem statement described in section 1.2, is addressed by the following research questions.

Research question (RQ) 1: How is the corporate use of IT services on mobile consumer devices affecting IT departments?

[21] Details on mobile IT- and mobile consumer IT-specific characteristics and benefits are presented in sections 5.2.1 and 5.2.2.

RQ 1a) Which challenges are created for IT departments by the corporate use of IT services on mobile consumer devices?

RQ 1b) Which countermeasures are applied (or planned to be applied) by IT departments to mitigate the challenges created by the corporate use of IT services on mobile consumer devices?

In RQ 1, the field of consumerization of IT is explored by analyzing the impact the mobile consumer device use has on IT departments. The consumerization of IT is a rather new and untouched research field, but it is of growing interest to researchers around the globe. For answering RQ 1a, challenges created by the mobile consumer device use for IT departments are outlined. The corresponding countermeasures applied (or planned to be applied) by IT departments have been extracted for replying to RQ 1b. By pointing out the impact constituted by existing challenges where there is a lack of possible countermeasures, gaps to be closed are highlighted.

RQ 1 has been addressed by applying the case study research as described in Eisenhardt (1989), Yin (2009), and Gläser and Laudel (2010). The analysis of four case studies at multinational companies shows a gap in the area of business value of mobile IT. In the cases considered, corporate IT departments encounter problems to assess the value added of mobile consumer IT. This challenge can create doubts on the value added of mobile IT and negatively affect business unit demand for it. It poses a major obstacle for IT service introduction on mobile consumer devices. The significance of assessing business value is discussed in the existing body of literature on mobile enterprise IT. Moreover, the importance of analyzing which processes take (most) benefits from mobile IT use can also be extracted from the related literature. Details of the body of literature on this problem statement are depicted in the previous section (1.2) of this thesis.

Research question (RQ) 2: How can the corporate introduction of value-adding IT services for mobile consumer devices be enabled by a method supporting IT departments to assess the value added of the service use ex ante?

RQ 2a) What are requirements for a method design?

RQ 2b) Do existing methods and approaches fulfill the design requirements?

RQ 2c) How can a respective method be constructed?

RQ 2d) Does the constructed method fulfill the put up design requirements?

In this thesis, value added[22] of corporate mobile IT use comprises on the one hand benefits coming from productivity gains and on the other hand costs occurring throughout its service lifecycle (Brynjolfsson/Hitt 1996; Kadyte 2004).

In RQ 2, the research gaps extracted from RQ 1 on the assessment of value added are addressed by constructing a respective method. The method is referred to as the *"IDA method"*, as it tackles the value assessment challenge and supports the introduction of IT services on mobile consumer devices based on three major process steps:

1) **I**dentification of corporate tasks that benefit from mobile consumer device support.

2) **D**efinition of value-adding service ideas for IT service use on mobile consumer devices for the identified tasks.

3) **A**ssessment of the productivity-related value added potentially provided through the defined service ideas of IT service use on mobile consumer devices.

The core of the method is made up of a procedure model and tool-supported techniques (Braun et al. 2005) considering consumer IT specifics. As part of the method, before an assessment of the mobile consumer device use can be carried out, mobile enterprise service ideas have to be defined for selected corporate processes and tasks. The IDA method allows companies to identify concrete tasks, which are best suited to be supported by mobile IT – based on a technique which pre-assesses potential benefits provided. In a next step, the method offers guidance on how to define a specific mobile enterprise service idea, for which the potential value added is eventually assessed (determined, illustrated, and quantified). The IDA method could to a certain extent as well be applied to solely assess the value added of existing mobile enterprise services or service ideas – without passing the identification (pre-assessment) and definition processes. Nevertheless, only with the holistic approach comprising identification, definition, and assessment steps, the method can fully enable the introduction of IT services on mobile consumer devices. It thereby helps companies to not only reap the benefits of service ideas they have already thought of, but also of service ideas for tasks that have not yet been obvious to them.

[22] The terms "value added of IT" or "corporate value added of IT" are used as synonyms for "business value of IT" or "IS business value" in this thesis.

The *specific characteristics and benefits of mobile IT use* in general and mobile consumer IT in particular, as discussed in the problem statement (section 1.2) and outlined in detail later in this thesis (in sections 5.2.1 and 5.2.2.), make it necessary to provide a customized solution statement. Moreover, the spread of consumer devices, particularly of tablet devices such as the iPad, can be expected to enable and boost the use of mobile enterprise, making it even more important to consider consumer IT characteristics (Drew 2011; Hess/Jung 2012). This is supported by the findings of the multiple case studies analyzed in RQ 1.

The method artifact has been built and evaluated in an *action and design research* setup in iterative cycles (Sein et al. 2011). First, in order to construct a method, requirements for its design need to be initially defined (RQ 2a). Requirements have been iteratively put up and refined based on case study findings (from RQ 1), action research, literature analysis, and expert evaluation. Secondly, the literature needs to be searched for existing approaches addressing the problem statement (RQ 2b). In the related body of knowledge, no approach has been found that provided detailed and structured procedures to determine, illustrate, and quantify the productivity-related value added of concrete mobile enterprise service ideas for consumer device use. However, existing approaches have been screened for (partial) reuse in the method design. Thirdly, the IDA method has been designed (RQ 2c) according to principles extracted from Hevner et al. (2004), March and Smith (1995), Markus, Majchrzak and Gasser (2002), and Schmidt-Rauch and Schwabe (2011). The design principles have been applied to build a method in an action research setting and iterative cycles (Susman/Evered 1978; Lindgren/Henfridsson/Schultze 2004; Cole et al. 2005; Iivari/Venable 2009; Sein et al. 2011). Finally, several evaluation steps have been carried out to test the IDA method against a set of design and quality criteria (RQ 2d): workshops, field studies, expert interviews, and feature-based evaluation (Fettke/Loos 2004). Answering research questions 2a) to 2d) is conducted iteratively and interwoven and refined based on complementary insights gathered by means of case study research (from RQ 1) and literature reviews.

The *theoretical contribution* provided by this doctoral thesis is twofold. In addressing research question 1, theory of explanation (Gregor 2006) is compiled by exploring and explaining the impacts the consumerization trend and particularly the mobile consumer device use creates for business companies. In addressing research question 2, theory of design and action (Gregor 2006) is generated by constructing a method supporting IT departments to assess the value added of mobile enterprise service use on consumer devices. With the constructed artifact, this thesis contributes to the body of knowledge through the creation of nascent design theory (Gregor/Hevner 2013). The method, particularly, provides prescriptive knowledge on how to determine, illustrate, and quantify value added of the mobile enterprise service use on consumer devices ex ante (Gregor/Hevner 2013).

1.4 Structure of the Doctoral Thesis

In this doctoral thesis, after having introduced the research context, problem statement, solution statement, and the research questions in chapter 1, the methodological background is depicted. An overview on the methodologies and how the different methodological blocks have been applied is given in chapter 2. Next, an overview of related work on consumerization of IT and mobile enterprise IT is provided in chapter 3. Research question 1 is addressed in chapter 4. Extracted from case study analysis, the impacts of mobile consumer device use for IT departments are outlined. Research results are presented, discussed and conclusions are drawn accordingly. Related work on business value of mobile IT (and IT in general) to be considered for research question 2 is discussed in chapter 5, including an evaluation and comparison of existing frameworks to tackle the problem statement motivating research question 2. In chapter 6, research question 2 is addressed. Design requirements for a method are illustrated and the cyclical IDA method construction and evaluation presented. Finally, results of answering research question 2 are discussed and a conclusion is drawn in chapter 6. The thesis is concluded by a summary of the contributions provided and future research areas to be addressed (chapter 7).

A visual overview on the building blocks of this doctoral thesis is depicted in Figure 5.

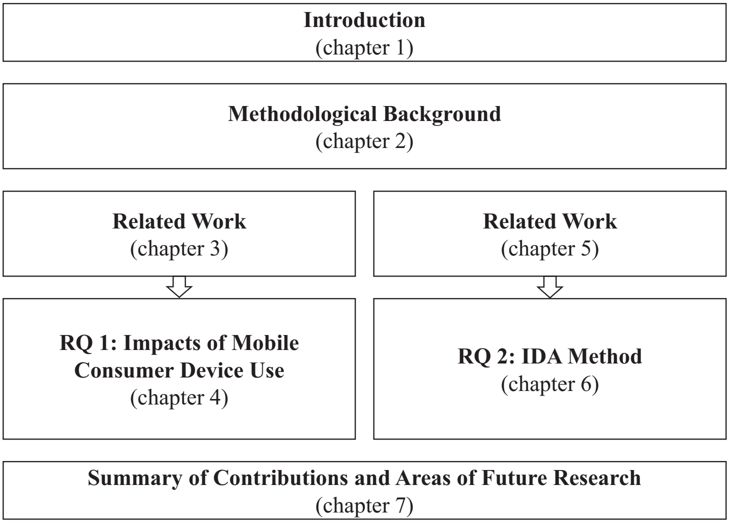


Figure 5: **Structure of doctoral thesis**
Source: Own illustration

2 Methodological Background

Mainly two research methods have been applied to conduct the underlying research studies of this doctoral thesis. Case study research (CSR) has been used for exploring the impacts of mobile consumer device use on IT departments in order to answer research question 1. For constructing and evaluating the IDA method to address research question 2, design research (DR) has been applied in an action research (AR) setting. The combination of these two research methods into a new research paradigm is also referred to as "action design research" (ADR) (Iivari 2007; Sein et al. 2011). In the following, a detailed overview on the research methods used within this thesis is given.

2.1 Case Study Research

A research approach to conduct social science research is case study research. Its key characteristics, mainly extracted from Eisenhardt (1989) and Yin (2009), are highlighted in the next paragraphs, followed by a presentation of evaluation criteria to assess its quality, concluded by a discussion of its possible limitations.

2.1.1 Key Characteristics of CSR Approach

The CSR method is an appropriate tool to answer research questions that address present circumstances, typically "how" or "why" questions, and focus an in-depth analysis of a social phenomenon (Yin 2009). A general definition cited by Yin (2009) is the following:

> "[..] *the essence of a case study, the central tendency among all types of case study, is that it tries to illuminate a decision or set of decisions: why they were taken, how they were implemented, and with what result*." (Schramm 1971, 6)

Case studies are applied in a wide range of fields, such as psychology, sociology, political science, business education, anthropology, or social work (Yin 2009). Case studies are often used in the preliminary and exploratory phase of a research study, but can also be applied to do explanatory or causal inquiries (Yin 2009). They can be applied to explore a current phenomenon in a real-life setting, especially in such cases when boundaries between context and phenomenon are not fully evident (Yin 2009). Yin (2009) further elaborates that case studies deal with situations with more variables than data points, exploit multiple sources of evidence, and use theoretical propositions to steer data collection and analysis. A process of building theory from case study research is proposed by Eisenhardt (1989). It covers the following steps to be conducted by case study researchers (Eisenhardt 1989):

1. *Getting started:* Initial definition of research questions and, if possible, constructs have to be defined to sharpen and formulate the research focus guiding the case study research.

2. *Selecting cases:* Cases have to be selected from an appropriate population, keeping in mind that this step sets limits to the later generalization of results. There are several sampling strategies, such as taking polar cases or cases that replicate previous ones. However, in a multi-case study design, at least four cases should be considered for analysis in order to derive complex theory.

3. *Crafting instruments and protocols:* Multiple methods for data collection should be applied to build theory by CSR (triangulation). Interviews, archival data, and observations are possible data collection methods. Triangulation, ideally considering quantitative and qualitative methods, provides stronger evidence for researched constructs and hypotheses. Multiple investigators can further enhance the quality of case study research.

4. *Entering the field:* Data collection and analysis should be parallelized to a certain extent to provide flexibility in the collection stage, allowing researchers to make adjustments during data collection, e.g., the addition of cases or the inclusion of other data sources.

5. *Analyzing data:* A major part of case study research, on the one hand most difficult and on the other hand least codified, is the data analysis. Data first is analyzed within each case, enabling the search for cross-case patterns and thus increasing the probability that the novel findings are extracted from the data. A way not to take premature or wrong conclusions is to analyze the data from different angles and perspectives. One tactic to overcome this bias is to divide the data to be analyzed among multiple investigators. Another option is, e.g., to conduct data analysis through predefined categories or dimensions.

6. *Shaping hypothesis:* Researches have to shape hypotheses in close iteration between evidence taken from the data and existing theory. Thereby, constructs have to be refined and evidence extracted from the data to measure these constructs.

Evidence for relationships emerging during hypothesis sharpening has to be verified across all cases under consideration (see Yin 2009). Successfully applying replication logic supports the validity of extracted relationships. Thereby, researchers have to understand the theoretical reasons that are building the foundations for these relationships to hold.

7. *Enfolding literature:* Comparing the findings (concepts, theory, and hypothesis) with the existing body of literature is an essential step in building theory through case study research. On the one hand, considering similar findings is important. On the other hand, conflicting literature is of particular interest and should not be neglected. Opposing findings that are not considered reduce the confidence, similar findings, e.g., enhance the generalizability of the CSR results.

8. *Reaching closure:* No new cases should be added to the research study when only minimal evidence or learning can be extracted from the previous case analyzed. This stage is also referred to as "theoretical saturation" (Glaser/Strauss 2012). The concept of theoretical saturation can be applied as well to determine when the iteration between theory and data should be stopped.

Sources of evidence to collect data during case study analysis are manifold. Most commonly used in CSR studies are the following ones: interviews, documentation, archival records, direct observations, participant-observation, and physical artifacts (Yin 2009, 101). A major source to gather relevant data in the case study analysis conducted in this doctoral thesis are expert interviews (see chapter 4). Collection and analysis of *expert interviews* is described in detail in Gläser and Laudel (2010). An expert thereby is regarded to have specific knowledge about the topic to be studied (Gläser/Laudel 2010). There are three different types of expert interviews: fully-standardized (questions and answers are predefined), semi-standardized (questions themselves are predefined but not how they have to be answered), and non-standardized (no predefined questions and answers) (Gläser/Laudel 2010). A specific type of non-standardized interviews are so-called guided interviews (Gläser/Laudel 2010). Guided interviews rely on predefined topics and a selection of questions to be discussed in the interview, but do not bind the interviewer to a specific formulation or sequence (Gläser/Laudel 2010). They provide flexibility to the interviewer and allow to discuss questions that may arise in the course of the interview (Gläser/Laudel 2010). In Gläser and Laudel (2010), an overview of several methods to analyze the data gathered through expert interviews is given. As described in section 2.3 and shown in detail in chapter 4, qualitative content analysis has been applied to analyze the data gathered through interviews and provided documentation in the case study analysis conducted. In Mayring (2010), foundations and techniques to conduct this type of data analysis are described (Gläser/Laudel 2010). The type of qualitative content analysis applied within this doctoral thesis relies on the elaborations in Gläser and Laudel (Gläser/Laudel 2010), which have been inspired by the tools described in Mayring (2010). Qualitative content analysis enables to extract relevant data from textual documents via search grid (Gläser/Laudel 2010). The extracted data is assigned to the categories of the search grid and further analyzed and interpreted apart from the original text (Gläser/Laudel 2010). Summarizing the key characteristics of the qualitative content analysis into a process model, as defined by Gläser and Laudel (2010), the following steps have to be considered:

1. *Preparation* of extraction (e.g., definition of search grid)
2. *Extraction* of relevant data from text
3. *Editing* of extracted data (e.g., synthesizing)
4. *Analysis and interpretation* of data

It is important to consider that the search grid, initially defined by theoretical propositions, can be adjusted in the course of the data extraction, if required (Gläser/Laudel 2010). The flexibility in terms of search grid adjustments constitutes the major difference from the method described by Gläser and Laudel (2010) compared to Mayring's approach (Mayring 2010). It allows a theory-guided data analysis on the one hand, and openness within the process on the other hand (Gläser/Laudel 2010). Throughout the analysis steps, references to the original textual documents are kept, allowing researches to iterate back to verify or re-evaluate if necessary (Gläser/Laudel 2010).

2.1.2 Evaluation of CSR Process

The CSR method has been mainly criticized for its lack of rigor (Yin 2009). The guidelines and systematic procedures developed by Yin (2009) on how to support validity and reliability of CSR mitigate this drawback and reduce possible bias. According to Yin (2009) four tests are generally applied to assess quality of empirical social research (see Kidder/Judd 1986, 26-29):

- "*Construct validity*: identifying correct operational measures for the concepts being studied" (Yin 2009, 40)

- "*Internal validity* […] : seeking to establish a causal relationship, whereby certain conditions are believed to lead to other conditions, as distinguished from spurious relationships" (Yin 2009, 40)

- "*External validity*: defining the domain to which a study's findings can be generalized" (Yin 2009, 40)

- "*Reliability*: demonstrating that the operations of a study – such as the data collection procedures – can be repeated, with the same results" (Yin 2009, 40)

Yin (2009) has defined tactics to test for validity and reliability in case study research:

- Construct validity is supported by the use of multiple sources of evidence, establishing a chain of evidence, and the review of the draft case study report through key informants.

- Internal validity is supported by doing pattern matching, addressing rival explanations, doing explanation building, and using logic models.

- External validity is supported by using theory in single-case studies and using replication logic for multiple-case studies.

- Reliability is supported by developing a case study database and the use of a case study protocol.

More details on the listed tactics will be presented in section 4.2, discussing the rigor and quality of the conducted case study research.

2.1.3 Limitations of CSR Approach

Concerns regarding the use of CSR result from the challenge to achieve *rigor* in research studies and from a lack of *generalizability* of results (Yin 2009). It is hard to know how to conduct good case study research and how to adequately assess it (Yin 2009). A way to address the problem of rigor are the guidelines developed by Yin (2009), described in the previous section. Moreover, case studies can be generalized to theoretical propositions but not to universes or populations (Yin 2009). Case study research aims to extend and generalize theories not through statistical but analytic generalization (Yin

2009). A third limitation may arise from the possibly high time *effort* to conduct CSR and the potentially produced mass of unreadable documents (Yin 2009). A fourth drawback of the CSR approach, depending on the purpose of its application, is that other research methods, such as experiments, are more adequate to establish *causal relationships* (Yin 2009).

2.2 Action Design Research

In Sein et al. (2011), ADR is proposed and discussed as a design research method applied in an organizational context. In the next paragraphs, key characteristics of the integrated ADR method and its foundations (DR and AR) are presented. The elaborations on the ADR approach are concluded by highlighting possible limitations and potential ways to support rigor and quality of ADR projects.

2.2.1 Key Characteristics of DR Approach

DR is a research paradigm rooted in sciences of the artificial and engineering (Simon 1996; Hevner et al. 2004). Design research – also referred to as design science research (DSR) – aims to build and evaluate *new and innovative artifacts* that meet specific business needs (Hevner et al. 2004). Artifacts can be: methods (algorithms and practices), models (abstractions and representations), constructs (vocabulary and symbols), and instantiations (implemented and prototype systems) (Hevner et al. 2004). These four types of artifacts are defined by March and Smith (1995), who further identify two major activities for constructing these artifacts: *build and evaluate*. Artifacts are constructed to tackle yet unsolved problems and evaluated against their capability to solve them (Hevner et al. 2004). According to Markus, Majchrzak, and Gasser (2002), build-and-evaluate activities are iterated several times in the artifact design process (Hevner et al. 2004). As illustrated by Schmidt-Rauch and Schwabe (2011), the process starts with identifying relevant issues that are transferred into design goals to guide artifact building and evaluation. When building the artifact, e.g., existing theory, frameworks, or methods are typically reused (Hevner et al. 2004). For several years, a dedicated process model to conduct and present design research consistent with the existing body of literature was missing (Peffers et al. 2006). This gap was closed by a model described in Peffers et al. (2007, 46), comprising the following six process steps: “problem identification and motivation, definition of the objectives for a solution, design and development, demonstration, evaluation, and communication.” More generally, rigor and relevance of a DR study can be assessed through the design research guidelines formulated by Hevner et al. (2004):

1. *Design as an artifact:* The result of design research has to be an artifact that addresses an organizational problem, described effectively so that it can be implemented and applied.

2. *Problem relevance:* Unsolved and important business problems have to be addressed by design research, which seeks to provide solutions for the problems in the form of innovative artifacts.

3. *Design evaluation:* The designed artifact has to be evaluated to demonstrate its quality, utility, and efficacy. Design evaluation is conducted based on the requirements established through the business environment.

4. *Research contributions:* Design research findings have to constitute a contribution to the existing body of knowledge through the design artifact, design construction knowledge, and/or design evaluation knowledge.

5. *Research rigor:* In the artifact build and evaluate steps rigorous methods have to be applied in design research. Rigor must be evaluated considering artifact applicability and generalizability.

6. *Design as a search process:* Design research is an iterative search process for the optimal or best artifact design. Applying heuristic search strategies supports the construction of good designs which can be implemented.

7. *Communication of research:* Design research findings must be communicated to practitioners and the research community, addressing both technology-oriented and management-oriented stakeholders.

2.2.2 Key Characteristics of AR Approach

Action research is applied in medical and social sciences since the mid-twentieth century and in information systems research since the end of the 1990s (Baskerville 1999). A definition of the AR paradigm widely referenced is the one given by Rapoport (1970, 499):

> "*Action research aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework.*"

Assuming that it is not possible to reduce complex social systems for meaningful study, action researchers believe that interactions between human organizations and IT can only be understood as whole entities (Baskerville 1999). Therefore, action research on information systems is embedded in an organizational context, thereby addressing a specific client's business need (Rapoport 1970; Iivari/Venable 2009). Three aspects define the major characteristics of action research: *interpretivist viewpoint*, *idiographic viewpoint*, and *qualitative data and analysis* (Baskerville 1999). One key aspect is the researcher becoming a part of the research study by intervening into the research setting (interpretivist viewpoint) (Baskerville 1999). Therefore, the action researcher's social values and a-priori knowledge have to be considered (Baskerville 1999). A second key aspect of AR focuses on the social setting and the underlying social values and frames of reference (idiographic viewpoint) (Baskerville 1999). In an AR setting, subjects are incorporated into the research and act as collaborators (Baskerville 1999). Finally, the adoption of interpretivist and idiographic viewpoints requires the adoption of qualitative data for empirical research (Baskerville 1999). A general baseline model on how to conduct action research is shown in Susman and Evered (1978). The cyclical process model described in there comprises five steps: 1) diagnosing, 2) action planning, 3) action taking, 4) evaluating, and 5) specifying learning (Susman/Evered 1978). AR based on the process model of Susman and Evered (1978) has been widely adopted and is also referred to as "canonical action research (CAR)" and (Davison/Martinsons/Kock 2004). For a general assessment of the rigor and relevance of canonical action research Davison, Martinsons, and Kock (2004) have defined five principles:

1. *The principle of the researcher-client agreement:* A researcher-client agreement providing details on the application of the CAR method within the organization (including the impact it might have) should be compiled. A well-defined researcher client agreement can help to build trust amongst the CAR stakeholders and supports the internal validity of the research study.

2. *The principle of the cyclical process model:* A cyclical process model, such as the model depicted in Susman and Evered (1978), should be applied to conduct the AR project. Using a cyclical process model, with iterative cycling through the stages, contributes to the systematic rigor of the CAR project.

3. *The principle of theory:* Even if the CAR project may start theory-free and no "grounded" theory emerges from the diagnosis stage, theorizing should be done at the planning stage. First, considering existing theoretical foundations for CAR

projects diminishes the risk of having a research problem that is irrelevant to the research community (Kock 1997; Avison/Baskerville/Myers 2001). Second, theory helps to focus data collection and analysis, thereby keeping the project manageable.

4. *The principle of change through action:* The goal of CAR projects should to produce change through intervention. A lack of change and action can be an indicator for not having a meaningful problem, intervention failing to address the problem(s), or that effective change is not possible in the current research setting.

5. *The principle of learning through reflection:* The generation of learning through reflection is important to satisfy the action researcher's responsibility to the client (focus on: practical outcomes) and the research community (focus on: new knowledge).

2.2.3 Key Characteristics of ADR Approach

A criticism regarding traditional DR approaches is that they do not incorporate the *organizational context* explicitly within its principles (Sein et al. 2011). It can be argued that there is a need for an artifact construction focusing on design, use, and continuous refinement in an organizational context (Sein et al. 2011). This pitfall of the design research approach can be mitigated by extending it with action research elements. Järvinen (2007) discusses in his paper the similarity of *AR and DR approaches*. In Cole et al. (2005), it is outlined that AR and DR are compatible and similar to a degree that common process models can be formed for. Overlaps but also dissimilarities are discussed by Iivari and Venable (2009). A major difference between AR and DR is the missing client participation and collaboration in the DR approach (Iivari/Venable 2009). Iivari and Venable (2009) further argue that in comparison to DSR, which is considered to be more a research orientation with different research methods that can be applied within, AR is a concrete research method. However, it is outlined that AR in particular can be used in the evaluation stage of DR activities, if building and evaluation are separate (Venable 2006; Johnstone/Venable 2008; Iivari/Venable 2009). If design and action research both aim to solve a socio-technical problem, by building an innovative artifact being evaluated in an organizational context, AR and DR activities even significantly overlap (Iivari/Venable 2009).

Combining action and design research, Sein et al. (2011) have built an integrated ADR approach, comprising four stages and seven guiding principles, as depicted in Figure 6.

The key aspects and scope of the ADR approach are summarized by the following statement taken from Sein et al. (2011, 53):

> "*ADR emphasizes the inseparability of building, intervention, and evaluation, reflecting the nature of ensemble artifacts. It is therefore neither a simple aggregation nor the simple interleaving of steps. Nor does it represent just a middle ground between AR and DR in terms of methodological guidance.*"

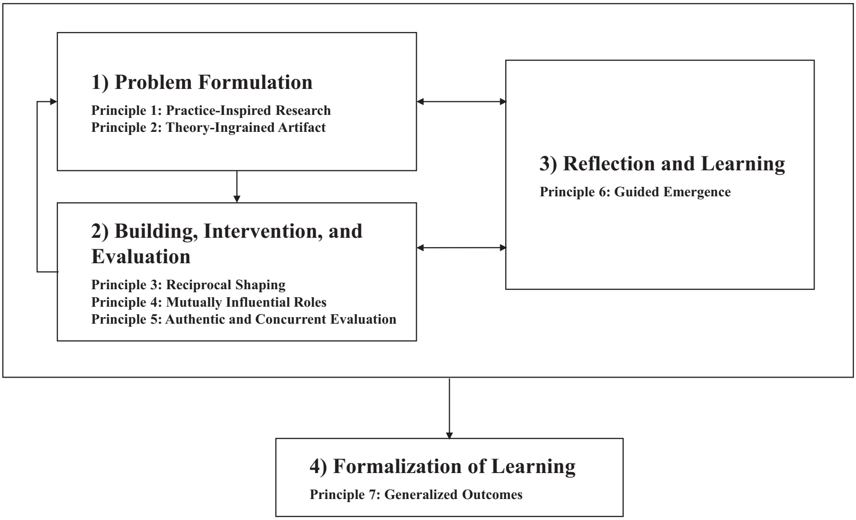


Figure 6: **ADR approach**
Source: Sein et al. (2011, 41)

In the first stage ("*problem formulation*") of their ADR approach, the research problem is framed (Sein et al. 2011). Problem formulation can be done through issues extracted from practice (principle 1, "practice-inspired research") and / or theory (principle 2, "theory-ingrained artifact") (Sein et al. 2011). The following tasks should be addressed in the first stage (Sein et al. 2011, 41):

1. "Identify and conceptualize the research opportunity"
2. "Formulate initial research questions"
3. "Cast the problem as an instance of a class of problems"

4. "Identify contributing theoretical bases and prior technology advances"
5. "Secure long-term organizational commitment"
6. "Set up roles and responsibilities"

Based on the problem formulation, in stage 2 ("*building, intervention, and evaluation - BIE*"), the IT artifact is built and evaluated in iterative design cycles in an organizational context (Sein et al. 2011). Thereby, problem and artifact are iteratively evaluated (Sein et al. 2011). In the BIE stage, three guiding principles have to be considered (Sein et al. 2011). First, the mutual influence between artifact and organizational context is emphasized by principle 3 ("reciprocal shaping") (Sein et al. 2011). Second, principle 4 ("mutually influential roles") emphasizes the importance of mutual learning among researchers and practitioners (Sein et al. 2011). Thirdly, principle 5 ("authentic and concurrent evaluation") states that evaluation is not a separate step but rather interwoven with build activities (Sein et al. 2011). The BIE stage consists of four tasks (Sein et al. 2011, 43):

1. "Discover initial knowledge-creation target"
2. "Select or customize BIE form"
3. "Execute BIE cycle(s)"
4. "Assess need for additional cycles, repeat"

In stage 3 ("*reflection and learning*"), learning is extracted from stages 1 and 2 and applied to a broader class of problems (Sein et al. 2011). This has to be done continuously and in parallel to stages 1 and 2 (Sein et al. 2011). Stage 3 is based on one guiding principle (principle 6, "guided emergence"), stating that the artifact represents not just the researcher-shaped artifact design, but also its ongoing shaping through organizational use, participants, and perspectives as well as outcomes of its authentic, continuous evaluation (Sein et al. 2011). The following tasks constitute stage 3 (Sein et al. 2011, 44):

1. "Reflect on the design and redesign during the project"
2. "Evaluate adherence to principles"
3. "Analyze intervention results according to stated goals"

Finally, in stage 4 ("*formalization of learning*") the situated learning extracted from the specific organizational context is transferred into solution concepts which can be generally applied for a class of problems (van Aken 2004; Sein et al. 2011). Generalizing the outcomes to general solution concepts and refinements to theory, as argued in principle 7 ("*generalized outcomes*"), is challenging due to ADR's situated nature (Sein et al. 2011). The tasks of the final ADR stage are the following (Sein et al. 2011, 45):

1. "Abstract the learning into concepts for a class of field problems"
2. "Share outcomes and assessment with practitioners"
3. "Articulate outcomes as design principles"
4. "Articulate learning in light of selected theories"
5. "Formalize results for dissemination"

ADR can be used to generate prescriptive knowledge, dealing "[…] with two seemingly disparate challenges: (1) addressing a problem situation encountered in a specific organizational setting by intervening and evaluating; and (2) constructing and evaluating an IT artifact that addresses the class of problems typified by the encountered situation" (Sein et al. 2011, 40). The ADR approach can be viewed as an extension of DR with AR elements, requiring a contribution in the form of innovative design principles that address a class of problems (Sein et al. 2011).

2.2.4 Evaluation of ADR Process and Results

A critical step in design and action research studies is the evaluation of the quality of the research process and its results. It is crucial to justify the research contribution on the one hand, and to derive learnings and enhancements to theory on the other hand.

Rigor and relevance of AR, DR, as well as the integrated ADR approach can be achieved and evaluated through the existing process models and guidelines / principles that have matured in the last years. The process models and principles to adhere to, particularly for the ADR approach, are presented in detail in sections 2.2.1 to 2.2.3. The integrated ADR approach, described in section 2.2.3, is the baseline and framework used to structure and conduct the overall research activities of this doctoral thesis. Therefore, the ADR process model and the principles developed by Sein et al. (2011) is used to evaluate the application of the ADR process in this thesis (see section 6.2).

Besides looking at the rigor and relevance of the research process, constructed artifacts have to be evaluated for their quality and problem-solving utility (Hevner et al. 2004; Peffers et al. 2007). Evaluation of the results of an ADR project further provides insights on the research problem, which may be used to improve the quality of the artifact but also to enhance the ADR process (Hevner et al. 2004). The evaluation of the artifact should be done based on the design requirements (design goals), derived from the problem formulation (Nunamaker/Chen/Purdin 1990-1991). There are several options to evaluate a design artifact. Hevner et al. (2004, 86) exemplary defined five evaluation methods for DR artifacts:

1. *Observational:* Case study ("study artifact in depth in business environment"), field study ("monitor use of artifact in multiple projects")

2. *Analytical:* Static analysis ("examine structure of artifact for static qualities"), architecture analysis ("study fit of artifact into technical IS architecture"), optimization ("demonstrate inherent optimal properties of artifact or provide optimality bounds on artifact behavior"), dynamic analysis ("study artifact in use for dynamic qualities")

3. *Experimental:* Controlled experiment ("study artifact in controlled environment for qualities"), simulation ("execute artifact with artificial data"),

4. *Testing:* Functional testing ("execute artifact interfaces to discover failures and identify defects"), structural testing ("perform coverage testing of some metric […] in the artifact implementation")

5. *Descriptive:* Informed argument ("use information from the knowledge base […] to build a convincing argument for the artifact's utility"), scenarios ("construct detailed scenarios around the artifact to demonstrate its utility")

As demonstrated earlier, action research can be considered as an additional "collaborative" evaluation method for design artifacts conducted in an organizational setting (Venable 2006; Johnstone/Venable 2008; Iivari/Venable 2009). The application of the action research paradigm in an ADR project depicts an inherent artifact evaluation achieved through cyclical BIE activities. Further benchmarks and guidelines on artifact evaluation can be derived from the perspectives on the evaluation of reference models presented by Fettke and Loos (2003; 2004), who classify evaluation methods from the following perspectives: descriptive (e.g., feature-based evaluation), IS theory-based (e.g., master reference model-based evaluation), non-IS theory-based (e.g., ontology-based evaluation), and empirical (e.g., field study, case study, action research).

2.2.5 Limitations of ADR Approach

The use of design research comes with certain limitations. First of all, its use holds the risk to create a well-designed artifact that has no utility for organizations (Hevner et al. 2004). Other drawbacks associated with design research are discussed by Hevner et al. (2004). From those discussed, I would like to point out two major ones. First, researchers applying DR methods to a large extent have to rely on their *intuition, personal experience, and trial-and-error* because of an often insufficient knowledge base (Hevner et al. 2004). Second, *rigorous evaluation methods* can hardly be applied in design research (Tichy 1998; Zelkowitz/Wallace 1998; Hevner et al. 2004).

Using the action research paradigm aims to solve the problem of producing an artifact being useless in organizational contexts. Nevertheless, action research, and applying it in particular to design research, has its own limitations that have to be acknowledged and mitigated where possible. One limitation comes from action research being based on *qualitative and interpretive foundations* (Baskerville 1999). AR further suffers from a *lack of evaluation criteria generally agreed* (Baskerville 1999). Additionally, action research can seem like *consulting and less like a research approach* (Baskerville 1999). Furthermore, the collaborative nature of action research can *limit the researcher's possibility to steer and control* the research study and its outcomes (Baskerville 1999).

Problems potentially arising from combining the DR and AR approaches are discussed in detail by Iivari and Venable (2009). A major problem of ADR potentially lies *in conflicting interests of its stakeholders*, coming from research and business (Iivari/Venable 2009). This can make it difficult to mutually agree upon an ethical framework (Iivari/Venable 2009). Conflicts of interest may derive from different goals stakeholders intend to achieve by participating in the ADR project (Iivari/Venable 2009). Scientists on the one hand want to build and evaluate an highly innovative artifact, clients on the other hand are more focused on costs and the robustness of the artifact, avoiding a disturbance of the operations by failure (Iivari/Venable 2009). Artifact development in an ADR setting is "on the fly", being potentially risky and conflicting with the client's goals of stable operations (Iivari/Venable 2009). Therefore, a research setting that poses a low and acceptable risk for the client should be chosen (Iivari/Venable 2009).

2.3 Overview of Applied Research Methodology

The case study research conducted to answer RQ 1 has a twofold scope: *exploratory* and *explanatory*. It strives to explore the rather new research field of consumerization of IT, with a focus on mobile consumer market technologies. Therefore, research started with defining constructs on potential impacts of the mobile consumer device use for corporate information management. These constructs were built by referring to the different layers and tasks of Krcmar's (2010) information management model (see section 4.2 for model details). They were tested in a single (pilot) case study. The constructs were explored during this pilot case study in a next step refined and reworked based on a literature review, and have finally been tested in multiple case studies.

Action design research has been applied to design a method to reply to RQ 2. ADR has been chosen to frame and guide the conducted research activities, since this thesis aims to *build a new and innovative artifact* that meets specific business needs and to address a currently unsolved problem (Hevner et al. 2004). By applying design principles in a collaborative action research setting, the organizational context has been explicitly considered (Sein et al. 2011). The applied ADR approach to construct the IDA method had two major phases and several iterative BIE cycles in order to realize the ongoing shaping of the artifact through organizational use as well as its authentic and concurrent evaluation (Sein et al. 2011), as depicted in Figure 7.

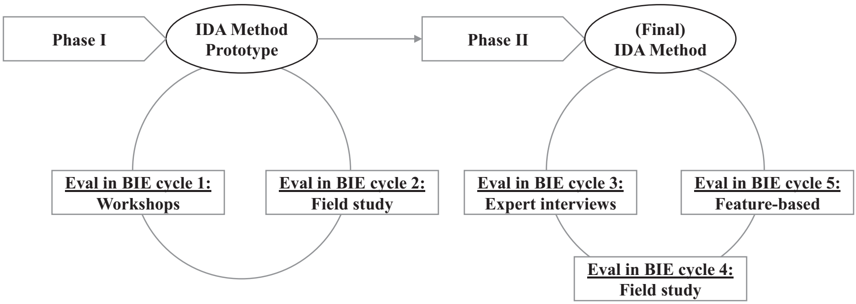


Figure 7: Applied ADR-based IDA method construction process
Source: Own illustration

In phase I, the "*IDA method prototype*" was built, applied, and evaluated in two BIE cycles. The problem formulation which guided the prototype construction is coming from practice, initially derived from the single (pilot) case study on the challenges of the corporate use of mobile consumer devices. It was refined and extended by the requirements put up in the action research project to construct the method prototype by the participating business company and its experts. The AR partner[23] is a large multinational business company. The prototype of the IDA method was built and subsequently evaluated in a series of workshops in BIE cycle 1 and through a field study in BIE cycle 2 at a selected sales department of the AR partner (for details on evaluation approaches see Fettke/Loos 2003; Hevner et al. 2004).

In phase II of the ADR process, the method prototype has been reworked into the final IDA method, referred to as "*IDA method*" in the following. Thereby, design goals as well as the method design have been substantially adjusted and refined. Not only insights gathered from the conducted field study of BIE cycle 2, but also additional case studies on the corporate challenges of mobile consumer device use, as well as findings from a literature review on business value of mobile IT build the baseline for the conducted rework. Thus, the final problem formulation guiding the ADR process has been extracted from practical and theoretical sources (Sein et al. 2011). Details on the final set of design goals are presented in section 6.3.2.1.

The initial rework of the IDA method in BIE cycle 3 was carried out without direct involvement of the AR partner (in contrast to phase I in which the prototype was developed together in a series of workshops). It was evaluated by means of interviews with an expert from academia who has expertise on the value of IT and service productivity, and three mobile enterprise experts from the consulting industry. In BIE cycle 4, the IDA method was applied in a second field study at the sales department of the AR partner. The results of the method application and the IDA method design were discussed with internal IT experts of the AR partner. Feedback and insights gathered in BIE cycles 3 and 4 have been incrementally incorporated to refine the design goals (problem formulation) and the method design, as far as possible and feasible. Finally, in BIE cycle 5, the IDA method has been evaluated for the features (attributes and elements) a method should possess (Fettke/Loos 2003). Throughout the ADR process and its BIE cycles, mutual influence not only between the artifact and the organizational context but also among researchers and practitioners is adhered to (Sein et al. 2011).

In parallel to the problem formulation and the iterative build-and-evaluate cycles, reflection and learning has been continuously conducted not only to build a method able to address the design goals specifically for the company participating in the ADR process but also for other business companies (Sein et al. 2011). Thereby, learning has been

[23] "AR partner" is used in this thesis to refer to the business company participating in the action research project to build the IDA method prototype.

formalized to generate a general solution concept for the challenges concerning the use of IT services on mobile consumer devices that motivated the definition of the design goals (Sein et al. 2011).

3 Related Work on Consumerization of IT and Mobile Enterprise IT

In 2013 and 2014, an in-depth literature review on consumerization of IT and mobile enterprise IT was conducted. The literature review comprised the following research databases:

- *AIS (Association for Information Systems) eLibrary*
  (http://aisel.aisnet.org/)

- *Science Direct by Elsevier*
  (http://www.sciencedirect.com/)

- *ACM (Association for Computing Machinery) Digital Library*
  (http://dl.acm.org/)

- *IEEE (Institute of Electrical and Electronics Engineers) Xplore Digital Library*
  (http://ieeexplore.ieee.org/)

- *EBSCOhost Research Databases*
  (http://web.a.ebscohost.com/)

- *JSTOR (Journal STORage)*
  (http://www.jstor.org/)

- *Emerald Insight*
  (http://www.emeraldinsight.com/)

- *Journal of Information Technology*
  (http://www.palgrave-journals.com/jit/)

The selection of research databases allowed a broad search for related work and at the same time included the top IS journals (Senior Scholars Consortium 2011):

- *European Journal of Information Systems* (EJIS)

- *Information Systems Journal* (ISJ)

- *Information Systems Research* (ISR)

- *Journal of the Association of Information Systems* (JAIS)
- *Journal of Information Technology* (JIT)
- *Journal of Management Information Systems* (JMIS)
- *Journal of Strategic Information Systems* (JSIS)
- *Management Information Systems Quarterly* (MISQ)

The journals EJIS, ISJ, ISR, JMIS, and MISQ were included into the literature review via the Business Source Premier database of EBSCOhost, the JAIS journal via the AIS eLibrary, and the JSIS journal via Science Direct. JIT articles were screened via direct journal access over the journal website. According to Webster and Watson (2002), a literature review should start with leading journals but should include relevant high-quality conferences. The AIS eLibrary allowed for the consideration of relevant academic IS conferences such as the ECIS (European Conference on Information Systems) or ICIS (International Conference on Information Systems).

The conduction of the literature review aimed on the one hand to gain an overview of the body of knowledge on consumerization and mobile enterprise IT, and on the other hand to extract the most relevant publications to be referenced for research question 1. The research databases were screened for relevant papers in several cycles using a variety of search terms related to consumerization and mobile enterprise IT such as (and others):

- "*enterprise mobility*"
- "*mobile enterprise*"
- "*mobile business application*"
- "*mobile business service*"
- "*mobile work*"
- "*mobile worker*"
- "*consumerization*"

- “*BYOD*”
- “*app*”
- “*iOS*”
- “*Android*”
- “*iPhone*”

The number of search strings applied was too numerous to list all strings in detail, therefore only a selection of search terms that the strings were built on is depicted. The search terms were used as single terms or combined with others to complex search strings. Depending on the database and the number of results returned, the search per database was not restricted or for selected search terms, e.g., limited to peer-reviewed publications, articles published after 01-01-2010 (only for selected searches on the AIS eLibrary), or to abstract, title and / or keywords searches to have less results. The searches over the eight databases between 2013 and 2014 returned 7279 results. These results were rated for their relevance mainly by screening their title- and / or abstract. Finally, 327 publications were selected for detailed analysis. An overview of the number of publications screened and selected across the eight research databases included in the literature review on consumerization of IT and mobile enterprise IT is given in Figure 8.

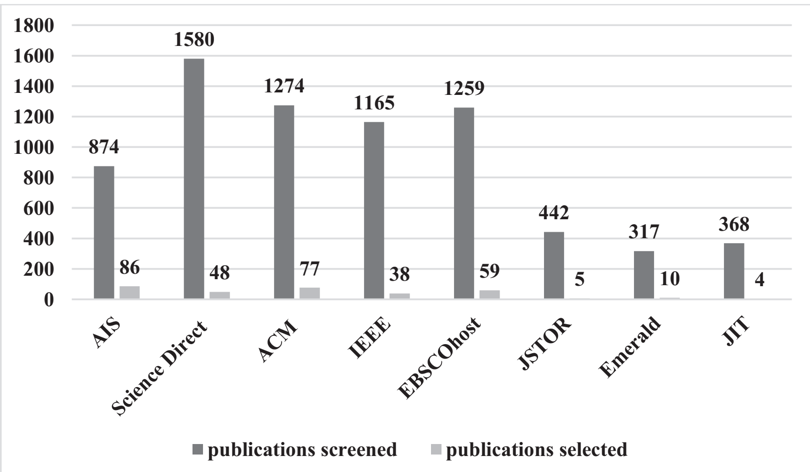


Figure 8: **Literature review on consumerization of IT and mobile enterprise IT**
Source: Own illustration

For the screening and selection of relevant papers, several principles were defined at the beginning of the literature review in order to guide it:

- Search for articles that deal with the use of mobile applications or services on mobile devices (smartphone, tablet, mobile phone, personal digital assistant / PDA) in business companies. This does neither include applications and services that companies provide their customers nor applications only used on laptops.

- The focus of the literature review is put on identification and assessment of mobile applications and services in the course of their introduction and use. Articles that from a purely technical perspective deal with mobile application development are not to be considered. The focus is not on programming of apps or underlying database architectures.

- Important topics to look for in articles are:

    - Introduction process of mobile services or applications in companies

    - Reasons for the use of mobile services or applications in companies

    - Benefits from the use of mobile services or applications in companies

    - Challenges of the introduction and use of mobile services or applications in companies

- Further evidence for the identification of relevant articles:

    - If there is a general focus on use of mobile technology in companies (as, e.g., in Basole 2007a; Basole 2008)

    - If there is no abstract existing but the term “mobile enterprise” referenced in the title

    - If there is a focus on “design” and it is obvious that it is not just about app programming (as, e.g., in Gaffar 2009)

    - If there is a focus on “nomadic work” and the use of mobile technology is not excluded (as, e.g., in Becerra-Fernandez/Cousins/Weber 2007)

- Evidence for search strings regarding "consumerization": Only articles dealing with IT are to be considered (web 2.0, mobile, etc.).

An overview of selected papers of the literature review related to the research field of consumerization of IT and mobile enterprise IT and an excerpt of articles rated to be most relevant for research question 1 (and its sub-questions) is presented in the next sections (3.1 and 3.2).

3.1 Consumerization of IT

Innovative devices and applications coming from the consumer market are more and more adopted by employees and are paving their way into corporate IT environments (Ingalsbe/Shoemaker/Mead 2011; Harris/Ives/Junglas 2012; Holtsnider/Jaffe 2012a; Ortbach et al. 2013). The corporate use of web 2.0 technologies such as blogs and wikis can be regarded to be an early indicator of this trend (Cummings/Massey/Ramesh 2009; Holtsnider/Jaffe 2012a) – referred to as consumerization of IT. Currently, mobile devices from the consumer market – *mobile consumer devices* – are finding their way into business companies (Ingalsbe/Shoemaker/Mead 2011; Harris/Ives/Junglas 2012; Holtsnider/Jaffe 2012a; Ortbach et al. 2013). In particular, iOS- or Android-based smartphones and tablets are increasingly being used by employees as a substitute for the legacy enterprise devices. This is supported by the results of a survey conducted by iPass (2013), seeing the iPhone, followed by the iPad and Android-based smartphones, as mobile workers' preferred choice of primary device. A comprehensive elaboration on the consumerization trend and possible resulting impacts on corporate information management are outlined by Weiß and Leimeister (2012). In this article the phenomenon of IT innovations coming up first on the consumer market and from there spreading into the companies is discussed (Terryn 2011). Holtsnider and Jaffe (2012a, 271) elaborate on an "[..] increase in availability and choices of new technology solutions for the consumer […]" and "[..] realization by these same consumers that these new products would not only be useful to them in their personal life, but in their corporate life as well" to have fostered the consumerization trend. In several recent publications, consumerization of IT is discussed. In Niehaves, Köffer, and Ortbach (2012, 1), it is more narrowly defined as "[…] privately-owned IT resources, such as devices or software that are used for business purposes." They present possible positive and negative effects (advantages and disadvantages) for employees and organizations resulting from this trend (Niehaves/Köffer/Ortbach 2012). Harris, Ives, and Junglas (2012) refer to the adoption of devices and applications from the consumer market in the workforce as IT consumerization. In their article, they name computer tablets and smartphones and apps such as social media applications as examples for consumer IT entering companies, while illustrating benefits of the consumerization trend but also how organizations can respond to challenges created by it (Harris/Ives/Junglas 2012). Quaadgras and Mohammed (2011) sharpen the definition of the consumerization trend and focus on employees which are using mobile consumer technologies such as smartphones and tablets for work and discuss ways to harness the trend. This focused view is in line with the research focus of this doctoral thesis, in which the impact of the mobile consumer device use on IT departments is evaluated.

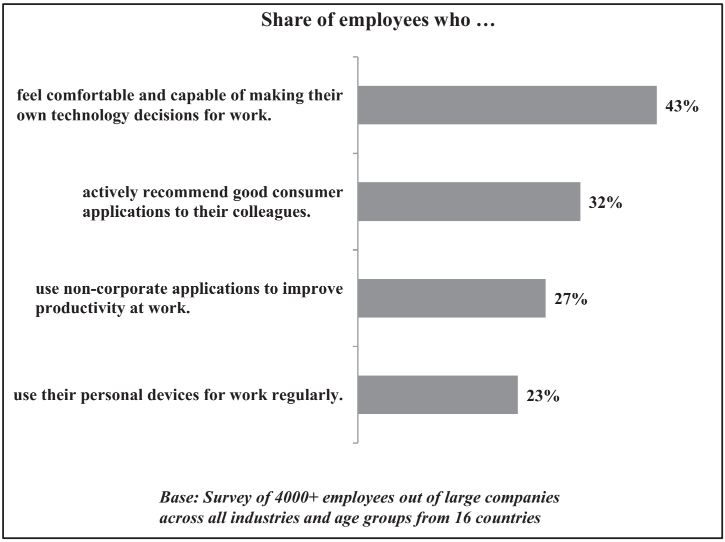


Figure 9: Statistics on use of consumer technology in companies
Source: Adapted from Accenture (2011)

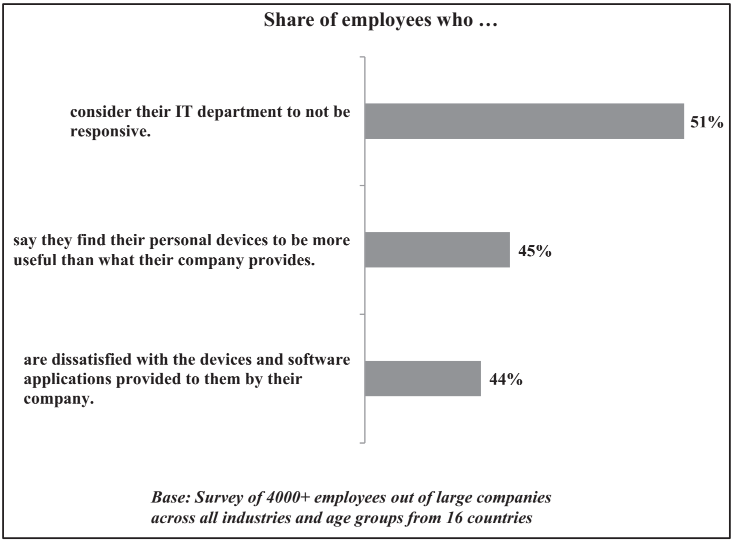


Figure 10: **Statistics on satisfaction of employees with corporate IT**
Source: Adapted from Accenture (2011)

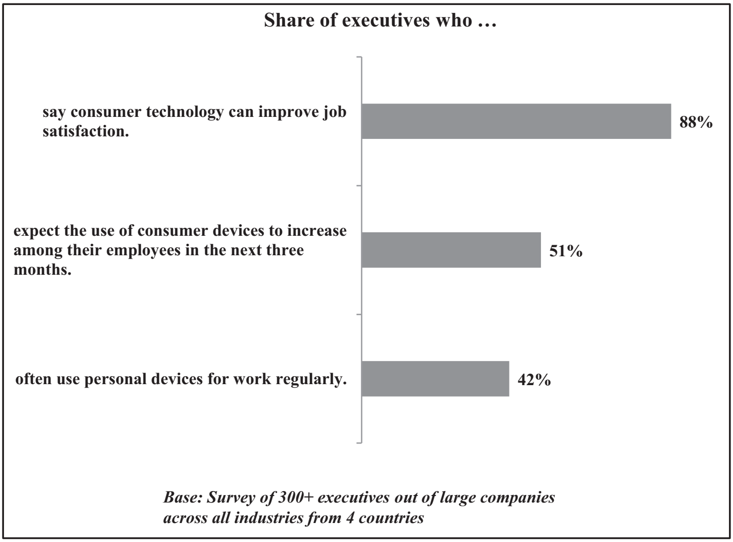


Figure 11: **Statistics on top management view on consumerization**
Source: Adapted from Accenture (2011)

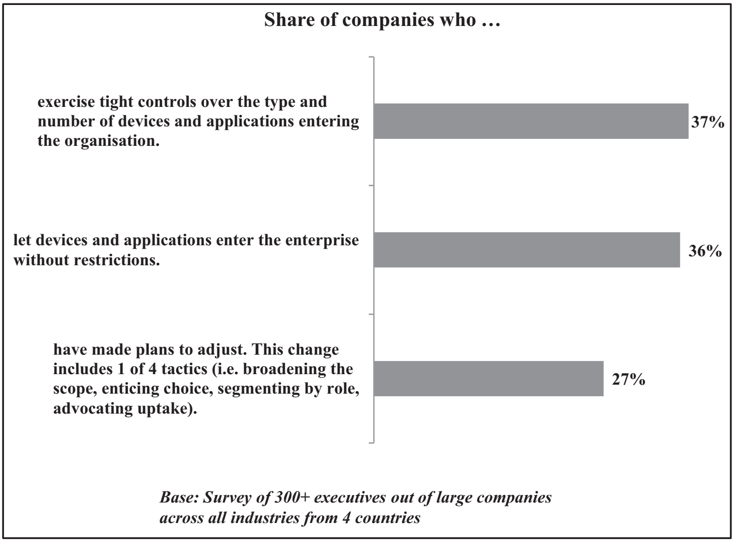


Figure 12: **Statistics on managing consumer technology use in companies**
Source: Adapted from Accenture (2011)

Exemplary survey results regarding the use of consumer IT in companies are illustrated in Figure 9, Figure 10, Figure 11, and Figure 12. The presented statistics are an excerpt of survey results presented by Accenture (2011). These figures outline the existence of the consumerization trend in business companies.

3.2 Mobile Enterprise IT

Mobile enterprise constitutes a paradigm shift to how work is and will be organized in the future (Basole 2007a). In Basole (2007a, 2), a mobile enterprise is defined as follows:

> "*The mobile enterprise is built on a foundation of processes and technologies allowing full access and instrumented insight to all organizational resources, resulting in improved adaptability, access, and interaction among employees, customers, partners, and suppliers, independent of location.*"

The term mobile enterprise comprises the corporate use of mobile technology such as mobile device & application and wireless communication technologies (Stanoevska-Slabeva 2004; Basole 2007a) – also referred to as *mobile IT* (see, e.g., Bowden et al.

2006; Gebauer/Shaw/Gribbins 2010) or mobile ICT[24] (see, e.g., Basole 2007a; Maddhann/Nahar 2012). Mobile technology in the wider sense, illustrated e.g., by Dekleva (2002), includes portable devices such as laptops or PDAs. In the narrow sense, taken as the baseline in this thesis for addressing research questions 1 and 2, the mobile technology scope excludes laptops (Derballa/Pousttchi 2004; Mladenova et al. 2011) and rather focuses on the use of smartphones and tablets as, e.g., similarly done in the recent research study of Gröger et al. (2013). Smartphones (or "smart phones") are a class of mobile phones that typically combine voice communication with advanced data access and processing capabilities (Zheng/Ni 2006). On smartphones besides PIM other mobile and wireless Internet applications can be accessed (Zheng/Ni 2006). Tablets are portable computing devices larger than smartphones which use the touch screen as the primary interaction method (Buttfield-Addison et al. 2012).

In the body of literature and particularly in Basole (2007a, 3-4), the following categories of mobile enterprise users working on-site or off-site are classified and discussed:

- "Desk workers, who work mostly behind their desks (e.g., software designers, operations, accounting)." (Basole 2007a, 3)
- "On-site rovers, who work mainly at their desks, but sometimes roam in the company (e.g., administrative assistants)." (Basole 2007a, 3)
- "Site wanderers, which are desk-less people who typically spend most of their time roaming on-site (e.g., IT troubleshooter)." (Basole 2007a, 3)
- "Tele workers, who work remotely (from home or from a location away from the office) most of the time." (Basole 2007a, 4)
- "Off-site rovers, who work off-site mainly away from their offices, but sometimes at their desks (e.g., consultants)." (Basole 2007a, 4)
- "Road warriors, who work mainly outside the company (e.g., account executive)." (Basole 2007a, 4)
- "Global cruisers, who often travel between different companies, customers, and locations (e.g., corporate executive)." (Basole 2007a, 4)

[24] ICT = information and communication technology

A related term frequently referenced in the mobile enterprise literature is “enterprise mobility”. In Barnes (2003, 342), it is described as the use of wireless applications in organizations and “[…] defined as the degree to which an organisation’s operations and information needs, typically employee activity, are supported in a geographically independent way”. Thereby, “mobility” is characterized as the degree of geographic independence supported by wireless data solutions (Barnes 2003). According to Barnes (2003), mobility can be “transient” (support of employees moving between locations), “mobile” (support of employees with a higher level of geographic independence for longer periods of time), or “remote” (support of employees which are nearly fully removed from the locations). An alternative classification of mobility categorizes into wandering, travelling, and visiting is made by Kristoffersen and Ljungberg (2000). Another term used in the related body of literature is “mobile business”. According to Barnes (2002), it constitutes the use of mobile IT for corporate communication, coordination, and management purposes.

Mobile enterprise IT is leveraged in business companies to support and optimize (business) processes. A business process is defined by Davenport (1993, 5) as “[…] a specific ordering of work activities across time and place, with a beginning, an end, and clearly identified inputs and outputs: a structure for action.” An activity can be described as a sub-process that cannot be split up into further steps, executed by a single person (Gruhn/Köhler/Klawes 2005; Mladenova et al. 2011). If a business process comprises at least one mobile activity, the process can be regarded as a “mobile business process” (Gruhn/Köhler/Klawes 2005). A mobile activity is characterized in Gruhn, Köhler, and Klawes (2005) – by referencing van der Heijden and Valiente (2002a) – through uncertainty of location for activity execution. Based on this concept of location uncertainty, a comprehensive definition of a mobile business process is provided by Gruhn, Köhler, and Klawes (2007, 661-662):

> “[…] *a mobile business process is a business process, in which:*
>
> *(1) at least one person is involved, who executes their tasks in different locations;*
>
> *(2) the actual location of task execution is known only vaguely and/or only shortly before the beginning of the task; and*
>
> *(3) this uncertainty (2) is determined externally and cannot be fully controlled by the task-executing person.*”

As illustrated above, the term “task” can be used instead of “activity” to describe the elements of a mobile work process executed by employees (see also Gruhn/Köhler 2007). In Gruhn and Richter (2010, 554), a task is defined to be “[…] an atomic unit of work to be performed assigned with a geographic location and a set of skills it demands.” A task represents an instance of an activity. In this doctoral thesis, the terms “activity” and “task” as well as “process” and “business process” are used synonymously.

The term “*mobile consumer IT*” (see, e.g., Sammer 2013) is taken in this doctoral thesis to reference mobile technology from the consumer market, originally designed for the personal and not corporate use. Mobile consumer devices, like iOS- or Android-based smartphones and tablets, are supposed to be increasingly deployed in organizations (iPass 2013). Their corporate use is an example of technology coming from the consumer market which is deployed in the mobile enterprise paradigm. The BlackBerry, on the other hand, is an example for a typical class of legacy enterprise devices (Barnes 2003).

3.2.1 Mobile Enterprise Services

Mobile services comprise applications and in the wider sense services deployed on a handheld device (Jain 2003b; Mouhmoud 2003). Corporate IT services made available on smartphones and tablets are referred to as “*mobile enterprise services*” in this doctoral thesis. According to Wiggers, Kok and de Boer-de Wit (2004a, 42), an IT service constitutes “an identifiable, measurable, orderable and chargeable unit of service from the customer’s view, which provides a required IT capability.” Mobile enterprise services can be regarded as a specific class of IT services provided to employees on mobile devices (such as tablets and smartphones) over a mobile network (such as WLAN, UMTS[25], or LTE[26]).

Mobile enterprise applications and services, in the broadest sense, can be classified in business-to-business (B2B), business-to-employee (B2E), and business-to-commerce (B2C) solutions (Basole 2007a). In this thesis, the narrow focus on B2B and B2E solutions is taken as the baseline for further research (as done, e.g., in Basole 2007a). Corporate fields of mobile enterprise application / service use are for instance the following ones:

[25] UMTS = Universal Mobile Telecommunications System
[26] LTE = Long Term Evolution

- Mobile office and personal information management (PIM): Instant mobile access to office information such as e-mail, calendar or contacts data (Basole 2007a)

- Mobile enterprise resource planning (ERP): Mobile access to ERP (e.g., finance, HR, or manufacturing) data through a mobile client (Zheng/Ni 2006; Basole 2007a)

- Mobile customer relationship management (CRM): Mobile access to customer database and, e.g., sales and marketing information (Zheng/Ni 2006; Basole 2007a)

- Mobile supply chain management (SCM): Integration of mobile information and communication technology (e.g., RFID-based) into SCM applications (Zheng/Ni 2006; Basole 2007a)

- Mobile knowledge management (KM): Mobile support of knowledge acquisition, retrieval, and sharing (Zheng/Ni 2006; Basole 2007a)

- Mobile collaboration: Set of tools to enable employee collaboration, including mobile multimedia or instant messaging applications (Zheng/Ni 2006)

Mobile applications developed for smartphones and tablets are in the body of literature also referred to as "2nd generation of mobile applications" or "apps" (Giessmann/Stanoevska-Slabeva/Visser 2012). Apps, in the stricter sense, constitute a class of native or browser-based mobile applications designed for mobile consumer devices, e.g., based on iOS or Android operating systems (Gröger et al. 2013).

Mobile applications designed for enterprise customers have different characteristics compared to those targeting consumer market customers. Tornack, Christmann, and Hagenhoff (2011) researched and discussed several technical (e.g., application architecture, devices and OS used, or security measures applied) and economic differences (e.g., creation of value added, cost components, or support and maintenance) between these two classes of mobile applications. The results underline the difference between traditional mobile enterprise IT and mobile consumer IT recently infiltrating companies.

3.2.2 Challenges of IT Service Use on Mobile Consumer Devices

A systematic literature review was conducted to capture the status quo of the body of knowledge on the challenges accompanying the use of mobile enterprise services on consumer devices. A set of publications on the effect of corporate mobile consumer device use for IT departments, rated to be most relevant, was extracted from this analysis.

Many of the analyzed publications focus on security-related issues in the context of the consumer device use such as data leakage and loss (Everett 2010; Drew 2011), malware threats (Everett 2010; Harris/Patten/Regan 2013), lack of enterprise-grade features (Holtsnider/Jaffe 2012a), and potentially unsecure consumer operating systems (Harris/Patten/Regan 2013). Moreover, the challenge of making the right trade-off between IT security and usability respectively being an innovation driver and not an obstacle is discussed (Everett 2010; Gröger et al. 2013; Sammer/Brechbühl/Back 2013). In addition, the integration of mobile consumer technology into corporate infrastructures is outlined as a possible issue (Everett 2010; Gröger et al. 2013). Furthermore, challenges are discussed regarding the development of mobile applications in a short time frame (Sammer/Brechbühl/Back 2013), for the existing heterogeneity of devices and operating systems (Gröger et al. 2013), with having the right staff capable of developing user-friendly applications (Sammer/Brechbühl/Back 2013), and by considering industry-specific regulations (Gröger et al. 2013). It is further outlined as a challenge for IT departments to manage different mobile device projects started independently by different departments (Sammer/Brechbühl/Back 2013). Holtsnider and Jaffe (2012a) point out that the heterogeneity of mobile devices as well complicates the provision of IT support. Establishing vulnerability checks for mobile applications and the management of devices and applications across the heterogeneous operating systems is further described to be a challenge (Gröger et al. 2013). The identification of processes and tasks that would benefit from app support are challenges as well seen to come up with the mobile consumer device use (Gröger et al. 2013). Pressure from employees demanding to use mobile consumer devices or personal devices within the company – in particular from top management – is seen in several publications (Holtsnider/Jaffe 2012a; Thomson 2012; Chan Chee 2013). The use of personal devices in a BYOD program and the resulting issues also are addressed by a plethora of authors (see, e.g., Everett 2010; Ingalsbe/Shoemaker/Mead 2011; Niehaves/Köffer/Ortbach 2012; Scarfo 2012; Banham 2013; Hayes/Kotwica 2013; Walters 2013; Smith/Forman 2014). Thereby, a bunch of topics specific to the use of personal devices, e.g., those related to data privacy, are discussed. Finally, there are challenges mentioned in the literature that are related to the missing support for so-called mouse input devices, flash, or specific business applications (e.g., for accounting) on consumer devices such as the iPad (Drew 2011).

The body of knowledge on mobile consumer IT reveals challenges which motivate and justify a dedicated analysis of the corporate mobile consumer device use. These challenges come, e.g., from security issues, app development and deployment requirements, BYOD use, missing device features, or device and OS heterogeneity. Their consumer IT specifics have been analyzed and outlined to a certain extent, depicting a starting point for further detailed analysis. Nevertheless, besides focusing on certain topics in-depth, the full impact mobile consumer device use creates on the various IT management activities needs to be captured and researched. A holistic analysis of the mobile consumer device impact on information management activities was conducted in the single (pilot) case study, which is part of the multi-case study analysis presented in chapter 4. It is in detail discussed in Weiß and Leimeister (2013a). Taking this pilot study as a benchmark, no article considered for literature analysis does holistically cover the full information management scope.

For dealing with challenges of mobile consumer device use, a variety of articles outlines security-related mitigation measures such as mobile device management (Chan Chee 2013; Hayes/Kotwica 2013), awareness measures (Chan Chee 2013; Harris/Patten/Regan 2013), encryption (Chan Chee 2013; Harris/Patten/Regan 2013), virtualization technologies (Scarfo 2012), or usage policies (Everett 2010; Drew 2011; Banham 2013). Other measures such as self-service for IT support (Holtsnider/Jaffe 2012a) as well as new staffing strategies (Sammer/Brechbühl/Back 2013) or hybrid, user-driven application development techniques (Gröger et al. 2013) to address application development challenges have only scarcely been described.

Finally, it has to be noted that a minority of publications reviewed and discussed is based on research studies, rather a majority is coming from industry experts and practitioners (e.g., Everett 2010; Drew 2011; Holtsnider/Jaffe 2012a; Thomson 2012; Chan Chee 2013; Walters 2013; Smith/Forman 2014).

Note: The literature review that laid the foundation to extract challenges of the corporate mobile consumer device use was conducted in 2013 and 2014. In August 2015, the eight databases that were initially screened were searched again for articles published in 2014 or 2015, by applying the strings “consumerization” or “consumerisation”. Search results were title-screened. If thereby publications turned out to possibly be relevant, existing abstracts and, if required, the full texts were screened for relevance. There are recent articles providing first studies on the consumerization impact on IT departments (Koch/Curry 2014; Koch et al. 2014). However, no research article was found that holistically and systematically addresses the challenges resulting from the mobile consumer device use for information management activities. A further screening for articles dealing with single challenges was not carried out. Due to the rapid evolvement of the topic it can be expected that there are publications dealing with single challenges in-depth.

3.3 Research Gaps on Enterprise Use of Mobile Consumer IT

The analysis of the extracted set of publications on challenges of enterprise use of mobile consumer IT revealed several research gaps. Firstly, there is a *lack of papers based on research studies* investigating the topic. The majority of related articles is not based on systematic research activities, leveraging a structured and thorough research methodology. Secondly, *no article holistically analyzes the existing challenges* – in the full information management scope. The reviewed publications mainly focus on certain aspects such as IT security.

4 Impacts of Mobile Consumer Device Use for IT Departments

Research question 1 and its sub-questions are addressed in chapter 4:

"*How is the corporate use of IT services on mobile consumer devices affecting IT departments?*"

At the beginning of this chapter, in section 4.1, a summary of related work on challenges of corporate IT service use on mobile consumer devices, relevant for research question 1, is discussed. In section 4.2, a detailed description of the applied research methodology is provided. Finally, results of the case study analysis are presented (section 4.3) and discussed (section 4.4), and conclusions are drawn (section 4.5).

4.1 Summary of Related Work Relevant for Research Question 1

From the literature review (see chapter 3 and in particular section 3.2.2), a set of publications rated to be most relevant for research question 1 was extracted. Among these publications, the majority of articles comes from industry experts and practitioners (e.g., Everett 2010; Drew 2011; Holtsnider/Jaffe 2012a; Thomson 2012; Chan Chee 2013; Walters 2013; Smith/Forman 2014). These articles not only discuss security-related issues but put a strong emphasis on these challenges. The reviewed research articles address IT security topics (Gröger et al. 2013; Harris/Patten/Regan 2013; Sammer/Brechbühl/Back 2013) and, e.g., issues related to the integration into corporate IT infrastructures (Gröger et al. 2013), application development (Gröger et al. 2013; Sammer/Brechbühl/Back 2013), identification of processes or tasks to be mobilized (Gröger et al. 2013), management of mobile device projects (Sammer/Brechbühl/Back 2013), or the BYOD use (Niehaves/Köffer/Ortbach 2012). Researching the challenges arising from the mobile enterprise service use on consumer devices still misses a holistic analysis of the various impacts created for IT departments and IT management activities. It can be argued that no paper selected for review provides a holistic analysis of the mobile consumer device impact on information management activities (see Weiß/Leimeister 2013a, for a first holistic analysis).

Heavily discussed in the reviewed articles are security-related mitigation measures (Everett 2010; Drew 2011; Scarfo 2012; Banham 2013; Chan Chee 2013; Harris/Patten/Regan 2013; Hayes/Kotwica 2013). Other measures such as self-service for IT support (Holtsnider/Jaffe 2012a) as well as new staffing strategies

(Sammer/Brechbühl/Back 2013) or hybrid, user-driven application development techniques (Gröger et al. 2013) to address application development challenges are less discussed in literature.

The use of mobile enterprise services on consumer devices is seen to create first, to a certain extent, consumer IT-specific challenges for IT departments, requiring a holistic investigation of the associated information management problems.

4.2 Details of Applied CSR Methodology

For answering research question 1 of this doctoral thesis, case studies with four multinational companies build the baseline to explore which challenges emerge for IT departments by the corporate use of IT services on mobile consumer devices (research question 1a), and to identify countermeasures applied (or planned to be applied) by IT departments to mitigate these challenges (research question 1b).

Case study research is an appropriate tool and applied to address this explanatory focus of identifying causal relationships related to the device use and generating new theory in a field such as consumerization of IT with limited research literature available (Eisenhardt 1989; Yin 2009). In 2012 and 2013, *four case studies* were conducted at multinational companies from different industries with one having less than 2,000 and three having more than 30,000 employees. Across the four companies, about 30 hours of *interview data* from a total of 27 (8-6-7-6) experts and 49 (8-13-17-11) *documents* were gathered. The documents include details on, e.g., mobile device & BYOD usage guidelines, mobile strategy, mobile device management, conducted proof of concepts, cost calculations, available mobile devices, and mobile enterprise services. Experts interviewed at the companies come from the top IT management or from departments (e.g., IT support, IT strategy, IT security, IT architecture, IT infrastructure, mobile applications) involved in the introduction and operation of mobile devices and services. Interviews were conducted by means of a semi-structured questionnaire, recorded, transcribed and – with the documents provided – coded, based on principles of *qualitative content analysis* (Mayring 2004; Gläser/Laudel 2010; Mayring 2010). All interviews were conducted and (together with the document data) coded by the author of this thesis – who has several years of working experience as a consultant on mobile enterprise topics. The questionnaire focused on the following topics (see Table 17 in Appendix for more details):

- Mobile consumer device, BYOD, and app use
- Motivation to introduce mobile consumer devices
- Integration of mobile consumer devices
- Impacts of mobile consumer device use on enterprise IT

The questionnaire explicitly asked for mobile consumer devices and provided examples of typical consumer devices to guide the interviewees to talk about consumerization and not about legacy enterprise IT effects (e.g., coming from BlackBerry use). Findings from the case study material were extracted with a search grid, referred to as coding scheme in the following (see Table 1), derived from the one used in a first analysis of one of the four conducted case studies.

The study of this single case acted as a pilot for the analysis of the multiple cases. The coding scheme used in the pilot case study was compiled based on constructs derived from Krcmar's (2010) information management (IM) model. This IM model consists of four layers: management of information exchange, management of information systems, management of information and communication technology, and managerial tasks for information management (Krcmar 2010). Constructs were built based on possible impacts of consumer technology use on the different IM layers. First, theoretical elaborations on possible impacts on information management can be found in Weiß and Leimeister (2012). Details on the pilot case study analysis conducted and the findings gathered are presented in Weiß and Leimeister (2013a). The pilot case study is one of the four case studies analyzed to extract the results presented in section 4.3. It was initially conducted with five interviewees and documentation they provided. In a second round, in parallel to the other three case studies, two additional experts were interviewed, two experts were interviewed a second time, and additional documentation was collected.

The coding scheme was refined based on the findings of the pilot case study and a literature analysis on challenges created by the mobile enterprise service use – not restricted to consumer devices. As only few research publications on challenges of mobile consumer device use in corporations exist, the literature analysis was extended to focus on corporate mobile device use in general. Findings were used to extract additional codes for the scheme. Based on the refined coding scheme, relevant information to answer the posed research questions was marked, assigned to at least one code, and extracted from the four case studies (including the pilot case study). During this analysis step, the *coding scheme* was slightly refined to constitute the final scheme, as depicted in Table 1. The extractions were reduced and evaluated to identify challenges of mobile enterprise service use on consumer devices and countermeasures applied (or planned to be applied). Thereby, data collected in interviews and documentation in the initial pilot case study (PCS) were analyzed again based on the reworked coding scheme.

In a next step, the findings were categorized and interpreted based on the *service lifecycle model* (see Figure 13) defined by Kohlborn, Korthaus, and Rosemann (2009). The model was not used for coding purposes but to categorize and further evaluate the impact constituted by the mobile consumer device use. For categorizing the identified challenges, a service lifecycle model (and not an IM model) is used, since it enables to further discuss the specific impact corporate use of IT services on mobile consumer devices has on the different stages of the service lifecycle.

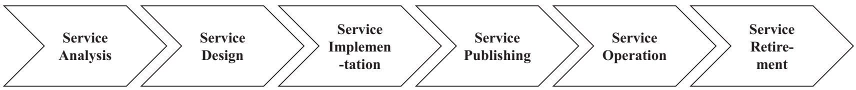


Figure 13: Stages of service lifecycle model
Source: Adapted from Kohlborn, Korthaus, and Rosemann (2009, 88)

It comprises the following six stages (Kohlborn/Korthaus/Rosemann 2009):

- Stage 1: In the initial service analysis stage, services are identified and contextualized.
- Stage 2: In the service design, a detailed model of the services appropriate for actual development and reuse is created.
- Stage 3: Based on this design, the service is built in the service implementation stage.
- Stage 4: After the service has been built, it is disseminated in the service publishing phase.
- Stage 5: Being brought to service operation, the service is actively provided and consumed.
- Stage 6: In the final stage of the service lifecycle model – the service retirement – if necessary, the service is taken out of the company's portfolio.

IT governance: - **Employee demand for consumer devices** (derived from PCS and literature: Holtsnider/Jaffe 2012b; Holtsnider/Jaffe 2012a; Thomson 2012; Chan Chee 2013): * Decrease of corporate control on mobile device and app portfolio - **Unclear device & app governance rules** (derived from PCS, no related literature found): * Use of forbidden apps and devices, governed by policies? - **Further BYOD demand** (derived from PCS and related literature: Everett 2010): * Demand, e.g., for use of personal laptops - **Few governance on app initiatives** (derived from PCS and related literature: Sammer/Brechbühl/Back 2013): * Business departments start app initiatives on their own, without IT involvement
IT change management: - **Resistance to change because of device status** (derived from PCS, no related literature found): * Life style device image is hindering consumer device adoption - **Resistance to change because of few IT affinity** (derived from PCS and related literature: O'Donnell et al. 2007): * Resistance to change on organizational / employee level when introducing new (mobile) technologies, because of less IT affinity
IT project management: - **Service introduction process length** (derived from PCS, no related literature found): * Existing IT service introduction processes are too tedious compared to short app development time - **Requirements definition** (derived from PCS, no related literature found): * Cross-business unit alignment or international requirements definition when introducing mobile enterprise services * Definition of requirements that can be realized and applied - **Management created time pressure** (derived from PCS, no related literature found): * High management attention in consumer device use creates high time pressure - **Management pilot participation** (derived from PCS, no related literature found): * Less fault tolerant executives participating in mobile service pilots - **Stakeholder support** (derived from PCS, no related literature found): * Management support is critical, which can be missing if too much IT-driven - **Resource shortage** (derived from PCS and related literature: Leskinen 2008): * IT resource shortage for to operate mobile services or to screen for innovations
IT knowledge: - **Lack of IT knowledge** (derived from PCS and related literature: Stanoevska-Slabeva 2004; Balocco/Mogre/Toletti 2009): * Lack of knowledge on the topics associated with the introduction of a mobile enterprise service * The reasons for not adopting these solutions are basically a lack of knowledge about mobile enterprise services (Balocco/Mogre/Toletti 2009) * Management needs to be aware of the specific features of mobile technologies in order to be able to develop visions for new processes (Stanoevska-Slabeva 2004) - **Lack of legal topic knowledge** (derived from PCS and related literature: e.g., Hayes/Kotwica 2013; Smith/Forman 2014): * Missing experience with legal topics (data privacy and HR)

IT business value: - **Limited value of devices without apps** (derived from PCS, no related literature found): * For enterprises, there is only limited use for mobile devices if they are not using mobile apps - **Few business unit demand for apps** (derived from PCS, no related literature found): * There is only few demand for using enterprise apps at corporate business departments - **Benefits quantification for business case calculation** (derived from PCS and related literature: Basole 2005b; Juntumaa/Tuunainen 2006; Basole 2007b; Balocco/Mogre/Toletti 2009; Wang/Xu 2012): * Complex benefits quantification / business value of device and app use - **Increase of costs** (derived from PCS and related literature: Juntumaa/Tuunainen 2006; Basole 2007b; Leskinen 2008): * Increase of IT costs through consumer device use and the resulting increase in data volume - **Complex cost calculation** (derived from PCS, no related literature found): * The quantification, e.g., of risks is complex and cost calculation more complex as for the BlackBerry use - **Future costs uncertainty** (derived from PCS and related literature: Holtsnider/Jaffe 2012b): * Uncertainty on IT cost development
IT support: - **Device heterogeneity** (derived from PCS and related literature: Holtsnider/Jaffe 2012b; Hayes/Kotwica 2013): * Complex IT support for heterogeneous consumer devices and personal devices (Holtsnider/Jaffe 2012b; Hayes/Kotwica 2013) * Short lifecycles of heterogeneous devices (Hayes/Kotwica 2013) - **Multi-provider setup** (derived from PCS, no related literature found): * Realization of user helpdesk when having multiple providers - **Inadequate self-service model** (derived from PCS, no related literature found): * Self-service support model potentially inadequate for top management support and if mobile devices get more and more integrated into business processes - **Technical support means** (derived from PCS, no related literature found): * Missing technical means, e.g., through a mobile device management (MDM) system to, e.g., get an overview of the used devices and apps
IT security: - **App security assessment** (derived from PCS and related literature: Gröger et al. 2013): * Challenging security assessment for plethora of mobile consumer apps - **Unsecure consumer OS** (derived from PCS and related literature: Juntumaa/Tuunainen 2006; Leskinen 2008; Everett 2010; Holtsnider/Jaffe 2012a): * Missing possibility to provide IT security by pure technical means for consumer OS - **Unsecure public cloud services** (derived from PCS and related literature: Walters 2013): * Use of unsecure public cloud services - **Insecurity through device mobility** (derived from PCS and related literature: Juntumaa/Tuunainen 2006; O'Donnell et al. 2007; Everett 2010): * Security concerns with mobile devices (lost devices, data protection, malware, …) - **Security-usability trade-off** (derived from PCS and related literature: Everett 2010; Gröger et al. 2013; Sammer/Brechbühl/Back 2013): * If there are too strict security measure this limits significantly the device usability

IT application management: - **Frequent device, app, and OS updates** (derived from PCS and related literature: Lakshman/Thuijs 2011; Holtsnider/Jaffe 2012b): * Regular application updates due to short consumer device or OS lifecycles - **Uncertain mobile OS and device trends** (derived from PCS, no related literature found): * Due to uncertain mobile OS and device developments (e.g., the iPad) in the consumer market the mobile infrastructure is supposed to be quickly changing - **Heterogeneous device and OS development** (derived from PCS and related literature: Scarfo 2012; Wang/Xu 2012; Gröger et al. 2013): * Complex application development for heterogeneous consumer devices - **Company web applications** (derived from PCS and related literature: Lakshman/Thuijs 2011): * Web applications like the corporate intranet are developed and optimized for the Microsoft Internet Explorer and cannot be accessed from the iPhone - **Internal app distribution** (derived from PCS and related literature: Lakshman/Thuijs 2011): * App distribution without MDM system - **Consumer license models** (derived from PCS, no related literature found): * License models for consumer device apps that are not enterprise-grade - **Microsoft Windows applications** (derived from PCS, no related literature found): * No native use of Microsoft windows applications - **Physical device restrictions** (derived from PCS and related literature: Scornavacca/Prasad/Lehmann 2008; Stockdale/Norris/Mirza 2008): * Device restrictions such as screen size or missing keyboard - **Wireless network availability** (derived from PCS and related literature: Jain 2003b; Leskinen 2008; Chen/Nath 2011; Scarfo 2012): * Availability of wireless networks with sufficient bandwidth
IT architecture: - **Backend data access** (derived from PCS and related literature: Juntumaa/Tuunainen 2006; O'Donnell et al. 2007; Everett 2010; Lakshman/Thuijs 2011; Hayes/Kotwica 2013): * Complex IT infrastructure integration, e.g., due to missing enterprise-grade certificate support on consumer devices (Juntumaa/Tuunainen 2006; O'Donnell et al. 2007; Everett 2010; Lakshman/Thuijs 2011) * Hardware and software incompatibility to company hardware and software (Hayes/Kotwica 2013) - **Data access from different devices** (derived from PCS, no related literature found): * Due to access from heterogeneous device types, need for cloud storage
Standards & regulations: - **Industry specifics** (derived from related literature: Jain 2003b; Gröger et al. 2013): * Industry-specific standards and regulations
IT service providers: - **Small companies in ecosystem** (derived from PCS, no related literature found): * Small, e.g., MDM, companies with few employees and potential instabilities
IT procurement: - **BYOD bundling loss** (derived from related literature: Hayes/Kotwica 2013): * Loss in purchasing bundling through BYOD

Table 1: Coding scheme for case study analysis
Source: Own illustration

Note: In Table 1, publications from the existing body of knowledge found to be related to specific codes of the scheme (printed in bold letters) are summarized and outlined. For codes marked with “no related literature found”, no related source was found in the analysis of selected publications on mobile enterprise IT. The cited publications were extracted from literature analysis conducted until July 2013. Some selected articles were added from a literature analysis made in 2014. Additionally, derived from the pilot case study findings and / or the related literature, for each code details and examples are presented in Table 1, explaining its scope.

The *tactics* defined by Yin (2009) – discussed and cited in section 2.1.2 – were applied to maximize construct validity, internal validity, external validity, and reliability of the research. Construct validity is supported through the use of multiple data sources (interviews and documents), the built-up chain of evidence (from research questions over extraction tables to the final results documented in the research database and protocol), and the sending of the case study findings for review to key informants of the participating companies (Yin 2009). Internal validity is increased by matching patterns against the propositions constituting the coding scheme and, if possible, by explaining any deviations (Yin 2009). Analytical generalization was applied to mitigate the problem of external validity by replicating the findings across multiple case studies (Yin 2009). Additionally, the four case study companies were carefully selected to have a mixture of large and small companies and corporations from different industries (Eisenhardt 1989). As stated in Eisenhardt (1989), by analyzing at least four cases, complex theory can be built by case study analysis. The importance of purposeful case selection is emphasized by Keutel, Michalik, and Richter (2014), who compared and evaluated case study research published in leading IS journals. The authors outline that beyond focusing on the pure number of cases, reaching theoretical saturation is decisive to decide upon the quantity of cases analyzed (Keutel/Michalik/Richter 2014). In the research study, well-developed findings are provided because a set of challenges could be replicated across all cases. It can thus be argued that a level of theoretical saturation is reached (Morse 2003). Finally, reliability is maximized via the case study protocol and database (Yin 2009). The case study protocol shows in detail the preparation, extraction, and evaluation steps conducted with corresponding timestamps. The case study database contains all interview and document data, extraction and evaluation tables, and the case study findings. Thereby, a reproduction of the findings is supported (Yin 2009).

4.3 Results of Case Study Analysis

In the following, the background of the conducted case studies is described and the challenges of mobile enterprise service use and mitigation measures are depicted. Finally, the findings are categorized and interpreted regarding their implications for IT departments by taking the service lifecycle lens (Kohlborn/Korthaus/Rosemann 2009).

4.3.1 Case Studies Background

The case studies were conducted at four multinational companies from different industries. Three of the four companies can be regarded as large enterprises, with more than 30,000 employees globally. The fourth company is – compared to the others – a small enterprise with less than 2,000 employees.

Note: The case study research was conducted with selected experts on mobile enterprise service use within the companies from selected business units. Thus, the extracted findings possibly do not hold for all mobile device and service use globally across all business units of the case companies. The findings extracted have a focus on and higher validity for the German subsidiaries of the researched companies.

At *case company A* (with more than 30,000 employees globally), various mobile devices are deployed, among which are consumer devices, such as iOS- and Android-based smartphones as well as iOS-based tablets. Besides the BlackBerry service, there is a mobile enterprise service in the corporate global IT service portfolio, providing PIM data, such as mail or calendar data, through a native application on mobile devices (including consumer devices). The native application can be used on personal employee devices in a BYOD program. Currently, the BYOD program is not offered to employees in the German subsidiaries. One reason for that is the still missing mobile device management (MDM) service, which is about to be globally introduced to better secure and support mobile devices, mainly those coming from the consumer market (e.g., for jailbreak detection). The MDM service can be regarded to be an infrastructure service enabling the provision of a BYOD program and the use of mobile applications with enhanced security features. Further app initiatives are recognized, but there is currently no clear picture which mobile enterprise apps are officially rolled out within the company. Initiatives reported do provide information services for top management or product catalogues on the iPad.

Consumer smartphones and tablets based on iOS and Android are used in *case company B* (with more than 40,000 employees globally). Thereby, iOS devices are limited to the top management level, at the researched business units. Before having introduced iOS and Android consumer devices, e.g., Nokia and Windows Mobile devices were used. The first mobile enterprise service provided was a mobile PIM service, which synchronizes the data into the native device client. PIM data can be accessed on corporate or personal devices (BYOD). Additionally, a mobile service for checklists to be filled by field service employees is deployed based on HTML5[27] (web app), targeting iOS and Android devices. This service is also available via an application on Palm devices and a JAVA application for Nokia and Windows Mobile devices. The mobile enterprise service portfolio is supposed to be extended by a KPI (key performance indicator) reporting service. It is implemented through a native app for iOS and Android devices. Currently, the service is in the PoC (proof of concept) stage and not officially rolled out. Additionally, an MDM service is tested in a pilot run. At one of the company's business units, a trial use of iPads for field service employees was conducted, for which all mobile enterprise services listed above were provided on the iPad. Access to further Microsoft Windows applications was realized through an app over a virtual machine in the company's data center. For future mobile enterprise projects, the consumer platforms Android and iOS are officially selected for company internal app provision.

At case *company C* (with more than 50,000 employees globally), officially, only personal mobile consumer devices based on iOS and Android are supported at the researched business units – with a main focus on iOS. Thus far, corporate devices of this type are not officially provided. For mobile PIM access mainly BlackBerry devices are used. Despite the absence of official channels to purchase corporate iOS devices, there are also some corporate iPhones. There is no strict ban on obtaining consumer devices through the company, e.g., if departments have the necessary budget. For personal mobile consumer devices, such as the iPhone, a PIM service has been introduced. In addition, an MDM service is currently being implemented, which is regarded to enable the secure provision, administration, and support of corporate mobile consumer devices and applications. A mobile enterprise use case beyond PIM reported in the case study analysis is the mobile sales service. The mobile sales service was originally implemented on Windows Mobile phones and is now migrated onto iPads. The service is designed to support the processing of sales orders and to eliminate media breaks.

[27] HTML = Hypertext Markup Language

At case *company D* (with less than 2,000 employees globally), iOS and Android smartphone devices – no tablets – are deployed at the business units researched. After having used BlackBerry and Windows mobile devices, the iPhone was the first mobile consumer device to be introduced. Nevertheless, Blackberry devices are still used. Mobile consumer devices are integrated into the corporate PIM infrastructure through a global MDM service. Apart from providing PIM data onto these consumer devices, the MDM service enables security measures, steered by the IT. For Android – to enhance the security level – an additional app on the devices is used to provide corporate PIM data. The MDM service also enables the provision of a BYOD service to the employees. Apart from this, there are no dedicated mobile enterprise services provisioned. However, there is a device-independent web application for booking corporate parking and office space, optimized for mobile device use. Further, it is planned to introduce Sharepoint 2013 and a social add-on. For this social add-on a mobile app is available that shall be deployed.

4.3.2 Challenges of Mobile Enterprise Service Use on Consumer Devices

From the case studies conducted, a set of challenges of mobile enterprise service use on consumer devices as well as measures applied or planned to be applied can be extracted.

In this thesis and in the conducted case study analysis the term "mobile consumer devices" is used to refer to smartphones and tablets originally targeting the consumer and not the enterprise market. This applies for iOS- and Android-based mobile devices (see, e.g., Basole/Karla 2011). BlackBerry, Windows Mobile, and Symbian devices can be regarded to originally have strongly focused (also) on the enterprise market (see, e.g., Dedo 2004; Hall/Anderson 2009; Basole/Karla 2011; Maske 2012). In this thesis and the conducted analysis they have not been considered to be mobile consumer devices.

Code group: IT application management
Challenge: App development for heterogeneous mobile OS *Countermeasures:* Web development (2), OS focus (2), standardized mobile app solution (1)
Challenge: Physical device restrictions *Countermeasure:* Tablet use (2)
Code group: IT architecture
Challenge: Corporate network access *Countermeasure:* Redesign of network access concept (2)

Code group: IT support
Challenge: Support for heterogeneous mobile OS or devices *Countermeasures:* Self-service (4), OS / device focus (4), MDM (3), devices tests (2), knowledge database (1)
Code group: IT security
Challenge: Insecure mobile OS platforms *Countermeasure:* MDM (4), OS / device focus (4), usage guideline (3), app capsulation (1), virus scanning (1)
Code group: IT governance
Challenge: Employee device demand *Countermeasure:* BYOD program (3)
Code group: IT business value
Challenge: Assessment of value added *Countermeasure:* -
Code group: IT knowledge
Challenge: Lack of knowledge *Countermeasures:* External support (4), knowledge database (1), web development (1), device tests (1)
Code groups: Standards & regulations, IT procurement, IT change management, IT project management, IT service providers
No challenges identified which could be replicated across all cases

Table 2: Challenges and countermeasures extracted from the multiple cases
Source: Own illustration

The extraction of insights from the collected interview and company data was steered by the coding scheme (see Table 1). This coding scheme is used to structure the challenges and measures presented in Table 2. Therefore, only challenges were extracted and are depicted that can be identified in all four cases. The number in brackets behind the identified countermeasures shows the number of cases in which the specific measure has been identified.

The data collection in the case study research focused on the corporate mobile consumer device use. Nevertheless, some information was provided on an aggregated level, focusing on the mobile device use in general. In the following, consumer platform specifics are highlighted to outline the specific impact of the consumerization trend.

App development for heterogeneous mobile OS: The heterogeneity of mobile operating systems depicts a challenge for corporate app development activities, as shown by the case study analysis. Developing apps for heterogeneous OS platforms can be a cost (cases C, D) and knowledge (case C) issue. The OS heterogeneity is increased by mobile consumer platforms, paving their way into business companies. At all case study companies, corporate or personal iOS and Android devices are used in addition to legacy devices such as the BlackBerry or Windows Mobile device. At two of the case study companies (A, B), particularly Android and its platform heterogeneity was rated to provide app development issues. Furthermore, the heterogeneity of operating systems constitutes an issue for mobile access of corporate web applications at three of the four case study companies (B, C, D). The Intranet web application is optimized for the Internet Explorer at companies B and C and cannot properly be used on iOS devices. Additionally, short consumer OS lifecycles were extracted from three cases (B, C, D) to increase the problem of mobile app development.

Web development based on HTML5 (cases B, D) and setting an OS focus (cases B, C) are measures taken to deal with the OS heterogeneity for app development, each implemented at two of the four case companies. Even though not applied or planned as of yet, at case company C, HTML5 use was mentioned to be a potential means to tackle the heterogeneity challenge. Another measure to ease app development implemented at one of the case companies (B) is the use of a standardized mobile app solution like the one provided by Microstrategy.

Physical device restrictions: Physical device restrictions of mobile consumer devices limit their corporate utility. Mainly the small screen size was seen amongst the case study companies to complicate the device use. Additionally, low battery life (case A) and missing keyboard (cases B, C) were identified as device characteristics restricting the use of certain devices. At case company B, the small screen size is complicating the effective mobile consumer device (smartphone) use for working on the device with application data. Moreover, as a result of the iPad test, editing of documents was rated to be cumbersome without mouse or keyboard. Nevertheless, at case company A, the larger screen in general was seen as an advantage of mobile consumer devices like the iPhone or Samsung Galaxy device compared to the BlackBerry.

At two of the researched companies (B, C), the use of tablets is considered a means to mitigate device restrictions such as the small screen size or low battery life. Particularly, consumer market tablets like the iPad in case C will soon be deployed and in case B have just been tested at selected business departments for internal mobile service use beyond PIM access. In case D, even not yet deployed, tablets like the iPad were rated to be much better for accessing internal websites or documents than smartphones.

Corporate network access: At case companies A and D, mobile consumer devices were rated to be somewhat insecure and therefore WLAN access is restricted for this class of devices, and the network access concept is even redesigned at case company A (e.g., to use extra virtual local area networks, VLANs) to deal with this issue. Currently, external network access to application backend systems is mainly realized through virtual private network (VPN) technology. However, VPN access was reported to be inadequate for backend access from mobile consumer devices in case A. One pitfall mentioned was that the establishment of VPN connections cannot be enforced. An alternative to the VPN access stated is certificate-based access. However, not all consumer OS platforms support the use of certificates at the same level (e.g., heterogeneity of Android devices). In case D, consumer devices are connected to the corporate WLAN via the guest access. At case company B, data can be accessed via mobile devices only through a cellular mobile network and a dedicated APN (access point name) application. Corporate WLAN access can only be used to access PIM data. The network access concept as well is currently being redesigned to replace the APN access by certificate-based authentication.

However, certificate-based access will possibly not solve the network access issue for consumer devices. The newly designed concept for certificate-based network access at case company C was seen to possibly not be applicable for personal employee devices. Integrating these devices might result in extra effort (e.g., own VLAN).

Support for heterogeneous mobile OS or devices: It appears that the heterogeneity of mobile devices respectively operating systems creates an IT support challenge in all researched cases. In most of the cases, short consumer device lifecycles additionally intensify this issue (cases B, C, D). As seen in case B, knowledge is needed for supporting the constantly changing device heterogeneity. Particularly, the consumer platform Android with its variety of versions is posing specific support challenges to the IT department (cases B, D). Findings extracted from case D provide insights into the difference in support complexity between mobile consumer devices and legacy BlackBerry devices from an employee perspective. In comparison to the BlackBerry, when using an iPhone, employees have to install an MDM client and create an Apple ID themselves. At case company B, the IT support for mobile apps internally developed is also complicated by the increasing device heterogeneity. The various versions (Java, Palm, web) of the mobile service for checklists, developed for different device platforms, all have to be supported.

A self-service model and a focus on selected operating systems or devices are measures to handle the heterogeneity in the mobile device ecosystem for the IT support. In all researched cases, self-service support is implemented. At case company A, there is a self-service model for the mobile PIM service (e.g., no support regarding app installation or incident management). However, for the BlackBerry PIM service, a full IT support is provided. One reason reported for implementing a self-service model for the mobile PIM service is the mobile consumer OS heterogeneity. In cases B and D, IT support has to be carried out by employees themselves for personal devices integrated into the corporate PIM infrastructure through the BYOD program. At case company D, this is the case for personal and even corporate mobile consumer devices. A focus on selected operating systems or devices has been set at all case companies. In case A, e.g., the focus is set on iPhones and Samsung Galaxy Android devices. However, as mentioned in case D, it can be regarded to be rather difficult to predefine a mobile device portfolio and to strictly stick to that because of the frequently upcoming new Android devices creating new user demands.

Another measure to mitigate the challenge of heterogeneity for the IT support, extracted from three of the cases, is the deployment of an MDM service. At case company D, the service has already been implemented, at case companies A and B, this is still ongoing. Learnings from case D indicate that technical control means are restricted for mobile consumer devices – compared to the BlackBerry. The use of a MDM system was reported to be a means to mitigate this. Nevertheless, the different Android OS versions cannot be integrated into the MDM and associated mobile PIM services to the same extent. To gather knowledge on supporting the device heterogeneity, device tests are conducted at case companies B and D. In case company D, additionally, a database is maintained to store the required support knowledge.

Insecure mobile OS platforms: In all cases, mobile consumer operating systems were identified to complicate the provision of IT security – in cases A, C, and D, in particular compared to the BlackBerry, a legacy enterprise platform. Especially the Android OS was seen to complicate the provision of IT security in all cases. Reasons were seen, e.g., in removable storage cards, limited encryption capabilities of certain OS versions, or the possibility to install potentially insecure apps. Particularly, the assessment of the security risks associated with the use of mobile apps was extracted from all cases to be challenging. Not only the plethora of apps to be checked (cases A, C) but also insufficient checks carried out in Android's public app store (cases B, D) are problematic. As stated in case C, security settings that can be configured differ between the mobile OS platforms, thus increasing the complexity for IT security. Additionally, it was rated to be challenging for the IT department to assess the security risks of the heterogeneous mobile consumer OS platforms. Analysis of data of case D indicates that compared to

BlackBerry, additional measures need to be but also can be implemented to secure the use of consumer operating systems such as Android in order to reach a security level comparable to the one on-board provided by the BlackBerry system.

All case companies have set a mobile device or OS focus and have or will implement an MDM service to provide IT security, mainly for mobile consumer devices. In case A, e.g., devices not managed by an MDM service currently globally have no access to the corporate network. An MDM system increases the IT security by forcing security settings on the devices, e.g., for the detection of jailbreaked devices, control on apps installed, shutting down public app store use, or the ability to distribute certificates. For case company A, this enhanced security level is reported to be necessary to provide applications on mobile devices and to be able to introduce a BYOD service. Nevertheless, data privacy regulations were seen to restrict the use of an MDM system (cases A, B). Setting a device focus is mainly done for the Android OS (cases A, D). At case company C, the focus is even put on iOS to increase IT security for the corporate mobile device use. Currently, this focus has been set for the German business units but thus far not for international units. Additionally, nearly all case companies (not in case D) have implemented a usage guideline for mobile devices. In these guidelines security-related aspects are governed, such as the device encryption, personal use, device lock, BYOD use, storage of data, connecting to public WLANs, or app use. In case B, the installation of public apps is only allowed from Apple's and even forbidden from Google's app store. In case A, app use in general is forbidden if the use of a specific app is not approved by the internal IT department. In case C, only the use of business apps is allowed. The usage guideline, as seen in cases A and B, can be regarded as an awareness creating measure. This measure is set to tackle the problem that for mobile devices, with their technically limited administrative possibilities, certain security-related restrictions cannot be set. Other measures increasing the IT security, identified at one of the case companies, include the deployment of a capsulated mobile service with a single interface into the company's infrastructure (implemented for the mobile PIM service in case C) and the use of virus scanning for Android devices (planned in case A).

Employee device demand: Employee demand to use mobile consumer devices in all cases resulted in pressure to provision this class of devices. At all case companies there is evidence of specific top management pressure and interest for use of mobile consumer devices. In case A, board members – against defined corporate guidelines – ordered certain consumer devices / smartphones. In case D, CEO demand resulted in high time pressure to support mobile consumer devices, in particular the CEO's iPad. This in turn resulted in high time pressure for the introduction of an MDM system. The MDM system enables the use of corporate and personal mobile consumer devices in case company D. Apart from just integrating mobile consumer devices into the corporate device portfolio, a measure to deal with the employee device demand can be the introduction of a BYOD program, as done in cases B, C, and D. It provides employees the option to use their personal devices, with which they are familiar.

Assessment of value added: In all case studies there was evidence extracted showing that the assessment of value added provided by the use of mobile enterprise services on consumer devices, constitutes a major challenge. Not only there are in all case companies doubts regarding or missing willingness to accept (e.g., productivity-related) value added resulting from the use of these mobile devices. The quantification of benefits is supposed to be complex. Benefits such as the increase of employee satisfaction (case C) and productivity (cases B, C) or the value of lost data (case A). From the case studies a focus on costs regarding value assessment (cases A, D) or a fear of costs (cases A, B, C) was extracted from the case studies. In cases B, C, and D, even a lack of business unit demand was observed. This lack of demand can result from doubts on value added (see cases B and C).

It has to be noted that a business case was successfully calculated for the existing mobile sales service migrated from Windows Mobile to iOS at case company C. The productivity gains and the resulting sales effectiveness of BlackBerry-, iOS-, or Android-based app services were compared to a paperwork-based sales process. Quantification of benefits was not rated to have been particularly challenging. One reason for this was seen in the structure of the sales organization for which the service is designed for and the organization's experience with mobile service use. The sales organization is dislocated and mobile in nature, not equipped with any laptops, does not have stationary offices, and is already using a mobile service.

Summarizing the insights gained from the case study analysis, it can be observed that it is particularly important to assess the value added provided with mobile enterprise services, which shall be introduced, e.g., on consumer devices, into the company. One specific problem can be the quantification of the benefits of the service use that have to outweigh, in particular, the occurring service implementation and operation costs. The case study analysis showed that when using consumer devices as the platform for mobile enterprise service use, e.g., high costs for iOS devices, mobile data usage, or native app development for a variety of OS platforms could occur. Case study companies have (pre-)defined measures, such as Android device use, new rate plans, or web app development, to mitigate a potential increase of IT costs. Nevertheless, they have not yet applied measures helping them to mitigate existing problems of value added assessment of IT services on mobile (consumer) devices to be introduced.

Lack of knowledge: In all researched cases there is a lack of knowledge on mobile consumer device use derived from the case material. This lack of knowledge was created not only by missing technological expertise on consumer platforms or MDM capabilities but is also associated with legal topics (possibly) needing to be clarified. Legal topics are by nature unfamiliar to IT departments. Questions such as "Who is liable to pay for broken or stolen personal devices?", "Can royalty-free apps be used for business purposes?", or "Can lost devices be wiped?" might have to be addressed by companies. Particularly, the introduction of BYOD programs and data privacy topics regarding the device use raise questions that can hardly be answered by the IT departments. In particular, the personal use of mobile devices in a BYOD program was observed or expected to involve data privacy issues in the short or long term. In all cases researched, the provision of mobile consumer devices was seen to be motivated by satisfying employee demand. For a BYOD program, the use of mobile consumer devices can also be expected to be the main driver. The lack of technological knowledge was mainly caused by unfamiliarity with mobile consumer technologies. At case companies there is evidence of a lack of expertise, e.g., on MDM features or native app development for iOS.

A measure to address specific legal or technological knowledge gaps applied in all cases is the use of external support, e.g., for the BYOD and MDM service introduction or app development. Other measures implemented at one of the case companies to handle knowledge gaps are: maintenance of a knowledge database to provide support for heterogeneous consumer operating systems (case D), use of familiar web technologies such as HTML5 for app development (case B), and testing of new devices for knowledge gathering (case B).

4.3.3 Interpretation of Results

The results of the case study analysis are interpreted in the following and their potential impact on the service lifecycle of a mobile enterprise service is discussed. Thereby, identified challenges and their potential effects are categorized based on Kohlborn, Korthaus, and Rosemann's (2009) service lifecycle model (see Figure 13 and the details discussed below). The *classification* highlights the service lifecycle stages seen to be mostly affected by the mobile consumer device use. In Table 3, this classification of challenges is illustrated, additionally outlining for which challenges countermeasures have been extracted from the case material. Apart from this, when discussing the interpretation details, consumerization specifics are summarized and highlighted.

Challenges / Service lifecycle stages (abbreviated[28])	**An.**	**De.**	**Im.**	**Pu.**	**Op.**	**Re.**
Assessment of value added						
App development for heterogeneous mobile OS						
Lack of knowledge						
Corporate network access						
Physical device restrictions						
Insecure mobile OS platforms						
Support for heterogeneous mobile OS or devices						
Employee device demand						

Table 3: Classification of challenges and existence of countermeasures[29]
Source: Own illustration

The *analysis stage* of the mobile enterprise service lifecycle can be affected by the problem to assess value added of by mobile enterprise service use. Doubts on the value added or problems to determine or quantify it could constitute a major obstacle for service introduction. The criticality of this service analysis challenge is emphasized by the fact that no measures have been identified in the case studies to address this issue. This challenge at first sight does not seem to have a specific consumerization aspect and may hold for IT services use on all mobile devices used within enterprises in general. However, the advent of mobile consumer devices supposedly will boost and enable the widespread adoption of mobile enterprise services. In the companies participating in the case

[28] An. = Analysis; De. = Design; Im. = Implementation; Pu. = Publishing; Op. = Operation; Re. = Retirement
[29] Bright color of cells in table shows that no countermeasure was extracted from the case studies; dark color of cells in table shows that countermeasures could be extracted.

study research, only few mobile enterprise services have been implemented at the researched business units as of yet. The case study results give the indication that particularly for consumer devices, mainly tablets such as the iPad, may change this. Advantages of their corporate use compared to legacy enterprise devices (e.g., the BlackBerry) appear to be the better usability and the plethora of apps available. The prospected boost of mobile enterprise service use through consumer devices may just unveil the challenge of assessing the value added of these services. If IT departments want to leverage the benefits of mobile enterprise services – most likely focused on consumer devices – they will have to prove the *value added* by presenting positive business case calculations to get the required stakeholder support to introduce mobile enterprise services.

Particularly, the *design and implementation* of IT services on mobile consumer devices can be complicated because of the following: the need to develop apps for heterogeneous mobile OS, an existing lack of knowledge, problems of corporate network access, physical device restrictions, and insecurity of mobile OS platforms. The heterogeneity of OS platforms is increased by the intrusion of devices from the mobile consumer market. As seen in the case studies, especially the Android OS heterogeneity can foster this issue. This heterogeneity together with the short consumer OS lifecycles can increase the problem of app development in the service design and implementation. A lack of knowledge on consumer market technology or legal issues of the BYOD use can have a large impact on the service lifecycle. It can complicate not only the mobile enterprise service design and implementation (e.g., because of missing technological know-how) but possibly its operation on consumer devices, especially if open topics (e.g., related to data privacy) are not addressed right at the beginning. Similar impact levels can be expected to result from the need to set up network access for mobile consumer devices, the physical limitations these devices possess, and the IT security challenge coming from the potential consumer OS insecurity. Service design and implementation activities have to consider that consumer platforms are mainly rated to be more insecure than the BlackBerry, a legacy enterprise platform. An initially inappropriate consideration of IT security topics during operation may on the one hand lead to bad service usability, if security settings are implemented too strictly, or to security vulnerabilities on the other hand, if not addressed thoroughly enough. Rating the heterogeneous consumer devices as rather insecure can lead to network access restrictions that have to be considered and as well be addressed during design and implementation. Moreover, mobile consumer devices can have physical constraints, e.g., related to low battery life and missing keyboard. If both is not addressed during design and implementation this may affect the service operation because the use of implemented IT services might have a bad usability.

Finally, there have been challenges identified in the case study analysis rated to mainly affect the *service operation* stage, in the area of IT support and IT governance on device demand. IT support departments have to deal with the increasing device / OS heterogeneity fostered by consumer technologies. This issue can be intensified through the Android platform heterogeneity or through short consumer OS lifecycles, creating complexity for IT operations. Furthermore, the personal employee demand – in particular from top management – for using mobile consumer devices for corporate purposes can create pressure on the corporate device portfolio and possibly imply constant changes to it. Even not explicitly extracted from the case studies, changes to the device portfolio used for an IT service during its operation could result in an unplanned and costly necessity to adjust the implemented service.

For the challenges supposed to affect service design, implementation, and operation mitigation measures applied (or planned to be applied) have been extracted from the case study material. Measures such as device / OS focus, web development, MDM use, self-service, or usage guidelines (see Table 2 for full list of measures).

4.4 Summary and Discussion of Results

The findings of the conducted case studies illustrate that there is a *plethora of challenges* IT departments have to face if they intend to reap the benefits mobile consumer devices offer for IT service use. These challenges derive from areas of IT application management, IT architecture, IT security, IT support, IT knowledge, IT governance, or IT business value.

They are created or fostered by *consumer IT-specific effects* such as an increase in mobile OS heterogeneity, short device and OS lifecycles, security concerns with OS platforms, lack of enterprise-grade device capabilities, personal employee interest in the corporate consumer device use, legal topics associated with the corporate use of personal devices, physical device restrictions, or a lack of knowledge on consumer market technologies at IT departments. Challenges of mobile consumer device use affect service analysis, design, implementation, and operation.

There have been *measures* identified in the case studies that are applied (or planned to be applied) and can help corporations to handle the challenges of mobile consumer device use. Besides those extracted from the case study material, there are most likely other possible measures. The focus of the conducted case study analysis is to show which countermeasures are known to IT departments and currently applied. For the identified service analysis challenge related to assessment of value added, no countermeasures could be extracted from the case study analysis. Assessing the value added of mobile enterprise services can constitute an early obstacle in the service lifecycle. The initial service analysis phase is important in the process of service introduction. The complexity of this challenge and the thus far missing best practices at the case companies to overcome it could stop the further introduction of innovative mobile service ideas for consumer devices right at the beginning.

The challenge of assessing business value of mobile IT use has been only very scarcely addressed in *research articles on consumerization of IT*, extracted from the literature review conducted (see section 3.2.2). Only in Gröger et al. (2013), the challenge to identify processes and tasks that would benefit from mobilization is discussed and seen to come up with the mobile consumer device use. In the broader field of mobile enterprise literature – as discussed in detail in the problem statement section (1.2) – the value assessment challenge and its significance for mobile device use is discussed in greater detail. As it can be seen in the body of literature, the problem of value assessment is discussed for the use of IT services on mobile devices in general (see, e.g., Gebauer/Shaw/Zhao 2002; van der Heijden/Valiente 2002b; Deibert/Rothlauf 2006; Deibert/Heinzl/Rothlauf 2008; Leskinen 2008; Balocco/Mogre/Toletti 2009; Picoto/Palma-dos-Reis/Bélanger 2010; Pousttchi/Becker 2012). Nevertheless, it can be expected that the progressive spread of mobile consumer devices will be the starting point for many companies to introduce mobile enterprise services. Mobile consumer devices such as iOS and Android tablets will most probably be the major platform for mobile IT services in the next few years and thereby the trigger for IT departments to deal with the problem of assessing service ideas for their value added.

4.5 Conclusion and Limitations

The case study research presented and discussed in chapter 4 aims to answer the following research question (RQ 1):

"*How is the corporate use of IT services on mobile consumer devices affecting IT departments?*"

To address this research question, not only challenges of the mobile enterprise service use on consumer devices have been extracted from case studies (RQ 1a), but also possible countermeasures to tackle these challenges (RQ 1b). A critical challenge identified through case study research is the assessment of the value added of IT service use on mobile consumer devices ex ante. This challenge poses an obstacle for the introduction of mobile enterprise services on consumer devices.

It has to be outlined that the qualitative nature of the conducted case study research implies the general problem of a *limited generalizability* of the findings gathered. Moreover, the case study data was collected from a group of selected experts on the use of mobile enterprise services from selected business units within the case companies. This implies that the findings extracted from the case study material may possibly not hold for all device and service use globally in the researched companies and all their business units. The case study findings rather have a focus on and higher validity for the German market. They should be validated and, if required, refined for specifics of other national or global markets. Moreover, it has to be noticed that the findings of the case study analysis are extracted for selected mobile consumer device types such as iPhones, iPads or Android-based devices, thus limiting their generalizability.

The interviewed experts are all involved in the introduction and / or operation of mobile consumer devices at the case companies, so that in the case study analysis a comprehensive overview on the variety *of challenges and countermeasures* IT departments are applying could be gathered. Nevertheless, there might be other challenges and countermeasures at the case companies which have not been extracted through the conducted case study analysis.

The interviews as well as the coding of the case study material, extraction of information, and its analysis was conducted by a *single person*, the author of this thesis. Having multiple investigators would have even increased the confidence in the extracted findings (Eisenhardt 1989). This limitation the conducted case study analysis suffers from was to a certain extent mitigated through the in-depth experience of the author of this thesis, coming from several years of experience as a consultant on mobile enterprise topics.

Finally, this case study analysis constitutes more than just a starting point for researching the impact of the consumerization trend for multinational corporations. It rather explores and qualitatively researches a set of hypotheses on the implications of the mobile consumer device use and describes in detail the impacts on IT departments and IT management activities. The countermeasures extracted and outlined show how companies handle the upcoming challenges and to a certain extent can be used as guidelines acting as best practices.

5 Related Work on Business Value of IT and Mobile IT

In addition to the literature review described in chapter 3, a second one was conducted focusing on the business value of mobile IT. This literature review included publications on business value of IT in general and mobile IT in particular. The purpose of this final literature review was to extract the relevant body of knowledge to be considered for research question 2.

The literature presented in this chapter included 50 selected papers from the literature review ("LitRev 1") presented in chapter 3 (on consumerization of IT and mobile enterprise IT) most relevant to the scope of this second literature review ("LitRev 2"). Additionally, the eight databases listed in chapter 3 were searched for articles that in general deal with "process productivity" and "task productivity" and for articles that in specific deal with productivity in the area of IT services, mobile enterprise, or mobile business. Therefore, in 2014, the databases were screened based on the following search strings across publication abstracts, titles, or keywords (if these options were given by the database):

- *"process productivity" OR "task productivity"*
- *("IT service" OR "IT services" OR "mobile enterprise" OR "mobile business" OR "mobile work" OR "mobile device" OR "mobile devices" OR "mobile service" OR "mobile services") AND ("efficiency" OR "productivity" OR "effectiveness" OR "effectivity")*
- *"Prozess-Produktivität" OR "Prozessproduktivität" OR "Aufgabenproduktivität" OR "Aufgaben-Produktivität"*
- *("IT Service" OR "IT Services" OR "IT-Service" OR "IT-Services" OR mobile OR mobiler OR mobiles) AND ("Produktivität" OR "Effizienz" OR "Effektivität")*
- *"mobile IT service" OR "mobile IT services" OR "mobiler IT service" OR "mobiler IT-Service" OR "mobile IT-Services" OR "mobiler IT Service" OR "mobile IT Services"*

Depending on the database, selected search strings were adjusted to produce more research results or limited to, e.g., selected terms or title search for selected terms in order to reduce the number of search results. Searching the JIT database, the strings could not be applied as predefined and had to be broken into several smaller strings to map the search focus. The searches over the eight databases returned 1569 results that were title-screened. If thereby publications turned out to possibly be relevant, existing abstracts and, if required, the full texts were screened for relevance. Finally, 28 publications were selected for detailed analysis. In addition to these 28 publications, 22 miscellaneous publications on value of IT and service productivity were identified following recommendations of other researchers. As suggested by Webster and Watson (2002), a "backward and forward search" was applied to determine further publications to be considered.

The references of the highly relevant papers from the 50 papers of the first & the 28 papers of the second literature review on the research databases and the 22 miscellaneous papers were title-screened (and if feasible further screened) for their relevance (backward search). Furthermore, through Google Scholar web search, other papers citing the most relevant ones out of these highly relevant papers were title-screened (and if feasible further screened) for their relevance (forward search). Thereby, identified papers with high relevance were iteratively screened for relevant references and other papers citing them. Through these reference reviews and web search 54 additional articles relevant for the literature analysis on business value of mobile IT could be identified. Within these 54 papers, few selected articles identified through random reference reviews and random web search were included.

An abstract graphical illustration of the distribution of the total 154 publications selected for detailed analysis in this literature analysis on business value of mobile IT, across the different research sources, is depicted in Figure 14. An overview on insights from selected papers extracted through the literature analysis, most relevant to research question 2 (and its sub-questions), is presented in the next sections (5.1 and 5.2). Finally, at the end of this chapter (in section 5.3) specific research gaps on business value of mobile IT are illustrated.

Note: Due to the newness of the consumerization topic, non-peer-reviewed articles were included in the literature reviews conducted for this thesis.

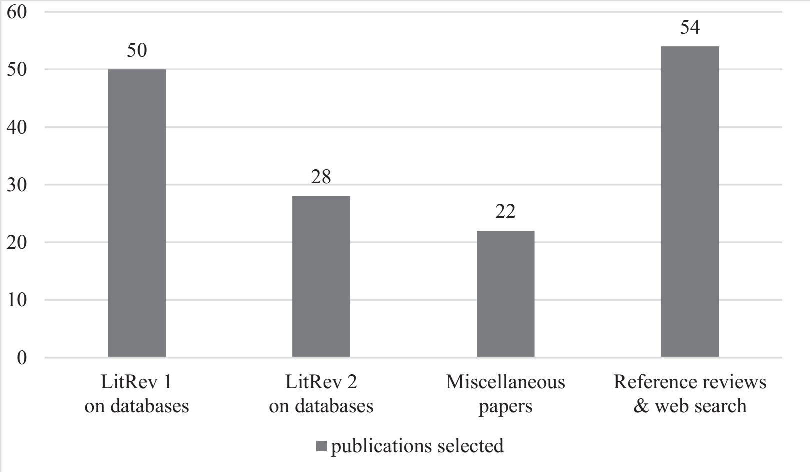


Figure 14: **Literature review on business value of mobile IT**
Source: Own illustration

5.1 Business Value of IT

A comprehensive and recent literature overview on relevant publications addressing the IS business value topic is provided by Schryen (2013). This paper "[…] provides a synthesis of key research findings, it identifies gaps in research, and it shows paths for overcoming the current research limitations by providing a research agenda" (Schryen 2013, 140). The literature review presented by Schryen (2013) was the baseline to start literature analysis on business value of IT with in this doctoral thesis. Elaborations in section 5.1 on defining business value of IT (section 5.1.1), value models and performance measures (section 5.1.2), and productivity concepts and measures (section 5.1.3) are to a large extent based on it and other selected publications.

5.1.1 Definition of Business Value of IT

Schryen (2013) summarizes that economic consequences of IS investments are referred to by "value", "benefit", "outcome", or "worth" and other terms. However, value of IT is defined differently and there is no widely accepted definition (Oz 2005; Schryen 2013). As one outcome of its literature analysis and synthesis, Schryen (2013, 141) provides a comprehensive definition of IS business value:

"*IS business value is the impact of investments in particular IS assets on the multidimensional performance and capabilities of economic entities at various levels, complemented by the ultimate meaning of performance in the economic environment.*"

The missing standard and the variety of existing definitions shows the challenge to operationalize IS business value (Schryen 2013) – synonymously used as (business) value of IT in this thesis. Exemplary constructs, illustrated in Schryen (2013), on how to operationalize business value of IT are "productivity" (Brynjolfsson/Hitt 1996) or "return on sales" (Bharadwaj 2000) and others, e.g., focusing on intangible assets such as the "strategic position" (Irani 2002). As illustrated in Walter and Spitta (2004), IS business value, besides considering the positive impacts (benefits), additionally has to consider potential negative impacts (sacrifices), related to financial or non-financial effects. Kadyte (2004) even provides a value of IT definition that only concentrates on financial aspects: *value = benefits - costs*.

In Schryen (2013), three perspectives – "level of examination", "object of evaluation", and "time of evaluation" – are considered to analyze and synthesize the existing literature on IS business value. Different level of examination of IS business value illustrated in Schryen (2013) are, e.g., economy level, industry level, firm level, and individual level. Objects of evaluation discussed in Schryen (2013) are IT capital (Hitt/Brynjolfsson/Walsham 1994; Barua/Kriebel/Mukhopadhyay 1995), or IS personnel and training (Chatterjee/Richardson/Zmud 2001; Mahmood/Mann 2005) or overall IS investments. The evaluation can be carried out "ex post" or "ex ante" (Kohli/Grover 2008; Schryen 2013). He further elaborates that "[…] the ex ante evaluation of IS value supports decision makers in answering the question as to which of the alternative IS investment(s) available will best achieve the organisation's goals or preferences, ex post research investigates the extent to which IS investments have actually created value" (Schryen 2013, 141).

5.1.2 Value Models and Performance Measures

For structuring his literature analysis on IS business value, Schryen (2013, 142) developed an *IS business value model* (depicted in Figure 15) from a synthesis of four prominent models:

- Model of Dehning and Richardson (2002, 10)
- Production-oriented model (Dedrick/Gurbaxani/Kraemer 2003, 3)
- Process-oriented model (Soh/Markus 1995, 37)
- Resource-based model (Melville/Kraemer/Gurbaxani 2004, 293)

The four models that have been synthesized have several overlaps for some basic insights (Schryen 2013). This includes performance measures for the impact of IS investments that are divided into measures on the process or firm / organizational level (Schryen 2013).

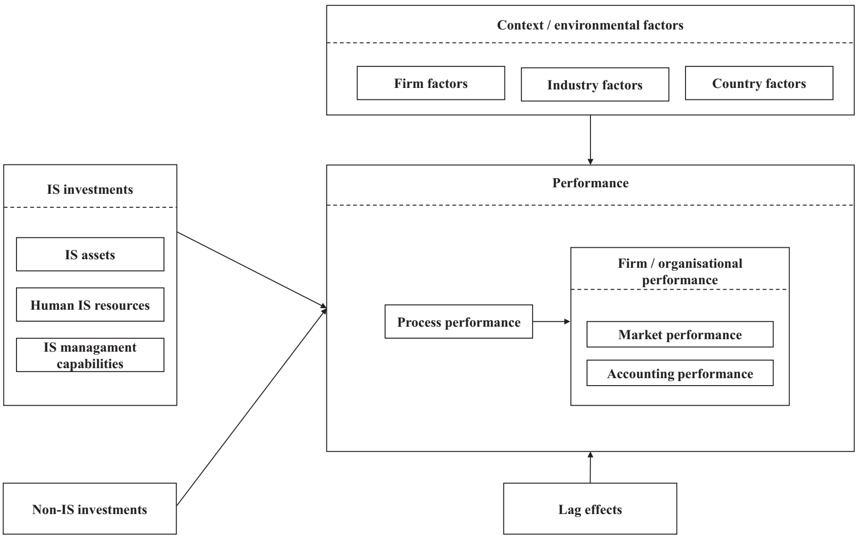


Figure 15: Synthesized IS business value model
Source: Schryen (2013, 144)

Firm / organization performance measures can thereby focus on the market or financial / accounting aspects (Schryen 2013). Thereby, process performance mediates the effect IS investments have on firm performance (Schryen 2013). Contextual / environmental factors, focusing on firm, industry, or country, affect the IS impact on process and firm performance (Schryen 2013). Furthermore, IS investments and assets can comprise IS management capabilities, human IS resources, and IT expenditures (technical infrastructure, hardware, software) (Schryen 2013). They are complemented with investments that are not IS-related (Schryen 2013). Both, IS and non-IS-related investments, affect process performance (Schryen 2013). As shown in the synthesized model in Figure 15 and described in Schryen (2013), potential time lags should be considered when analyzing the effects of IS investments (Brynjolfsson/Hitt 1998; Jain 2003a; Santhanam/Hartono 2003; Mahmood/Mann 2005).

Schryen (2013) provides a comprehensive overview on the variety of performance measures existing and discussed in literature. According to Schryen (2013), the classification proposed by DeLone and McLean (1992) is probably the one most frequently adopted. It provides a IS success taxonomy comprising six categories: “organizational impact”, “individual impact”, “user satisfaction”, “use”, “information quality”, and “system quality” (DeLone/McLean 1992). This model was primarily tested and validated by two studies (DeLone/McLean 2003): Seddon, Kiew, and Patry (1994) and Rai, Lang, and Walker (2002). Based on this feedback and other research contributions on the IS success model, DeLone and McLean (2003) reworked their model as depicted in Figure 16.

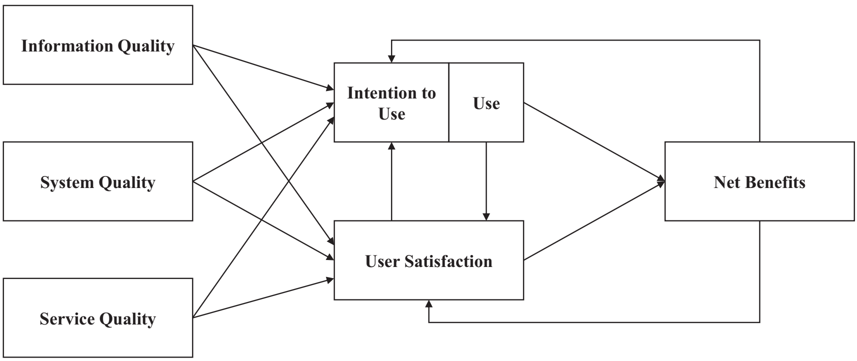


Figure 16: **Updated DeLone and McLean IS success model**
Source: DeLone and McLean (2003, 24)

The dimensions of the updated IS success model are “information quality”, “system quality”, “service quality”, “intention to use / use” , “user satisfaction” and “net benefits” (DeLone/McLean 2003). Besides Delone and McLean’s IS success model and the models merged into Schryen’s synthesized IS business value model, there are a plethora of other models, constructs, taxonomies, and frameworks on value of IT such as those in Grover, Seung Ryul, and Segars (1996), Irani (2002), Gable, Sedera, and Chan

(2008), Mitra, Sambamurthy, and Westerman (2011), Chang and King (2005), or Torkzadeh and Doll (1999).

A review of the effectiveness of existing *ex ante evaluation* approaches for IS investments is carried by Walter and Spitta (2004), based on a set of general criteria. Approaches such as the payback, net present value, balanced scorecard, and other approaches have been considered in their evaluation (Walter/Spitta 2004). As a result of their analysis, they conclude that most of the approaches reviewed insufficiently consider qualitative factors, investment risk, and indirect effects (Walter/Spitta 2004). Moreover, Löfgren (2006) emphasizes the inadequateness of traditional methods for financial investment evaluations (such as the net present value or return on investment approaches) for the assessment of value added of IT for business companies, because of their missing focus on intangible qualitative benefits.

Finally, it can be constituted that measuring the business value of IT creates challenges for practitioners and academics. Benefits not only result from advantages of IT use that are quantifiable but often only from qualitative aspects (Wolf/Krcmar 2005). Wolf and Krcmar (2005) summarize major challenges for a quantitative assessment of these benefits, based on Huber (1999, 111 et sqq.) and Krcmar (2003, 332), as follows:

- IT service and production processes are often different to those of the company and have a cross-divisional character, resulting in problems to directly assess the benefits of IT use and leading to an assessment of these benefits at most through possible savings.

- Joint assessment of benefits of IT use by IT and other departments is often hindered because of internal communication issues between these departments.

- Relating performance increase to IT is complicated because properly running IT often is regarded to be a hygiene factor.

- With an increase of the strategic value of the IT investment the assessments of the benefits of IT use is complicated.

5.1.3 Productivity Concepts and Measures

As depicted in Schryen's (2013) synthesized IS business value model (see Figure 15), the impact of IT use on firm / organizational performance is mediated by *process performance*. Mooney, Gurbaxani, and Kraemer (1995), who support this paradigm, even constitute that a process view of interactions in IT-organizations is required to identify IT mechanisms adding value and to enable measurement of IT business value. A widely discussed measure for process performance in this context is "*productivity*" (Schryen 2013). A comprehensive, general definition of the productivity concept is provided by Grönroos and Ojasalo (2004, 414-415):

> "*The productivity of an operation is related to how effectively input resources in a process (manufacturing process, service process) are transformed into economic results for the service provider and value for its customers.*"

The traditional productivity concept (coming from manufacturing) focuses on production efficiency, also referred to as internal efficiency in this thesis (Grönroos/Ojasalo 2004). In Grönroos and Ojasalo (2004, 416), productivity is according to the traditional concept (see, e.g., Sink 1985) "[…] defined as the ratio between outputs produced and inputs used, given that the quality of the outputs is kept constant (the constant quality assumption) […]":

$$Productivity = \frac{Outputs\ produced}{Inputs\ used} \quad | \ Constant\ quality\ of\ outputs$$

In Schryen (2013), doubts on the performance impact of IT use in early studies (see Brynjolfsson/Yang 1996, for an overview) are discussed. These studies resulted in the formulation of the "productivity paradox" on the possibly missing productivity impact of IT (Schryen 2013). Based on a literature review, Brynjolfsson (1993) elaborates on the productivity paradox of IT and concludes that this paradox is caused by measurement and tool deficiencies and mismanagement of IT developers and users. More recent literature reviews, discussed in Schryen (2013) find a positive productivity effect (see, e.g., Devaraj/Kohli 2000; Dedrick/Gurbaxani/Kraemer 2003) but nevertheless outline impact variations among different companies. However, Wan, Fang, and Wade (2007, 1) analyzed 150 articles published between 1996 and 2006 and conclude "[…] that the original paradox has largely been resolved due to more sophisticated and refined data sources, a shift in the level of analysis, and a refocus on the management of IS." Dedrick, Gurbaxani, and Kraemer (2003) support the positive résumé taken by Wan, Fang, and Wade (2007) based on a review of more than 50 articles. In their literature analysis, they find a positive relation between productivity and IT investments growth at firm and country level (Dedrick/Gurbaxani/Kraemer 2003).

Measuring productivity in services is challenging because of some inherent problems, the process analysis problem, and the problem of selecting an appropriate measurement technique (McLaughlin/Coffey 1990). According to McLaughlin and Coffey (1990), inherent problems for service productivity measurement can result from the intangibility of services (Gadrey 1988). Intangibility can complicate the quantification of service inputs and outputs, required for productivity measurement (McLaughlin/Coffey 1990). The measurement of productivity implies that a given level of quality is met (McLaughlin/Coffey 1990). Compared to, e.g., manufacturing processes, measuring service quality is challenging since it is mainly based on the subjective judgment of the (internal or external) customer (McLaughlin/Coffey 1990). An additional inherent problem for service productivity measurement lies in the needed timing of demand and the available service capacity (McLaughlin/Coffey 1990). When measuring service productivity, it is crucial to know if there is the required capacity to meet the actual service demand (McLaughlin/Coffey 1990). Besides those inherent problems, measuring service productivity is complicated through the process analysis challenge (McLaughlin/Coffey 1990). One has to clearly know which process to be analyzed before undertaking a productivity measurement (McLaughlin/Coffey 1990). McLaughlin and Coffey (1990) further state that the right unit of analysis has to be selected. Finally, selecting the appropriate measurement technique is decisive (McLaughlin/Coffey 1990). A scheme is needed to classify services in order to select the right productivity measurement technique (McLaughlin/Coffey 1990).

McLaughlin and Coffey (1990) have developed a classification scheme for services that comprises three dimensions: “Consumer Involvement and Customisation”, “Complexity of Inputs and Outputs”, and “Aggregation and Disaggregation”. Details on these dimensions and which productivity measures are proposed to be applied, based on this classification, can be found in McLaughlin and Coffey (1990). Service productivity measures presented are: “Output/Input Ratios”, “Work Measurement Methods”, “Quality Plus Techniques”, “Practice Variation Studies”, “Statistical Comparisons”, “Deterministic Models”, “Data Envelopment Analysis” (McLaughlin/Coffey 1990).

Grönroos and Ojasalo (2004) outline the challenge to define “one unit of a service”. The problem of defining a unit of service causes that service productivity measurements are normally just partial measurements (Grönroos/Ojasalo 2004). Secondly, it is emphasized that a change in the configuration of input resources may change the perceived service quality (Grönroos/Ojasalo 2004). This can lead to a decrease of service quality despite an increase of efficiency for the used input resources which, e.g., may impact the (internal or external) customer satisfaction and thereby the firm's ability to make profits (Grönroos/Ojasalo 2004). These specific challenges have been tackled by development of a service productivity model supporting the service productivity measurement (Grönroos/Ojasalo 2004). The model is developed based on the concepts of internal and external efficiency (suggested by Ekholm 1984) that are defined the following:

- "[…] *how effectively input resources into the service (production) process are transformed to outputs in the form of services (internal efficiency)* […]" (Grönroos/Ojasalo 2004, 414)
- "[…] *how well the quality of the service process and its outcome is perceived (external efficiency or effectiveness)* […]" (Grönroos/Ojasalo 2004, 414)

Internal and external efficiency "[…] describe how efficiently a firm converts resources internally and how effectively it creates external interest in the conversion output, respectively" (Grönroos/Ojasalo 2004, 416). Both concepts and their interrelationship have to be considered in a service productivity model (Grönroos/Ojasalo 2004). Finally, Grönroos and Ojasalo (2004) included a third dimension into their service productivity model: capacity efficiency. The utilization of an (internal or external) service provider's capacity impacts its internal efficiency, because no inventories can be kept to deal, e.g., with excess demand (Grönroos/Ojasalo 2004). Capacity efficiency is defined the following:

- "[…] *how effectively the capacity of the service process is utilized (capacity efficiency)*"(Grönroos/Ojasalo 2004, 414)

Summarizing the elaborations on Grönroos and Ojasalo's (2004, 417) service productivity model, service productivity can be modeled as a function over internal efficiency, external efficiency, and capacity efficiency:

$$\begin{aligned}&Service\ productivity\\&= f(internal\ efficiency, external\ efficiency, capacity\ efficiency)\end{aligned}$$

In the *service productivity model*, outputs of a process are (Grönroos/Ojasalo 2004, 418):

- "Quantity of output (volume)"
- "Quality of output (process and outcome)"

The three elements of the service productivity model are interdependent (Grönroos/Ojasalo 2004). For instance, an increase of demand and output quantity (higher internal efficiency) could cause a decrease in output quality (lower external efficiency), through affecting the service process and / or outcome because of less service orientation (Grönroos/Ojasalo 2004). A decrease of service output quality in turn could result in lower customer demand and lead to less output quantity (lower internal efficiency) in the end (Grönroos/Ojasalo 2004). Details on the interdependence of the three service productivity elements are presented in Grönroos and Ojasalo's (2004, 418-420). Service productivity measurements should consider not only the traditional productivity concept of internal efficiency but also include perceived service quality (external efficiency) and capacity utilization (capacity efficiency) (Grönroos/Ojasalo 2004).

For measuring service productivity, intangible and qualitative aspects have to be considered (as described above). A technique to incorporate inputs and / or outputs that can hardly be quantified is "subjective productivity measurement" (Torkzadeh/Doll 1999; Lynch/Riedel 2001; Kemppilä/Lönnqvist 2003; Vuolle et al. 2008). Thereby, subjective productivity assessments are gathered, e.g., through interviews or questionnaires (Torkzadeh/Doll 1999; Lynch/Riedel 2001; Kemppilä/Lönnqvist 2003; Vuolle et al. 2008).

5.2 Business Value of Mobile IT

Publications extracted from the literature analysis conducted within this doctoral thesis (see beginning of chapters 3 and 5) build the foundation and baseline for the elaborations on business value of mobile IT presented in this section. From there on, selected publications have been added to the elaborations illustrated below.

In the following, mobile technology characteristics and possible performance impacts, discussed in the related literature, are illustrated (sections 5.2.1 and 5.2.2). Moreover, the use of mobile IT not only results in benefits but also in costs for the company and has to face specific obstacles in corporate settings. In sections 5.2.3 and 5.2.4, existing literature on these topics is presented. Finally, the elaborations on business value of mobile IT are concluded by a discussion and comparison of existing frameworks for their capabilities to identify / pre-assess and assess corporate value added in the service analysis phase (section 5.2.5).

Note: Mobile device use respectively mobile enterprise IT, as defined in section 3.2, in this doctoral thesis is based in the narrow sense on the use of smartphones and tablets on which apps can be installed. However, legacy devices such as laptops or PDAs also are labeled as mobile devices in publications that can be found in the literature. Modern mobile devices such as smartphones and tablets can be regarded to be an enhancement of these legacy devices, sharing a group of basic and essential features. For these reasons publications focusing on legacy mobile devices like, e.g., laptops or PDAs were also considered in the analysis of literature presented in section 5.2.

5.2.1 Characteristics of Mobile IT

Mobile IT has specific characteristics. These technology characteristics provide benefits to corporate users or result in obstacles for the corporate use of mobile enterprise services. These *mobile IT characteristics* and existing related literature are presented in this section. In Table 4, an overview of mobile IT characteristics is given and for each characteristic, exemplary publications are listed in which the characteristic is discussed additionally, a "(+)" or "(-)" illustrates whether the characteristic is supposed to have a positive (+) or negative (-) impact. Finally, at the end of the section, it is reported which characteristics are reported to have mobile consumer technology specifics, according to the literature analyzed.

Mobile IT Characteristics
Device portability (+) *Related literature:* Basole (2004), Drew (2011), Junglas and Watson (2003), Molina et al. (2014), Pitt, Berthon, and Robson (2011), Hess and Jung (2012)
Ubiquitous connectivity (+) *Related literature:* Barnes, Scornavacca, and Innes (2006), Basole (2004), Basole (2005a), Breu, Hemingway, and Ashurst (2005), Bazijanec, Pousttchi, and Turowski (2004), Derballa and Pousttchi (2004)

User and device authentication (+) *Related literature:* Bazijanec, Pousttchi, and Turowski (2004), Junglas and Watson (2003), Pousttchi and Thurnher (2006), Derballa and Pousttchi (2004)
Less expensive devices (+) *Related literature:* Basole (2007b), Gebauer, Shao, and Zhao (2002)
Instant-on device use (+) *Related literature:* Drew (2011), Hess and Jung (2012), Pitt, Berthon, and Robson (2011), Gebauer, Shao, and Zhao (2002)
Multi-media use (+) *Related literature:* Strategic Growth Concepts (2012), Sheng, Nah, and Siau (2005), Walker and Barnes (2005)
Enhanced sensors and interfaces (+) *Related literature:* Basole (2004), Bazijanec, Pousttchi, and Turowski (2004), Buttfield-Addison et al. (2012), Aerospace Industries Association (2011), Pitt, Berthon, and Robson (2011), Botzenhardt and Pousttchi (2008), Leskinen (2008), Scherz (2007)
Plethora of apps (+) *Related literature:* Strategic Growth Concepts (2012), Drew (2011), Perez (2014), Hess and Jung (2012), Molina et al. (2014), Wikipedia (2014)
Intuitive use (+) *Related literature:* Breu, Hemingway, and Ashurst (2005), Hess and Jung (2012), Murdoch, Harris, and Devore (2010), Pitt, Berthon, and Robson (2011), Junglas and Harris (2013)
Innovative technology (+) *Related literature:* Isaac and Leclercq (2006), Hess and Jung (2012), Sheng, Nah, and Siau (2005), Niehaves, Köffer, and Ortbach (2013), Botzenhardt and Pousttchi (2008), Pitt, Berthon, and Robson (2011), Junglas and Harris (2013)
Personal employee use of enhanced devices (+) *Related literature:* Bernoff and Schadler (2010), Hudson and Grant (2013), Junglas and Harris (2013), Unisys (2010), Niehaves, Köffer, and Ortbach (2012), Pousttchi and Becker (2012), Murdoch, Harris, and Devore (2010), Aerospace Industries Association (2011)

Limited mobile network coverage (-) *Related literature:* Chen and Nath (2008), Guerrero et al. (2006), Scherz (2007), Chen and Nath (2004), Mladenova et al. (2011), Basole (2004), Deibert and Rothlauf (2006), Gebauer, Shaw, and Zhao (2002), Stieglitz and Brockmann (2012), Wigelius, Aula, and Markova (2007)
Limited legacy enterprise app support (-) *Related literature:* Drew (2011), Hess and Jung (2012)
Limited use of input devices (-) *Related literature:* Drew (2011), Guerrero et al. (2006), Chen and Nath (2004), Mladenova et al. (2011), Gebauer, Shaw, and Zhao (2002), Wigelius, Aula, and Markova (2007)
Small screen size (-) *Related literature:* Chu and Huang (2008), Scherz (2007), Chen and Nath (2004), Derballa and Pousttchi (2004), Mladenova et al. (2011), Gebauer, Shaw, and Zhao (2002)
Larger tablet screen size (+) *Related literature:* Hess and Jung (2012), Pitt, Berthon, and Robson (2011)
Limited battery capacity (-) *Related literature:* Guerrero et al. (2006), Mladenova et al. (2011), Deibert and Rothlauf (2006), Stieglitz and Brockmann (2012)
Higher tablet battery capacity (+) *Related literature:* Hess and Jung (2012), Pitt, Berthon, and Robson (2011)
Less disturbing tablet use (+) *Related literature:* Hess and Jung (2012)

Table 4: **Mobile IT characteristics**
Source: Own illustration

Device portability: A feature distinguishing mobile IT to other information and communication technologies lies in its device portability allowing users to carry the mobile device while on the move (Junglas/Watson 2003; Basole 2004; Molina et al. 2014). Even tablet devices such as the iPad are reported to be easily portable (Drew 2011). The low weight of the iPad, e.g., was seen as an additional advantage in comparison to the laptop use (Pitt/Berthon/Robson 2011; Hess/Jung 2012). Mobile devices generally are regarded to be light weighted and small in size, supporting their portability (Junglas/Watson 2003). Device portability is an outstanding mobile IT characteristic as it enables several other specific characteristics to distinguish mobile technology, e.g., from traditional e-commerce technology (Junglas/Watson 2003).

Ubiquitous connectivity: Permanent network connectivity, e.g., over WLAN or cellular networks, is a further characteristic of mobile technology outlined in many publications that enables employees to transmit and receive data without restrictions of place and time (e.g., Basole 2004; Bazijanec/Pousttchi/Turowski 2004; Breu/Hemingway/Ashurst 2005). Ubiquitous connectivity comprises the abilities "[…] to access the network at any place and any time, and be in touch, be reached, and located at any place and any time using always connected portable devices" (Basole 2004, 4).

User and device authentication: The (most likely) user of a mobile device can be identified based on his subscriber identification (International Mobile Subscriber Identity, IMSI) in the cellular network (Bazijanec/Pousttchi/Turowski 2004). The SIM (Subscriber Identity Module) card that is inserted into a mobile device can act as a virtual substitute for the user's identity – if the person the SIM card is assigned to is the one using the device (Junglas/Watson 2003). Additionally, devices can be identified through the IMEI (International Mobile Station Equipment Identity) number (Pousttchi/Thurnher 2006).

Less expensive devices: There are portable and less expensive handheld devices compared to computing devices such as desktop computers (Basole 2007b). This is supported by Gebauer, Shao, and Zhao (2002), who point out that mobile devices typically are less expensive than regular computers.

Instant-on device use: Mobile devices such as phones and PDAs, compared to desktop computers and wired laptops, take less time to be booted up (Gebauer/Shaw/Zhao 2002). Particularly, tablets such as the iPad are reported to instantly turn on with low booting time and turn off with no waiting time, compared to most laptops (Drew 2011; Pitt/Berthon/Robson 2011). The so-called "instant-on" feature enables immediate task execution and was reported to be a highly positive characteristic of the iPad (Hess/Jung 2012).

Multi-media use: Mobile phones have support for a variety of media types such as messages, websites, music, video, QR (Quick Response) codes, or books (Strategic Growth Concepts 2012). Sheng, Nah, and Siau (2005) reported on the use of audio, video, and other presentation media on tablets at the customer site. Walker and Barnes (2005) for instance illustrate how sales representatives showed their customers television commercials on their tablet devices.

Enhanced sensors and interfaces: Mobile devices have several sensors and interfaces that can be exploited for mobile enterprise service use. Amongst these can be sensors and interfaces, e.g., for getting the user's current location, taking photos, scanning RFID[30] tags, connecting to WLAN and Bluetooth devices, or even determining vital user functions (Bazijanec/Pousttchi/Turowski 2004; Scherz 2007; Botzenhardt/Pousttchi 2008; Leskinen 2008; Aerospace Industries Association 2011; Buttfield-Addison et al. 2012). An additional sensor integrated into mobile devices (and supposedly not into laptops) for measuring device movement is the accelerometer (Pitt/Berthon/Robson 2011). The first computing device this sensor was built into was the iPad (Pitt/Berthon/Robson 2011). A unique feature of the iPad 2 was the gyroscope, a sensor for measuring orientation (Pitt/Berthon/Robson 2011).

Plethora of apps: A variety of existing mobile applications supports employee collaboration or communication with customer and business partners (Strategic Growth Concepts 2012). Drew (2011) particularly mentions the plethora of apps existing for the iPhone and the iPad. Apple reported in June 2014 to have more than 1,200,000 iOS apps available in the App Store (Perez 2014). At the same time Google was expected to also provide about 1,200,000 Android apps in the Google Play Store, according to http://www.appbrain.com (Perez 2014). In the BlackBerry World, BlackBerry's mobile application store, e.g., there are about 230,000 apps reported by Wikipedia (2014) for April 2014, extracted from http://www.appworldreport.com/.

Intuitive use: Mobile technology is reported to be easy to use, e.g., compared to laptops (Breu/Hemingway/Ashurst 2005). Particularly, iPads are reported to provide an intuitive usage, supported, e.g., through the integrated touch screen (Pitt/Berthon/Robson 2011; Hess/Jung 2012). Junglas and Harris (2013) state that employees perceive their own IT devices, such as personal smartphones and tablets, to be easier to use than those provided by their employer. Especially, mobile consumer IT can be regarded to be more intuitive than enterprise IT (Murdoch/Harris/Devore 2010).

Innovative technology: Mobile IT can be regarded to have a modern character (Isaac/Leclercq 2006; Botzenhardt/Pousttchi 2008). Moreover, in a study on consumer IT, authors talk about "innovative consumer devices" (Niehaves/Köffer/Ortbach 2013). In particular, in an iPad test conducted at an applied research company, it was reported that at project acquisitions customers associated innovativeness with the device use (Hess/Jung 2012). In line with this finding, Sheng, Nah, and Siau (2005) illustrate the

[30] RFID = Radio-Frequency Identification

advantage of being perceived innovative because of the use of cutting edge technology such as tablet devices. However, consumer IT is potentially more innovative than legacy corporate IT (Junglas/Harris 2013). This is supported by the example of the iPad and its innovative use of enhanced sensors (Pitt/Berthon/Robson 2011).

Personal employee use of enhanced devices: Workers are familiar with use of mobile consumer devices from their personal use (Unisys 2010; Niehaves/Köffer/Ortbach 2012; Pousttchi/Becker 2012). Employees are even seen by Hudson and Grant (2013), (citing Bernoff/Schadler 2010, 125-126), to invest in own consumer IT to do their work, thereby seeking better results. Personal mobile consumer devices often are more valuable for employees and more powerful than those provided by their company (Aerospace Industries Association 2011; Junglas/Harris 2013). These powerful mobile consumer devices owned by employees, such as personal iPhones and iPads, provide the potential to be – and are already – used in the work place (Murdoch/Harris/Devore 2010; Unisys 2010).

Limited mobile network coverage: Mobile IT use requires connectivity with sufficient bandwidth to a wireless network (such as WLAN or cellular radio), which is not always given or potentially instable (Deibert/Rothlauf 2006; Chen/Nath 2008; Mladenova et al. 2011). Especially in rural areas coverage can be problematic (Chen/Nath 2008). As Basole (2004) states, limited network coverage is a constraint to mobile connectivity. Network coverage and bandwidth most likely continuously improve (Basole 2004), but nevertheless can constitute a limitation.

Limited legacy enterprise app support: In the iPad test Hess and Jung (2012) elaborate on, the limited support of Microsoft Windows and Office applications, which can be regarded to be legacy enterprise software, was outlined as a limitation. In particular, they mention missing support, e.g., for project management and project acquisition business applications (Hess/Jung 2012). Particularly, for the area of accounting a lack of specific apps is mentioned by Drew (2011), in his elaborations on the corporate use of iPads in accounting firms. He further states that the missing support for Adobe flash applications is a pitfall of the corporate iPad use (Drew 2011).

Limited use of input devices: In comparison to mobile phones or PDAs, laptops are reported to be more suitable for data-intensive tasks because of their keyboard-based input mechanism (Guerrero et al. 2006). Moreover, Chen and Nath (2004) and Mladenova et al. (2011) discuss usability issues, e.g., for text input, with the built-in keypad of mobile devices. A limitation reported for the use of, e.g., the iPad – a modern device – is the missing opportunity to use a wireless mouse (Drew 2011).

Small screen size: The small screen size of mobile devices can constitute a challenge for the visualization of meaningful data and large files and can depict a limitation for the mobile app use (Chen/Nath 2004; Chu/Huang 2008; Mladenova et al. 2011). This is supported by Scherz (2007) and Derballa and Pousttchi (Derballa/Pousttchi 2004), who illustrate disadvantages of the handheld or mobile phone use for reading longer documents because of the smaller screen size.

Larger tablet screen size: The larger screen size of tablets such as the iPad is seen an advantage compared to other mobile devices by the participants of the test illustrated by Hess and Jung (2012). Pitt, Berthon, and Robson (2011) support this and additionally point out that the iPad has a nearly ideal screen size.

Limited battery capacity: For the use of a mobile device, battery capacity is crucial but can also be only insufficiently available (Deibert/Rothlauf 2006; Mladenova et al. 2011). A limited battery life can restrict the use of mobile devices (Guerrero et al. 2006). Load- and resource-intensive interactions thereby have a battery-limiting effect (Mladenova et al. 2011).

Higher tablet battery capacity: Long battery capacity of iPads is reported by Hess and Jung (2012). Pitt, Berthon, and Robson (2011) emphasize the longer battery life of the iPad, compared to most laptops, which supports its continuous use, e.g., on long flights.

Less disturbing tablet use: In the iPad test described in Hess and Jung (2012), the use of a tablet device in meetings is depicted to be barrier-free compared to laptops. No barrier builds up between the meeting participants (Hess/Jung 2012). It is outlined that the tablet is put on the desk similar to a pad of paper (Hess/Jung 2012). Additionally, low noise of the mobile device use – compared to the laptop use – was reported for iPads by Hess and Jung (2012).

In the literature, several potential *mobile consumer technology specifics* have been identified. In this thesis, tablets and smartphones running operating systems originally focused on the consumer market such as iOS or Android are meant to be mobile consumer devices. Even considering preceding types of enterprise tablets, the current generation of tablets, which was heavily impacted by the iPad, in general can be regarded to be originally designed mainly for the consumer market (Mitchell/Christian/Rosenstiel

2011; Griffey 2012). In the following, gathered insights on consumer technology specifics of mobile IT characteristics are summarized and discussed:

- *Limited legacy enterprise app support:* A missing support of legacy enterprise application such Microsoft Windows, Office, or Adobe Flash, accounting applications was only found for the iPad, a mobile consumer device, in the body of literature (Drew 2011; Hess/Jung 2012). However, it can be assumed that this limitation could also affect other mobile consumer and to a certain extent also enterprise devices like the BlackBerry.

- *Sensors and interfaces:* As reported for the iPad, there are sensors that first have been introduced into the iPad, a mobile consumer device (Pitt/Berthon/Robson 2011). This example provides an indication that enhanced sensors and interfaces first might be found in selected devices mainly designed for the consumer market. Whether this is also the case for other mobile consumer devices could not be derived from the analyzed literature.

- *Plethora of apps:* A huge amount of apps exists for consumer platforms like iOS and Android (Perez 2014). As shown, the number of apps available for iOS or Android is comparably much higher than the number of apps available for BlackBerry, the legacy enterprise mobility platform (exemplary numbers reported for 2014 in Perez 2014; Wikipedia 2014). The huge difference between these selected consumer and enterprise platforms gives a good indication for the much higher variety of apps for consumer devices.

- *Intuitive use:* There are recent publications outlining the more intuitive or easier use of consumer IT compared to enterprise IT (Murdoch/Harris/Devore 2010; Junglas/Harris 2013). The usage of mobile consumer devices (more precisely iPads) is reported to be intuitive, e.g., because of the integrated touch screen (Pitt/Berthon/Robson 2011; Hess/Jung 2012).

- *Innovative technology:* As described, there are authors who emphasize the use of “innovative consumer devices” (Niehaves/Köffer/Ortbach 2013) and there are authors reporting that customers associated innovativeness in specific with the use of iPads (Hess/Jung 2012). Furthermore, the potential of consumer IT to be more innovative than legacy corporate IT is supported by literature (Pitt/Berthon/Robson 2011; Junglas/Harris 2013).

- *Personal employee use of enhanced devices:* Personal smartphones and tablets (mobile consumer devices) are perceived by employees to be more powerful than the mobile technology provided by their employer (Murdoch/Harris/Devore 2010; Unisys 2010; Junglas/Harris 2013).

- *Larger tablet screen size, less disturbing tablet use, and higher tablet battery capacity:* Tablets, and as reported in particular the iPad, seem to have specific characteristics resulting in specific advantages for companies (Pitt/Berthon/Robson 2011; Hess/Jung 2012). These advantages are a large screen size, a less disturbing device use, and a high battery capacity (Pitt/Berthon/Robson 2011; Hess/Jung 2012). It can be assumed that these advantages not only hold for iPads but also for other comparable tablets.

Note: The mobile IT characteristics presented above depict a selection of most relevant (positive or negative) characteristics according to the analysis of related literature. There are further negative mobile technology characteristics discussed in the literature. For instance, Gebauer and Shaw (2002), Guerrero et al. (2006), and Mladenova et al. (2011) illustrate possible limitations due to on-device storage restrictions. Tarasewich (2003) and Guerrero et al. (2006) mention the less processing power compared to desktop computers to be a possible limitation. Other publications, e.g., such as Deibert and Rothlauf (2006) or Niehaves, Köffer, and Ortbach (2012) outline potential performance concerns regarding mobile (consumer) technology use. To mention one last example, Gebauer, Shaw, and Zhao (Gebauer/Shaw/Zhao 2002), Drew (2011), Chen and Nath (Chen/Nath 2008), and Hess and Jung (2012) discuss security issues related to mobile (consumer) IT. Particularly, the mobile IT characteristics with potential negative impacts listed above were selected from the related literature by looking for potential obstacles which – based on the current state of the mobile enterprise market – are supposed to eventually hinder or strongly affect the use of mobile enterprise services. The examples presented in this paragraph – even security issues – are rated to less likely hinder the service use.

5.2.2 Performance Impacts of Mobile IT Use

Mobile technology can be exploited by companies through providing optimized IT service support for specific employee tasks in corporate processes. The provided mobile work functions offer support for different types of corporate tasks. These *mobile work functions* respectively characteristics of tasks that are supposed to benefit most from mobile IT support can be divided on a top-level into three groups:

- **Information access:**

  Mobile technologies can improve data and information access (Basole 2007b; Botzenhardt/Pousttchi 2008). Employees can, e.g., look up product information and sales manuals, verify stock levels, or access customer relationship management data remotely (Basole 2004; Sheng/Nah/Siau 2005; Chu/Huang 2008; Strategic Growth Concepts 2012). Additionally, information retrieval from the internet is supported by mobile devices like, e.g., tablets (Sheng/Nah/Siau 2005; Hess/Jung 2012). Through the use of data on the context the mobile enterprise service is used within (e.g., location), information access can be supported by filtering of search results based on the context information (Deibert/Hemmer/Heinzl 2009). In particular, the reading of documents on tablets such as the iPad is reported to be an advantage provided by mobile IT (Drew 2011; Hess/Jung 2012).

  Related literature: Strategic Growth Concepts (2012), Basole (2007b), Basole (2004) Basole (2005a), Botzenhardt and Pousttchi (2008), Chu and Hang (2008), Deibert, Hemmer, and Heinzl (2009), Deibert and Rothlauf (2006), Drew (2011), Isaac and Leclercq (2006), Hess and Jung (2012), Sheng, Nah, and Siau (2005), Walker and Barnes (2005), Derballa and Pousttchi (2004), Gebauer, Shaw, and Gribbins (2004), Breu, Hemingway, and Ashurst (2005), Krotov and Junglas (2006), Stieglitz and Brockmann (2012), Gebauer, Shaw, and Gribbins (2010)

- **Data capturing and storage:**

  Mobile IT enables enhanced data collection and seamless storing of this data into corporate IT backend systems (Deibert/Rothlauf 2006; Basole 2007b; Botzenhardt/Pousttchi 2008). For instance, customer relationship management data cannot only be accessed, it can also be updated while at the client's site (Strategic Growth Concepts 2012). Particularly, tablets such as the iPad can be used to take notes and automatically store or easily distribute the data (Drew 2011; Buttfield-Addison et al. 2012; Hess/Jung 2012). Taking pictures or recording interviews are other options to capture data with tablet devices reported in literature (Sheng/Nah/Siau 2005; Buttfield-Addison et al. 2012). Moreover, new ways of data capturing can be achieved if mobile device usage is combined with the use of tracking technology, e.g., for data gathering based on RFID tags or bar codes (Bowden et al. 2006; Deibert/Rothlauf 2006; Deibert/Hemmer/Heinzl 2009).

Related literature: Strategic Growth Concepts (2012), Basole (2007b), Botzenhardt and Pousttchi (2008), Buttfield-Addison et al. (2012), Deibert, Hemmer, and Heinzl (2009), Bowden et al. (2006), Deibert and Rothlauf (2006), Drew (2011), Hess and Jung (2012), Sheng, Nah, and Siau (2005), Walker and Barnes (2005), Stieglitz and Brockmann (2012)

- **Collaboration and communication:**

  Using mobile devices for corporate purposes along with a plethora of mobile applications enhances collaboration amongst employees and communication between the company and its customers or business partners (Sarker/Wells 2003; Strategic Growth Concepts 2012). Mobile employees are enabled, e.g., to use apps, make presentations, send and receive mails, jointly prepare tender responses, or deliver trip reports on time while travelling (Sheng/Nah/Siau 2005; Strategic Growth Concepts 2012). Sheng, Nah, and Siau (2005) point out that particularly the product presentation is improved by tablet use. Barnes, Scornavacca, and Innes (2006), for instance, report about benefits in supporting the information exchange at field force workers. It can be summarized that mobile IT fundamentally changes the way in which workers interact internally amongst each other and externally with, e.g., customers or vendors (Basole 2005a; Strategic Growth Concepts 2012).

  Related literature: Strategic Growth Concepts (2012), Barnes, Scornavacca, and Innes (2006), Basole (2005a), Belous (2013), Breu, Hemingway, and Ashurst (2005), Sarker and Wells (2003), Sheng, Nah, and Siau (2005), Derballa and Pousttchi (2004), Gebauer, Shaw, and Gribbins (2004), Chen and Nath (2004), Botzenhardt and Pousttchi (2008), Gebauer, Shaw, and Gribbins (2010)

Especially for the tasks depicted above, the deployment of mobile technology is reported to provide *benefits*. The advantageous mobile technology characteristics presented in section 5.2.1 provide benefits that can result in performance impacts for corporate processes, particularly for these tasks.

Mobile IT Benefits
Location-independence (functional) *Related literature:* Strategic Growth Concepts (2012), Basole (2007b), Basole (2005a), Belous (2013), Botzenhardt and Pousttchi (2008), Davis (2002), Derballa and Pousttchi (2004), Sarker and Wells (2003), Sheng, Nah, and Siau (2005)
Real-time support (functional) *Related literature:* Strategic Growth Concepts (2012), Barnes, Scornavacca, and Innes (2006), Basole (2007b), Belous (2013), Botzenhardt and Pousttchi (2008), Isaac and Leclercq (2006), Pavin and Klein (2013), Sheng, Nah, and Siau (2005), Falk and Leist (2014)
Context-sensitivity (functional) *Related literature:* Barnes, Scornavacca, and Innes (2006), Basole (2004), Deibert, Hemmer, and Heinzl (2009), Bazijanec, Pousttchi, and Turowski (2004), Junglas and Watson (2003), Pousttchi and Thurnher (2006), Derballa and Pousttchi (2004), Pitt, Berthon, and Robson (2011)
Media break & paper use reduction (functional) *Related literature:* Basole (2007b), Basole (2005a), Belous (2013), Botzenhardt and Pousttchi (2008), Breu, Hemingway, and Ashurst (2005), Buttfield-Addison et al. (2012), Deibert and Rothlauf (2006), Krotov and Junglas (2006), Leskinen (2008), Sheng, Nah, and Siau (2005), Falk and Leist (2014)
Legacy device replacement (functional) *Related literature:* Basole (2007b), Basole (2005a), Bazijanec, Pousttchi, and Turowski (2004), Derballa and Pousttchi (2004)
Technology innovation potential *Related literature:* Botzenhardt and Pousttchi (2008), Isaac and Leclercq (2006), Junglas and Harris (2013), Pitt, Berthon, and Robson (2011)
Technology user experience *Related literature:* Breu, Hemingway, and Ashurst (2005), Hess and Jung (2012), Junglas and Harris (2013), Murdoch, Harris, and Devore (2010)
Ease of learning technology use *Related literature:* Breu, Hemingway, and Ashurst (2005), Leskinen (2008), Molina et al. (2014), Nyri (2003), Murdoch, Harris, and Devore (2010), Niehaves, Köffer, and Ortbach (2012), Unisys (2010)

Table 5: **Mobile IT benefits**
Source: Own illustration

An overview of potential benefits of mobile IT use thereby and exemplary related literature is given in Table 5. Those labeled to be “functional” are rated to directly provide functional benefits. In the following, it is discussed how the benefits of mobile IT use are reported and anchored in the related body of literature.

Location-independence: A major benefit resulting from mobile IT use is an increase in employee mobility (Sarker/Wells 2003; Sheng/Nah/Siau 2005) in the sense of mobile communication, mobile commerce, and mobile collaboration (Sarker/Wells 2003). Mobile IT thereby enables employees to conduct their work without being bound to their office space (Davis 2002), supporting the location-independent use and update of corporate data (Strategic Growth Concepts 2012). Employees can make use of corporate resources when they are out on sales calls, travel to meetings, or work from home or a client’s site (Strategic Growth Concepts 2012) and can perform work “[…] where it makes the most sense” (Botzenhardt/Pousttchi 2008, 264).

Real-time support: Mobile technology enables companies to immediately transmit data remotely – at nearly any time – and to immediately have it available at the designated recipients (Falk/Leist 2014). It provides the ability to receive and communicate information in real-time, e.g., about billing, inventory, products logistics, and customers (Isaac/Leclercq 2006). Pavin and Klein (2013), e.g., report on the possibility of sending orders in real-time through the use of a mobile ERP system. Sheng, Nah, and Siau (2005) outline in their study the support real-time availability of sales and product information or the instantaneous notifications on product updates on tablet devices.

Context-sensitivity: Mobile enterprise services can be customized to consider workers’ particular needs through the use of context data, e.g., provided by device sensors or personal profiles (Bazijanec/Pousttchi/Turowski 2004; Pousttchi/Thurnher 2006). For instance, the use of context data such as the identification of the worker using the device, can improve information search on a mobile device (Deibert/Hemmer/Heinzl 2009). Information search, e.g., can be filtered based on this contextual data (Deibert/Hemmer/Heinzl 2009). Based on the geographic position of the user, so-called location-based services can be designed and provided (Junglas/Watson 2003). Especially selected mobile consumer devices provide future potential to have innovative sensors built-in, enabling an enhanced context-sensitivity (as reported for the iPad by Pitt/Berthon/Robson 2011).

Media break & paper use reduction: A media break (also referred to as media disruption) occurs if for conducting a task changing from one media type to another is required

(Botzenhardt/Pousttchi 2008). Media breaks can typically be found in paper-based processes or tasks (Botzenhardt/Pousttchi 2008). Tablets, for instance, can reduce media breaks and paper use by providing the option to directly take notes with the device or photos with the built-in camera (Breu/Hemingway/Ashurst 2005; Buttfield-Addison et al. 2012). Sheng, Nah, and Siau (2005) report in their study on the minimized need to carry sales manuals due to the tablet use. Another example for less paper use is described by Krotov and Junglas (2006). They illustrate how the police department in Santa Clara, California, issue traffic violation citations electronically with a PDA instead of using paper (Krotov/Junglas 2006). Moreover, the reduction of paper use is outlined as one of the greatest benefits of digital tools like mobile applications by Belous (2013).

Legacy device replacement: Mobile devices can be used as a substitute for other devices and provided to perform a variety of tasks on one single device (Basole 2005a). Especially portable handheld devices that are less expensive can be used as a substitute for computing devices such as desktop computers (Basole 2007b). Additionally, mobile devices and their ubiquitous connectivity can be exploited to remotely control other devices and can be used in situations where formerly only stationary devices could be remotely controlled (Bazijanec/Pousttchi/Turowski 2004).

Technology innovation potential: Mobile technologies offer the possibility to apply innovative state of the art solutions (Botzenhardt/Pousttchi 2008). Customers are reported to associate "being professional" and "being modern" with the use of mobile IT (Isaac/Leclercq 2006). However, consumer IT such as personal smartphones and tablets can be regarded to be more valuable and state of the art than IT usually provided by the company (Pitt/Berthon/Robson 2011; Junglas/Harris 2013).

Technology user experience: User experience of devices and services is supposed to influence the outcome of employees' work (Hess/Jung 2012). In general, mobile IT and, in particular, consumer IT are illustrated to have a high ease of use (Breu/Hemingway/Ashurst 2005; Murdoch/Harris/Devore 2010; Hess/Jung 2012; Junglas/Harris 2013), supposedly leading to a positive user experience. Moreover, in an iPad test report of Hess and Jung (2012), a positive user experience of the device usage is outlined. Thereby, the user experience (for e-mail use) is rated to be higher compared to the smartphone (Hess/Jung 2012). Nevertheless, user experience of apps, e.g., for taking notes, is rated to be bad (Hess/Jung 2012).

Ease of learning technology use: Molina et al. (2014) (citing Nyíri 2003) illustrate the use of smartphones and tablets to not require additional technical training. This is supported by a study conducted by Breu, Hemingway, and Ashurst (2005), in which the use of mobile technology is reported to be easily learned by participants. Feedback discussed in Leskinen (2008) on the use of mobile services in the construction industry as well showed that piloted mobile applications were seen to be easily learned what motivated workers to use them. In particular, the mobile consumer IT, familiar to users, reduces the need for training on technology use (Murdoch/Harris/Devore 2010; Unisys 2010; Niehaves/Köffer/Ortbach 2012).

These general benefits provided by mobile IT can be expected to directly or indirectly result in performance impacts for business companies. As outlined, e.g., in Barnes, Scornavacca, and Innes (2006) or Basole (2004), performance impacts of mobile IT can be categorized as *efficiency* or *effectiveness* impacts. Additionally, convenience is mentioned in Basole (2004) as a third category of value proposition of corporate mobile IT use. The convenient use of mobile technology can be expected to positively influence the wellbeing of employees (referred to as "*employee satisfaction*" in this thesis). By citing the results of the Gallup study (Harter/Schmidt/Keyes 2003), Hess and Jung (2012) point out that high wellbeing amongst workers positively influences work quality and business outcomes. Employee satisfaction is a qualitative outcome of mobile IT use often referred to in literature (e.g., Sheng/Nah/Siau 2005; Pousttchi/Becker 2012). Particularly, for consumer IT devices such as smartphones and tablets employee satisfaction is said to be a major benefit (Junglas/Harris 2013). This is supported by Niehaves, Köffer, and Ortbach (2012), who state that the consumerization trend will positively influence employee satisfaction and thereby workforce productivity.

For the purpose of this thesis, gains in efficiency and effectiveness (Grönroos/Ojasalo 2004) as well as employee satisfaction are regarded as the dimensions of performance impacts of mobile IT use on corporate processes and their productivity. Thereby, employee satisfaction is regarded to be able to have an indirect impact on efficiency and effectiveness gains. This assumption is supported by the findings of case studies presented by Vuolle (2011), in which convenience and job satisfaction impacts on employee productivity were discovered.

Potential impacts on one or more of these performance dimensions resulting from the general benefits of mobile IT use (summarized in Table 5), and related literature are listed in Table 6. Additionally, a categorization of the impacts according to the performance dimensions potentially affected taken in this doctoral thesis is provided in Table 6. The *performance impacts* illustrated below have in some cases been generalized in comparison to how they are presented in the existing literature. Further details on the selected performance impacts will not be discussed in this thesis, but can be found in the cited publications.

Mobile IT Performance Impacts
Joy of (consumer) device use (➔ employee satisfaction) *Related literature:* Hess and Jung (2012), Junglas and Harris (2013), Murdoch, Harris, and Devore (2010)
Personal experience with (consumer) device use (➔ employee satisfaction) *Related literature:* Junglas and Harris (2013), Unisys (2010)
Single (consumer) device use for business and personal life (➔ employee satisfaction) *Related literature:* Aerospace Industries Association (2011)
Higher perceived social status (➔ employee satisfaction) *Related literature:* Isaac and Leclercq (2006), Hess and Jung (2012)
Higher perceived (individual or corporate) image (➔ effectiveness) *Related literature:* Botzenhardt and Pousttchi (2008), Isaac and Leclercq (2006), Hess and Jung (2012), Sheng, Nah, and Siau (2005)
Higher flexibility in work organization (➔ effectiveness) *Related literature:* Barnes, Scornavacca, and Innes (2006), Basole (2007b), Breu, Hemingway, and Ashurst (2005), Deibert and Rothlauf (2006), Falk and Leist (2014)
Higher transparency on (job or process) performance (➔ effectiveness) *Related literature:* Botzenhardt and Pousttchi (2008), Leskinen (2008), Pavin and Klein (2013)
Higher data quality or lower error rate in information (transfer or collection) (➔ effectiveness, efficiency) *Related literature:* Basole (2007b), Basole (2005a), Botzenhardt and Pousttchi (2008), Chu and Hang (2008), Deibert and Rothlauf (2006), Krotov and Junglas (2006), Leskinen (2008), Pavin and Klein (2013), Walker and Barnes (2005), Falk and Leist (2014)

Better customer service (➔ effectiveness) *Related literature:* Strategic Growth Concepts (2012), Isaac and Leclercq (2006), Kadyte (2004), Sheng, Nah, and Siau (2005), Walker and Barnes (2005), Picoto, Palma-dos-Reis, and Belanger (2010)
Better decision-making (➔ effectiveness) *Related literature:* Basole (2007b), Basole (2004), Basole (2005a), Breu, Hemingway, and Ashurst (2005), Gebauer, Shaw, and Gribbins (2004)
New (external or internal) products and services (➔ effectiveness) *Related literature:* Strategic Growth Concepts (2012), Junglas and Harris (2013), Niehaves, Köffer, and Ortbach (2012), Picoto, Palma-dos-Reis, and Belanger (2010), Basole (2007b)
Increased work capability while not at desk (➔ efficiency) *Related literature:* Breu, Hemingway, and Ashurst (2005), Hess and Jung (2012), Gebauer, Shaw, and Gribbins (2004)
Increased work capability from home (➔ efficiency, employee satisfaction) *Related literature:* Strategic Growth Concepts (2012), Botzenhardt and Pousttchi (2008), Isaac and Leclercq (2006), Hess and Jung (2012)
Increased work capability after office hours (➔ efficiency) *Related literature:* Hess and Jung (2012), Junglas and Harris (2013), Niehaves, Köffer, and Ortbach (2012)
Increased work capability while travelling (➔ efficiency) *Related literature:* Strategic Growth Concepts (2012), Barnes, Scornavacca, and Innes (2006), Isaac and Leclercq (2006), Hess and Jung (2012), Breu, Hemingway, and Ashurst (2005), Gebauer, Shaw, and Gribbins (2004)
Faster data & information capturing (➔ efficiency) *Related literature:* Basole (2007b), Deibert and Rothlauf (2006), Sheng, Nah, and Siau (2005), Walker and Barnes (2005)
Faster data & information storing (➔ efficiency) *Related literature:* Basole (2007b), Sheng, Nah, and Siau (2005)
Faster data & information access (➔ efficiency) *Related literature:* Basole (2007b), Botzenhardt and Pousttchi (2008), Breu, Hemingway, and Ashurst (2005), Krotov and Junglas (2006), Sheng, Nah, and Siau (2005)
Faster data & information exchange (➔ efficiency) *Related literature:* Breu, Hemingway, and Ashurst (2005), Sheng, Nah, and Siau (2005), Chen and Nath (2004), Barnes, Scornavacca, and Innes (2006)

Faster data & information editing (➔ efficiency) *Related literature:* Breu, Hemingway, and Ashurst (2005), Sheng, Nah, and Siau (2005)
Faster response time (➔ efficiency) *Related literature:* Barnes, Scornavacca, and Innes (2006), Chu and Hang (2008), Hess and Jung (2012), Sheng, Nah, and Siau (2005), Falk and Leist (2014)
Faster order processing (➔ efficiency) *Related literature:* Basole (2007b), Chu and Hang (2008), Pavin and Klein (2013), Sheng, Nah, and Siau (2005), Walker and Barnes (2005)
Faster invoicing and billing (➔ efficiency) *Related literature:* Strategic Growth Concepts (2012), Pousttchi and Becker (2012)
Less transportation time (➔ efficiency) *Related literature:* Basole (2007b)
Less travelling time (➔ efficiency) *Related literature:* Botzenhardt and Pousttchi (2008), Isaac and Leclercq (2006), Kadyte (2004), Pousttchi and Becker (2012), Falk and Leist (2014)
Less waiting time (➔ efficiency) *Related literature:* Deibert and Rothlauf (2006), Chen and Nath (2004), Falk and Leist (2014)
Less paper use costs (➔ efficiency) *Related literature:* Botzenhardt and Pousttchi (2008), Buttfield-Addison et al. (2012), Sheng, Nah, and Siau (2005)
Less device costs (➔ efficiency) *Related literature:* Basole (2007b), Basole (2005a), Pousttchi and Becker (2012)
Less travelling costs (➔ efficiency) *Related literature:* Isaac and Leclercq (2006), Kadyte (2004), Pousttchi and Becker (2012), Falk and Leist (2014)
Less office space costs (➔ efficiency) *Related literature:* Isaac and Leclercq (2006)
Less inventory costs (➔ efficiency) *Related literature:* Basole (2007b), Pousttchi and Becker (2012)
Less transportation costs (➔ efficiency) *Related literature:* Botzenhardt and Pousttchi (2008), Pavin and Klein (2013)
Less staff costs (➔ efficiency) *Related literature:* Basole (2007b), Botzenhardt and Pousttchi (2008), Isaac and Leclercq (2006), Pavin and Klein (2013), Falk and Leist (2014)

Less communication & collaboration costs (➔ efficiency) *Related literature:* Botzenhardt and Pousttchi (2008)
Less service level agreement (SLA) obligation costs (➔ efficiency) *Related literature:* Botzenhardt and Pousttchi (2008), Falk and Leist (2014)
Less capital costs (➔ efficiency) *Related literature:* Botzenhardt and Pousttchi (2008), Pousttchi and Becker (2012), Falk and Leist (2014)

Table 6: Mobile IT performance impacts
Source: Own illustration

Note: It has to be acknowledged that there are overlaps and interdependencies between the performance impacts listed in the table above. For instance, from Falk and Leist (2014), a relation between ad hoc decision-making and flexibility can be derived. Pousttchi and Becker (2012), e.g., state that faster billing can lead to less capital costs through interest savings. However, existing interdependencies or overlaps are not further outlined or discussed in this thesis.

The potential efficiency gains can be further categorized into sub-dimensions. As it can be extracted from Table 6, efficiency impacts through mobile IT use are supposed to mainly result from the reductions in a) *task idle time*, b) *task execution time*, and / or c) *task input costs*. Reduction in idle (or unproductive) time could result, e.g., from an increase of work capability from home or when travelling, reductions in execution time, e.g., through faster information access or less travelling time, and cost reductions, e.g., because of using less expensive devices or less paper use costs. Between these three efficiency sub-dimensions there might be specific dependencies: saving idle time could lead to a faster overall task execution that might decrease the input costs for the task execution.

The illustrated sub-categorization of efficiency impacts of mobile IT use is on the top-level (or partially) supported by current literature. According to Botzenhardt and Pousttchi (2008), usage of mobile technology can increase process efficiency through reduction of unproductive labor resulting in reduced process input. Reduced process inputs are illustrated through time savings by the authors (Botzenhardt/Pousttchi 2008). They further state: “More efficient processes result in a high reduction of costs by reducing unnecessary labor and speed up the processes” (Botzenhardt/Pousttchi 2008, 266). Moreover, Segev, in his paper on business value of mobile applications in the process context, describes efficiency gains from mobile IT use to result, e.g., from faster execution, reduced cost, or higher throughput for existing processes (Segev 2003).

In their study on effects of mobile solutions for corporate environments and business processes, Falk and Leist (2014) list cost and time besides qualitative effects to structure their findings. Gruhn and Köhler (2007) as well outline cost, time, and quality dimensions for mobile process optimizations. These publications support the overall classification of performance gains of mobile IT use into quantitative cost & time efficiency impacts and qualitative effectiveness impacts.

Note: Amongst the publications considered there are articles and findings with a specific or limited focus that might only hold, e.g., for specific industries, processes, or tasks.

5.2.3 Costs of Mobile IT Use

The use of mobile IT or more concrete the usage of mobile enterprise services has certain beneficial performance impacts (as outlined above) but creates additional costs.

The costs of mobile technology use can be captured by applying the *total-cost-of-ownership* (TCO) approach, thus considering the costs of IT use occurring along the service lifecycle (Wiggers/Kok/de Boer-de Wit 2004b). As mentioned by Wiggers, Kok, and, de Boer-de Wit (2004b), the TCO approach was initially developed by the Gartner Research Corporation (see Redman/Kirwin/Berg 1998). It is used to capture all direct and indirect costs that arise throughout the lifecycle of an information technology deployed within an enterprise (Wiggers/Kok/de Boer-de Wit 2004b). TCO calculations comprise expenditures occurring at the beginning of the deployment lifecycle (e.g., for acquisitions) as well as costs resulting from technology use (e.g., for operations) and disposal of the technology (Wiggers/Kok/de Boer-de Wit 2004b). As typical for information technology, the major share of costs incurs through technology use and maintenance, the TCO approach is appropriate to assess the holistic monetary impact.

For capturing costs along the *service lifecycle*, the model of Kohlborn, Korthaus, and Rosemann's (2009) described in section 4.2 can be referred to. By applying their service lifecycle model to determine the TCO for a mobile enterprise service, costs for the following stages have to be calculated (Kohlborn/Korthaus/Rosemann 2009):

1. Mobile service analysis
2. Mobile service design
3. Mobile service implementation

4. Mobile service publishing
5. Mobile service operation
6. Mobile service retirement

Specific costs potentially arising for the deployment of mobile enterprise services extracted from selected publications of the related literature include:

- Hardware and software costs, e.g., for mobile devices, apps, RFID systems, GPS[31] receivers (Love/Irani/Edwards 2005; Deibert/Rothlauf 2006; Pousttchi/Thurnher 2006)
- Networking and telecommunications costs, e.g., for cellular data transport (Love/Irani/Edwards 2005; Pousttchi/Thurnher 2006)
- IT system integration costs, e.g., for ERP or communication server integration (Pousttchi/Thurnher 2006)
- Training costs for employees (Love/Irani/Edwards 2005; Deibert/Rothlauf 2006; Pousttchi/Thurnher 2006; Basole 2007b)
- Maintenance costs, e.g., for mobile hardware and software (Love/Irani/Edwards 2005; Deibert/Rothlauf 2006; Pousttchi/Thurnher 2006)
- Support costs, e.g., for helpdesk set up (Deibert/Rothlauf 2006)
- Consultancy and project costs, e.g., for process analysis and documentation (Love/Irani/Edwards 2005; Pousttchi/Thurnher 2006)
- Costs due to employees' resistance to change (Love/Irani/Edwards 2005; Basole 2007b)
- Costs due to loss of productivity (Love/Irani/Edwards 2005; Basole 2007b)
- Costs for organizational changes (Love/Irani/Edwards 2005; Löfgren 2006)

[31] GPS = Global Positioning System

- Costs for distractions and interferences (Love/Irani/Edwards 2005; Löfgren 2006)

Costs of mobile IT use can further be categorized into investment costs (capital expenditure, CAPEX) and running costs (operational expenditure, OPEX) (Pousttchi/Becker 2012). Costs for the acquisition of mobile devices or training costs, e.g., are CAPEX (Pousttchi/Becker 2012). Cellular telecommunications costs or maintenance costs, e.g., are OPEX (Pousttchi/Becker 2012).

5.2.4 Obstacles for Mobile IT Use

Basole (2005a) summarizes four critical factors for adoption of mobile technology in companies: *technological*, *individual*, *organizational*, and *environmental* factors. Technological factors seem to be most important, referring to the characteristics of the technology to be adopted (Basole 2005a). Individual factors focus on the users supposed to adopt and use it (Basole 2005a). For all groups of critical factors, extracted from literature, Basole (2005a) lists examples such as ease of use (technology), individual innovativeness (individual), top management support and risk orientation (organizational), or regulatory and vendor influence (environmental).

Secondary, in accordance with these four critical adoption factors, Basole (2005a) outlines transition barriers for mobilizing the enterprise. He lists barriers related to organizational / strategic, technological, and environmental factors. A basic requirement is an alignment of mobile enterprise service use with the company's business strategy and goals (Basole 2005a). On the organizational level, further transition barriers can result from end-users' resistance to change and adopt the innovation or the company's level of innovativeness and organizational culture (Basole 2005a).

Thirdly, Basole (2005a) emphasizes the importance of enterprises being prepared and capable to adopt, implement and use mobile technology. He refers to this preparedness and capability with the term "mobile enterprise readiness" (Basole 2005a; Basole 2007b) and names eight dimensions to assess this readiness:

1. Technology: "Technology readiness refers to the ability of the underlying technology infrastructure (network services, hardware, software, and security) to support the adoption and implementation of mobile ICT." (Basole 2007b, 7)

2. Data and information: “Data and information readiness refers to the ability to federate data from multiple sources, provide a single view of enterprise data, and make it available to any system at the time when it is needed.” (Basole 2007b, 7)

3. Process: “Process readiness refers to the ability of organizational processes (e.g. human processes, information processes, organizational change processes, etc.) to facilitate the adoption and implementation of mobile ICT.” (Basole 2007b, 7)

4. Resource: “Resource readiness represents an organization’s ability to support mobile ICT adoption and implementation. These resources may include (1) financial, (2) human, and (3) technical assets.” (Basole 2007b, 7)

5. Knowledge: “Knowledge readiness reflects both the general and specific knowledge required by decision makers for mobile ICT adoption and implementation.” (Basole 2007b, 7)

6. Leadership: “Leadership readiness, hence, reflects an appropriate level of skills, innovativeness, knowledge, and risk orientation of top management.” (Basole 2007b, 7)

7. Employee: “Employee readiness reflects the end-users attitude towards change, their level of skills, and perceived benefits by the end-users.” (Basole 2007b, 7)

8. Values and Goals: “Values and goals readiness reflects the fit between existing structural and nonstructural enterprise characteristics and mobile ICT characteristics.” (Basole 2007b, 7)

More details on the eight dimensions of mobile enterprise readiness can be found in Basole (2007b). The dimensions can be categorized in those focusing on individual factors (employee dimension) and those focusing on other organizational (including technology-related) factors.

The elaborations of Basole (2005a; 2007b) are supported by findings that can be derived from other publications. For instance, Chen and Nath (2008) take a socio-technical perspective and mention people, technology, structure, and task as the elements of the technical and social sub-systems of mobile work. In their study, they illustrate a generational gap (in the people dimension) between elder and younger employees (Chen/Nath 2008). For instance, elder people were thereby seen to have some resistance to newly introduced mobile technology (Chen/Nath 2008). In the structure dimension, e.g., for organizational culture a need to accept mobile work and the resulting decrease of physical on-site office presence is reported (Chen/Nath 2008). Also resistance of management is mentioned as a possible management issue in this dimension (Chen/Nath 2008). For the technology construct, e.g., the requirement to have wireless connectivity with sufficient bandwidth is reported (Chen/Nath 2008). Finally, Chen and Nath (2008) are addressing issues such as, e.g., those coming from regulations in the task dimension. The socio-technical dimensions and the presented examples (Chen/Nath 2008) support the four groups of potential obstacles for the mobile IT use derived from Basole (2005a; 2007b).

Summarizing the elaborations of Basole (2005a; 2007b), Chen and Nath (2008), and other publications, obstacles for the corporate adoption and use of mobile IT can result from characteristics deriving from:

- **Mobile technology (technology-related):** An overview on mobile technology characteristics with potential negative impact that constitute technology-related obstacles for mobile IT use, extracted from the body of related literature, has been provided in section 5.2.1 of this thesis. These obstacles can come from limited mobile network coverage, limited legacy enterprise app support, limited use of input devices, small screen size, and limited battery capacity.

- **Employees (employee-related):** Employee-related obstacles for mobile IT use can, e.g., come from individual innovativeness (Basole 2005a) or resistance to adopt new technology amongst elders (Chen/Nath 2008; Lembach/Lane 2013).

- **Organization (organizational-related):** Organizational-related obstacles for mobile IT use can, e.g., come from missing top management support (Basole 2005a; Chen/Nath 2008) or inadequate organizational culture for mobile work (Chen/Nath 2008).

- **Environment (environmental-related):** Environmental-related obstacles for mobile IT use can, e.g., come from regulatory influence (Basole 2005a; Chen/Nath 2008), vendor influence (Basole 2005a), weather conditions (Tarasewich 2003), or noise level (Tarasewich 2003).

5.2.5 Evaluation and Comparison of Assessment Frameworks

The body of literature was screened for approaches[32] which can be applied to *assess the value added* of the corporate IT service use on mobile consumer devices – scope of research question 2. Several respective frameworks have been identified and compared based on a set of evaluation criteria derived from the identified problem statement (see section 1.2). They have been included into the comparison if a procedure model or techniques, describing process steps that have to be conducted, are provided or can be extracted.

Frameworks have been mainly evaluated for their value assessment capabilities. As discussed in section 1.3, pre-assessment of value added for task support and definition of service ideas are required pre-steps to holistically enable the introduction of mobile enterprise services in the service analysis phase (as described in section 1.2). These pre-steps have to comprise the capabilities to identify tasks suitable for mobilization (referred to as pre-assessment) and to define mobile enterprise service ideas for. Evaluation criteria to reflect this need have been included into the analysis of frameworks.

The value assessment capabilities have been broken down into two evaluation criteria, C-3 and C-4; C-1 asks for pre-assessment capabilities; C-2 asks for capabilities to define service ideas:

C-1) **Identifying suitable corporate tasks:** Framework shall support companies to explore the suitability of tasks for mobilization and enable them to select tasks that would benefit most from mobilization.

C-2) **Defining mobile enterprise service ideas:** Framework shall support companies to define detailed descriptions of service ideas for tasks identified to benefit from mobilization.

C-3) **Determining and illustrating value added of service ideas (ex ante):** Framework shall support companies to determine and illustrate the productivity-related value added of mobile enterprise service ideas ex ante.

[32] In this thesis, structured approaches are also referred to as "frameworks".

C-4) **Quantifying value added of service ideas (ex ante):** Framework shall support companies to quantify the value added of mobile enterprise service ideas ex ante.

C-1 to C-4 are referred to as functional evaluation criteria in the following. Additionally, to adhere to the scope of research question 2, it has to be verified whether the frameworks consider consumer IT characteristics.

C-5) **Consideration of mobile consumer IT specifics:** Framework considers specifics of mobile consumer technology as part of its process steps.

In Table 7, selected frameworks identified to possess value assessment capabilities are shown. The fulfillment of the evaluation criteria is rated with "x" (not covered), "0" (partially covered), or "+" (fully covered). The frameworks that have been analyzed to possess the most holistic coverage of the criteria (listed on top of Table 7) are presented and discussed in detail in the following. Other frameworks are described in a compressed format.

Framework / Criteria	**C-1**	**C-2**	**C-3**	**C-4**	**C-5**
Mobility-M (Gumpp/Pousttchi 2005; Pousttchi/Thurnher 2006; Pousttchi/Becker 2012)	+	**0**	**0**	**0**	**x**
Mobile Process Landscaping (Köhler/Gruhn 2004a; Gruhn/Köhler/Klawes 2005; Gruhn/Köhler/Klawes 2007)	+	**0**	**0**	**0**	**x**
Mobile Eligibility of Business Processes (Mladenova et al. 2011)	+	**0**	**0**	**0**	**x**
Mobile Business Service - Unified Modeling Language (Wigelius/Aula/Markova 2007)	+	**0**	**0**	**0**	**x**
Framework for Mobile Business Applications (Chen/Nath 2004)	+	**0**	**0**	**x**	**x**
Performance Impacts of Mobile Business Services (Vuolle 2011)	**x**	**x**	**0**	**0**	**x**
Benefits of a Mobile Application System (Schmidt-Eisenlohr 2010)	**x**	**x**	**0**	**0**	**x**
CBA Approach to Mobile IS (Kadyte 2004)	**x**	**x**	**0**	**0**	**x**
e-Mobility Value Based on Application Classes (Segev 2003)	**x**	**x**	**0**	**x**	**x**

Table 7: **Frameworks supporting value assessment**
Source: Own illustration

Note: If an analyzed framework has no specific name given, a description of its scope is used to reference it in the table and descriptions below.

The "*Mobility-M framework*" enables companies to design and implement mobile-integrated business processes (MIBPs) (Gumpp/Pousttchi 2005; Pousttchi/Thurnher 2006; Pousttchi/Becker 2012). As summarized by Gumpp and Pousttchi (2005, 1), the framework "[..] puts the technology and the business processes in context with each other by using the theory of informational added values." Potential benefits of mobile IT use can thereby be shown (Gumpp/Pousttchi 2005).

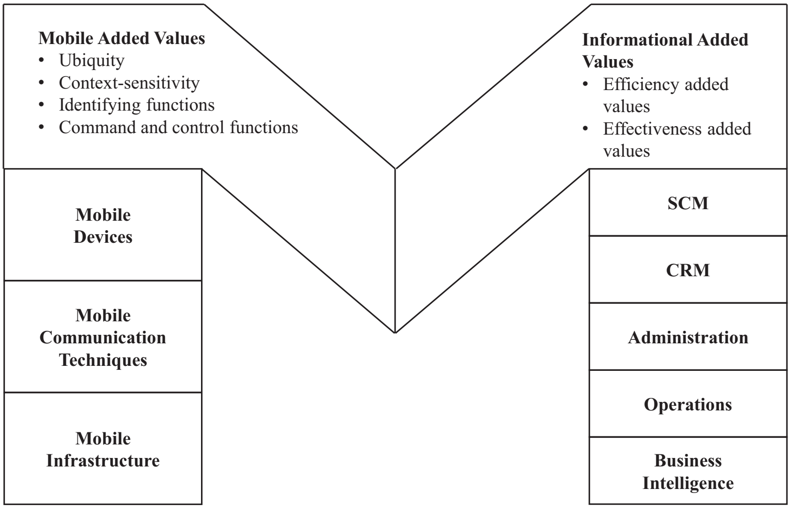


Figure 17: Mobility-M framework
Source: Gumpp and Pousttchi (2005, 526)

Figure 17 provides a graphical illustration of the framework (Gumpp/Pousttchi 2005). In the left pillar, different mobile technology elements needed for mobile business processes are listed (Gumpp/Pousttchi 2005). Functional areas of mobile processes are depicted in the right pillar (Gumpp/Pousttchi 2005). Mobile Added Values (MAV) and Informational Added Values (IAV) are showing the potential benefits of mobile technology use and the possibly resulting process enhancements, and thus are connecting the two pillars (Gumpp/Pousttchi 2005). When applying the framework, initially the company's business processes and available mobile technologies are evaluated (Gumpp/Pousttchi 2005). The pre-selection of processes to potentially be mobilized and to be further analyzed can be supported through applying a scoring technique based on process characteristics, as exemplary depicted in Pousttchi and Thurner (2006). Through applying business process reengineering (Hammer/Champy 1993) with mobile technology, selected processes can be redesigned to create mobile-integrated business processes (Gumpp/Pousttchi 2005; Pousttchi/Becker 2012). This is followed by an analysis of possible mobile technology application benefits (Gumpp/Pousttchi 2005). Only if it is possible to identify at least one MAV impact (context-sensitivity, identifying functions, ubiquity, or command and control functions), an improvement can be realized through process reengineering based on mobile technology use (Gumpp/Pousttchi 2005). In a next step, an assessment of the possible improvement(s) is conducted to figure out whether potential IAV impacts (e.g., efficiency and effectiveness gains) result from these enhancements (Gumpp/Pousttchi 2005). Thereby, financial calculations shall be conducted to support this assessment (Gumpp/Pousttchi 2005). The assessment results provide the baseline to decide on the implementation of the redesigned process (Gumpp/Pousttchi 2005).

Evaluating the Mobility-M framework according to the set up criteria, it can be constituted that only the task identification is supported as required. This rating is based on the assumption that the described scoring technique (on which only few details are provided in the cited publications) is applied. Even if by declaration it does not consider the task level, the proposed scoring technique (if regarded as a possible framework extension) can enable organizations to identify tasks which are suitable for mobilization, based on process (respectively task) characteristics and predefined rules. Rules for process or task selection can be defined referring to the compiled scores. These processes or tasks can then be further analyzed. Based on this assumption, the framework can be rated to sufficiently enable identifying processes and tasks that benefit from mobile IT support. Looking at the other functional evaluation criteria, only partial fulfillment can be constituted. The Mobility-M framework does not show in detail how to carry out process reengineering to create MIBPs. It helps to identify tasks for which service ideas could be build, but it does not provide a detailed procedure to determine for which task which service idea would be adequate or a way to make detailed service idea descriptions in the predetermined functional areas. Finally, the assessment of productivity-related value added is part of the framework, but there are again no detailed procedures (techniques) that enable companies to determine, illustrate, and calculate the detailed benefits, potential costs, and the resulting value added of a mobile enterprise service idea in a predefined approach. It is for instance not shown which potential service ideas, in what way, lead to which qualitative and quantitative value added. The initial scoring only provides some abstract and rough quantification details.

“*Mobile Process Landscaping”* is another framework possessing capabilities from value pre-assessment to assessment (Köhler/Gruhn 2004a; Gruhn/Köhler/Klawes 2005; Gruhn/Köhler/Klawes 2007). Mobile Process Landscaping “[…] allows the goal-oriented analysis of a process model and its distribution structure to explore mobilisation opportunities, as well as deducing requirements for the software engineering process” (Köhler/Gruhn 2004a, 1). In this framework, initially objectives (e.g., cost savings) are defined and mobile business processes (see section 3.2 for a definition) are identified and analyzed (Gruhn/Köhler/Klawes 2005; Gruhn/Köhler/Klawes 2007). Processes are modeled as a landscape showing process dependencies, to enable these steps (Gruhn/Köhler/Klawes 2005; Gruhn/Köhler/Klawes 2007). In selected publications on Mobile Process Landscaping, it is shown how, based on a scoring technique with predefined evaluation criteria, sub-processes respectively activities can be identified and selected for further analysis (Gruhn/Köhler/Klawes 2005; Gruhn/Köhler/Klawes 2007). The thereby applied criteria are on the one hand related to general optimization areas and on the other hand to the mobility of involved persons (Gruhn/Köhler/Klawes 2005; Gruhn/Köhler/Klawes 2007). Shortcomings related to personal mobility can be discovered (Gruhn/Köhler/Klawes 2005; Gruhn/Köhler/Klawes 2007). In a next step, based on the identified shortcomings new, improved versions of the process can be designed (Gruhn/Köhler/Klawes 2005; Gruhn/Köhler/Klawes 2007). Developed alternative solutions are then economically evaluated and compared (Gruhn/Köhler/Klawes 2005; Gruhn/Köhler/Klawes 2007). Finally, requirements for the software architecture can be put up for alternatives that shall be realized, selected based on the evaluation results (Gruhn/Köhler/Klawes 2005; Gruhn/Köhler/Klawes 2007). A graphical overview on the steps of the Mobile Process Landscaping framework is depicted in Figure 18.

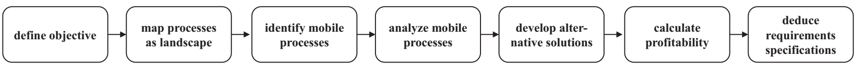


Figure 18: Mobile Process Landscaping framework
Source: Gruhn, Köhler, and Klawes (2007, 662)

Summarizing the support of the required capabilities by the framework, it can be recognized that the identification of tasks to be mobilized is sufficiently supported. Based on personal mobility and potential value added and the depicted scoring technique, sub-processes and activities can be selected (Gruhn/Köhler/Klawes 2007). Finally, based on an economic evaluation, the candidates for implementation are to be chosen (Gruhn/Köhler/Klawes 2007). Overall, explicit rules can be predefined for sub-process and activity (respectively task) selection. Service idea definition is to a certain extent addressed in the step to develop alternative solutions. It can be partially enabled by the results of the process identification & analysis steps. Nevertheless, there is no technique provided in the framework on how to create detailed service idea descriptions related to the activities identified. This also applies for the assessment of value added, which is not supported with a detailed, systematic technique. There is "only" the need to assess the economic profitability mentioned and incorporated into the framework, but without any details on how to do it. However, in the selected publications (Gruhn/Köhler/Klawes 2005; Gruhn/Köhler/Klawes 2007) examples on how to assess value added to a certain extent can be extracted from a presented case study.

Mladenova et al. (2011, 1) developed "[…] an approach that supports the systematic analysis and assessment of the mobile eligibility of business processes, taking into account a set of structured, adaptable criteria to deliberate between potential business values added by mobile devices and the typical mobile device characteristics." The overall structure of this framework, focused on "*mobile eligibility of business processes*", is depicted in Figure 19.

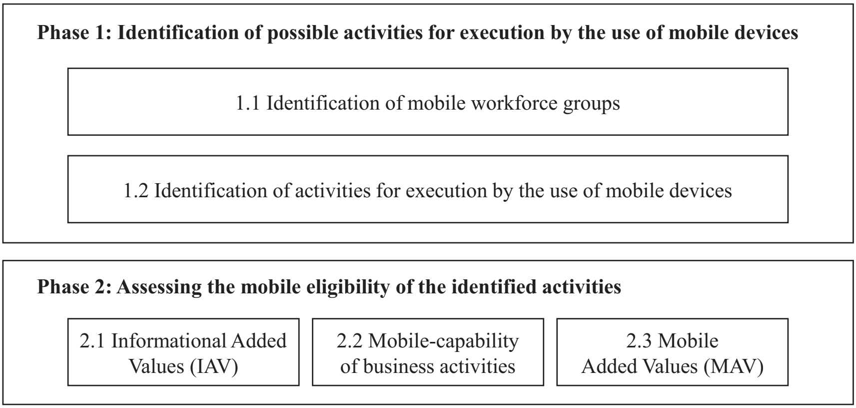


Figure 19: Mobile eligibility of business processes framework
Source: Mladenova et al. (2011, 3)

Thereby, the approach is divided into two major parts (Mladenova et al. 2011). The milestone of the first phase is the identification of possible activities for mobile IT support that are to be further analyzed (Mladenova et al. 2011). Thereby, mobile workers are initially extracted and the activities conducted by them are gathered (Mladenova et al. 2011). These activities depict the starting point for the second phase (Mladenova et al. 2011). In the second phase, the activities' so-called degree of mobile eligibility is evaluated (Mladenova et al. 2011). The set of criteria to assess the mobile eligibility consists on the one hand of IAV (efficiency and effectiveness added values) and MAV (command and control functions, identifying functions, context-sensitivity, and ubiquity) items (Mladenova et al. 2011). They are complemented by mobile capability items, focusing on activity and typical device characteristics (Mladenova et al. 2011). Activity requirements come, e.g., from execution frequency and number of employees (Mladenova et al. 2011). Device characteristics comprise, e.g., internet connection, display size / keyboard, or battery life time (Mladenova et al. 2011). Thereby, the impact of mobile capabilities on eligibility can be positive (through IAV, MAV, and activity characteristics) or negative (through typical device characteristics) (Mladenova et al. 2011). Finally, the degree of mobile eligibility can be calculated based on expert ratings and constituted as a score as illustrated in the exemplary application of the framework by Mladenova et al. (2011).

The framework, considering task characteristics, in a comprehensive way enables the identification of activities respectively tasks that would benefit from mobilization. This is additionally enhanced by the presented possibility to quantify the mobile eligibility (e.g., across MAV and IAV benefits) based on subjective expert assessments as a score (Mladenova et al. 2011). This score enables the rule-based task selection. Nevertheless, the framework only partially supports the definition of service ideas based on the identified activities and, e.g., the expected MAV enhancements through task mobilization. It does not support companies in deriving detailed descriptions for mobile enterprise service ideas from the identified tasks by a systematic approach. It further only partially supports the assessment steps. Multidimensional value added is considered and aggregated to scores. However, IAV and MAV benefits are only determined on a high-level to support the ratings and scorings for the selection of activities to be mobilized. The framework does not provide details on how the value assessments shall be carried out in the predefined dimensions for defined service ideas. Neither are any monetary value added quantifications supported. Only (abstract) quantifications are provided through the scorings.

Wigelius, Aula, and Markova (2007) proposed "*Mobile Business Service - Unified Modeling Language (MoBiSUML)*", an approach to design mobile business services and to study the benefits of mobile IT use (see Figure 20). The core of this framework is made up by UML-based notation for process modelling (Wigelius/Aula/Markova 2007). In particular the UML Sequence Diagram notation was adjusted (Wigelius/Aula/Markova 2007). Frequencies of essential actions are outlined and problems in the process are highlighted by attaching explaining notes to the diagram (Wigelius/Aula/Markova 2007). By applying MoBiSUML, the as-is status of processes for further analysis is modeled, based on information collected about the process (e.g., through interviews and field studies) (Wigelius/Aula/Markova 2007). The as-is process notation is analyzed, e.g., for tasks where information is produced that is required by others, repetitive or calculatory tasks, and existing problems (Wigelius/Aula/Markova 2007). Based on this process analysis, potential process enhancements are modeled into a to-be process model (Wigelius/Aula/Markova 2007). Finally, the modeled mobile service shall be studied in the field and enriched, e.g., based on observations regarding usability problems (Wigelius/Aula/Markova 2007).

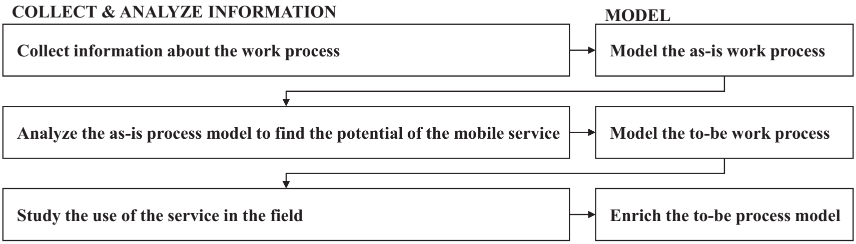


Figure 20: MoBiSUML framework
Source: Adapted from Wigelius, Aula, and Markova (2007, 8)

According to the evaluation criteria, the MoBiSUML framework can be regarded to cover the identification of suitable tasks for mobilization as required. Based on the UML Sequence Diagram notation, the outlined task characteristics (e.g., frequency), and the defined rules tasks can be selected for optimization through mobile IT (Wigelius/Aula/Markova 2007). The UML notation and the incorporated details on tasks partially support the definition of mobile enterprise service ideas, but there is no technique to define detailed service ideas. Insights on potential benefits of process mobilization can be extracted from the problems noted into the diagram and potentially by comparing the as-is and to-be process models. Benefits such as time savings could be derived. However, there is no technique provided to determine and illustrate the productivity-related value added of service ideas nor to quantify it. Quantification steps are further addressed in the conclusions of the article by Wigelius, Aula, and Markova (2007). It is mentioned that the framework "[…] can be used as the basis for calculating the financial potential of the mobile service by comparing the time and other resources needed in the as-is and to-be processes" (Wigelius/Aula/Markova 2007, 17).

Another framework that enables companies to identify suitable tasks for mobilization, in line with the defined evaluation criterion is the "*framework for mobile business applications*" presented by Chen and Nath (2004). This framework enables the rule-based identification of processes respectively tasks that would benefit from mobile IT support. Even if just two task characteristics are referred to, a technique can be derived that can be applied to identify tasks. In their framework (see Figure 21), Chen and Nath outline the characteristics user mobility and data / transaction time-sensitivity (Chen/Nath 2004). Through enabling task identification, the framework partially supports the definition of mobile enterprise service ideas. It does not provide a technique to define detailed service ideas, but it offers input for idea creation through the tasks selected for mobilization. As part of their framework, Chen and Nath additionally provide a matrix showing potential mobile application impacts (related to time, mobility, relationship, location leverage) and how they can lead to certain benefits (efficiency, effectiveness, innovation gains) (Chen/Nath 2004).

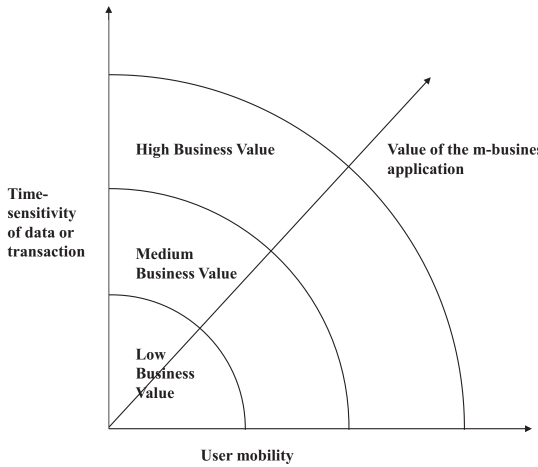


Figure 21: Framework for mobile business applications – task identification
Source: Chen and Nath (2004, 373)

In Figure 22, the multiple value dimensions and their relationship to concrete mobility impacts are depicted. Examples extracted from literature and real-world cases thereby illustrate the possible performance impacts (Chen/Nath 2004). The matrix partially supports the determination and illustration of value added, but does not provide a technique to link performance impacts to concrete service ideas nor to assess service ideas

(Chen/Nath 2004). It further shows some insights on potential mobile enterprise service ideas (Chen/Nath 2004).

Value			
Impact	*Efficiency*	*Effectiveness*	*Innovation*
Time	Reduce business process cycle time	Reduce information float	Enhance service quality
Mobility	Capture information electronically anytime-anywhere	Access critical information anytime-anywhere	React to problems and opportunities anytime-anywhere
Relationship	Enhance connectivity and communication	Increase collaboration	Increase information transparency to improve supply chain
Location Leverage	Track and surveillance	Alert and m-marketing campaigns	Localise

Figure 22: Framework for mobile business applications – value assessment
Source: Chen and Nath (2004, 374)

The framework presented by Vuolle (2011) enables the measurement of "*performance impacts of mobile business services*" (Vuolle 2011, 5) and partially supports value added assessments. Vuolle (2011) addresses the need for multidimensional measures for the performance assessment of mobile IT use. Employee-related, structural, relational, and monetary value dimensions are mentioned (Vuolle 2011). A subjective measurement technique is proposed to assess the value added of mobile IT use (Vuolle 2011). A questionnaire-based collection of employee feedback regarding the performance of mobile services offers an abstract level of value quantification, based on a Likert scale. According to the evaluation criteria set up at the beginning of this section, the major disadvantages of the framework derive from its focus on ex post application for performance assessment.

Schmidt-Eisenlohr (2010) developed a framework to evaluate the "*benefits of a mobile application system*". For this purpose, he constructed a criteria catalogue of potential benefits of mobile application system use, focusing on the multidimensional value for the user and the process (Schmidt-Eisenlohr 2010). Additionally, he evaluated and compared techniques for conducting value assessments based on this catalogue (Schmidt-Eisenlohr 2010). In the end, value added assessment is only partially supported, as there is no systematic assessment technique incorporated into the framework. It is neither shown systematically nor in detail which benefits can be created by which type of service idea. There is also no detailed value quantification enabled by the criteria catalogue, e.g., regarding productivity impacts. However, in general, abstract value quantification based on the criteria catalogue and a scoring technique is demonstrated and conducted but not integrated into the framework (Schmidt-Eisenlohr 2010).

The "*CBA (Cost / Benefit Analysis) Approach to Mobile IS*" is another framework with at least partial support for assessment and, in particular, quantification of mobile IT value (Kadyte 2004). It provides a stage model showing how companies can evaluate mobile IT investments based on a series of cost-benefit-analysis, during and after the mobile IS implementation (Kadyte 2004). Value is thereby supposed to be assessed by financial and intangible measures (Kadyte 2004). In her paper, Kadyte (2004) provides details on quantitative and qualitative value dimensions and on how to quantify value added. These details are to a certain extent specific to the paper industry and the complaint handling process, thereby limiting their generalizability (Kadyte 2004). The industry specifics of the shown details, the focus on ex post evaluation, and the missing technique to link the quantitative and qualitative value dimensions in a structured way to types of service ideas are limiting the frameworks adequateness to conduct value assessments, as asked by the evaluation criteria C-3 and C-4.

Segev (2003) presents a framework of "*e-Mobility value based on application classes*". This framework enables the value assessment of mobile application use through putting application classes in relation to expected process disruptions and the potential resulting benefits (Segev 2003). However, no technique but mainly high-level guidelines are provided to determine and illustrate value added. Thereby, a major limitation comes from the fact that the value impacts are only exemplary (with few details) but not comprehensively depicted. Therefore, this framework only provides partial assessment support (with no capabilities to quantify value added) and to a great extent relies on the expertise of the one applying it.

Finally, it has to be mentioned that none of the approaches analyzed considers and incorporates mobile consumer technology specifics (criterion C5). As outlined earlier and researched through the case studies presented in chapter 4, the consumerization trend pushes mobile consumer IT into corporations. Therefore and because of the variety of specific characteristics and benefits of mobile consumer IT (see sections 5.2.1 and 5.2.2), consideration of these specifics is important.

In August 2015, a third literature review ("LitRev 3") was conducted to search for new publications on frameworks with value assessment capabilities for the corporate mobile IT use (published in 2014 or 2015). The search strings and settings were applied as done in LitRev 2 (details are illustrated at the beginning of chapter 5), with some minor adjustments. Additionally, five databases were screened with selected search strings of LitRev 1, with some minor adjustments and a new search string focused on value added / business value of mobile IT. A focus was set on the AIS eLibrary, Science Direct, ACM Digital Library, IEEE Xplore Digital Library, and EBSCOhost databases because in LitRev 1 and LitRev 2 most papers were selected from these sources. Details on the strings are not illustrated in the following. Search results were title-screened. If thereby publications turned out to possibly be relevant, existing abstracts and, if required, the full texts were screened for relevance. Four papers were extracted from the conducted searches and analyzed in detail. In the end, no additional framework found in LitRev 3 was rated to be relevant for the evaluation of frameworks conducted in this thesis.

Apart from the frameworks listed in Table 7, several others were initially analyzed for their coverage of assessment capabilities, but excluded from the final evaluation. Those frameworks were excluded because they were finally rated to, e.g., not possess assessment capabilities (according to C-3 and / or C-4), not provide a procedure model, or suffer from a lack of generalizability (mainly because of their specific focus on industries and / or selected processes and tasks).

Task-technology fit (TTF) frameworks were identified to be intensively discussed in the body of literature (see, e.g., Goodhue/Thompson 1995, for general TTF characteristics). They examine the ideal fit between mobile technology and task characteristics for a positive usefulness respectively performance impact (Gebauer/Shaw/Gribbins 2004; Yuan et al. 2010; Zhang et al. 2011). By formulating theoretical constructs into a research model and evaluation of these constructs in research studies, authors have examined which tasks are best suited for the deployment of mobile IT (Gebauer/Shaw/Gribbins 2004; Yuan et al. 2010; Zhang et al. 2011). The TTF concept as well as the insights gathered in these studies can be exploited to identify tasks for mobilization. TTF frameworks were excluded from the comparison and are not listed in Table 7 because they do not provide a procedure model and do not directly support value assessment.

There is also recent in-depth research on the effects of the corporate mobile IT use in publications such as Picoto, Bélanger, and Palma-dos-Reis (2014), Falk and Leist (2014), or Fischer and Smolnik (2014). In these articles, benefits resulting from mobile device use and impacts on, e.g., productivity are discussed and illustrated. However, a procedure model to be applied is not depicted. For this reason, they were not included in the conducted evaluation presented in this section. Nevertheless, the benefits listed and explored could be used and incorporated into techniques for the assessment of value added.

Note: Ratings of the frameworks are to a certain extent subjective, even if the objectiveness is increased by means of applying detailed and structured evaluation criteria. Although extensive literature reviews were carried out as part of this thesis (described at the beginning of chapters 3 and 5), there might be additional publications with more details on the presented frameworks or articles on further frameworks. A further challenge of analyzing and comparing the frameworks is how to consider examples and case studies presented in the articles and to decide whether these could be regarded to be part of the frameworks. Moreover, not all frameworks explicitly exclude consumer applications and services and rather have a complete focus on mobile business services used by employees or customers.

5.3 Research Gaps on Business Value of Mobile IT

There have been frameworks identified (see section 5.2.5) which provide capabilities to support all functional evaluation criteria (C-1 to C-4) to a certain extent (Mobility-M, Mobile Process Landscaping, MoBiSUML, and the framework which focuses on mobile eligibility of business processes). For all these frameworks it can be constituted that only the identification of tasks which benefit from mobilization (C-1) is fully supported with a detailed procedure (technique). The determination & illustration (C-3) and quantification of the value added of the corporate mobile IT use (C-4) is not supported with an assessment technique. These frameworks suffer from missing details on how to assess the value added for specific service ideas. Nor do these frameworks offer techniques to define detailed service ideas for tasks identified to benefit from mobile IT use.

There are also frameworks which purely focus on the value assessment steps (C-3 and C-4), like those presented by Vuolle (2011), Schmidt-Eisenlohr (2010), or Kadyte (2004). For instance Schmidt-Eisenlohr (2010) presents a criteria catalogue of benefits of mobile IT app use and Kadyte (2004) provides details on quantitative and qualitative value dimensions focused on the complaint handling process in the paper industry. They provide more details which are helpful for assessing value added of corporate mobile IT use. Nevertheless, they suffer from the same drawbacks as the frameworks discussed above: they do not offer detailed techniques showing how to operationalize and carry out thorough value added assessments considering costs and productivity-related benefits of the mobile IT use.

Summarizing the results of the evaluation of existing frameworks, the following drawbacks have been identified across all compared approaches. These drawbacks depict existing research gaps of business value of mobile IT use:

1. *No technique for determination and illustration* of productivity-related value added of mobile enterprise service ideas ex ante.

2. *No technique for quantifying* productivity-related value added of mobile enterprise service ideas ex ante.

3. *No technique to define* detailed mobile enterprise service ideas for tasks identified to benefit from mobile IT support.

4. *No consideration of mobile consumer IT specifics*.

These research gaps identified in specific for mobile IT are in line with the research gaps found by Schryen (2013) for business value of IT. Schryen (2013, 146) concludes that "[…] the recent literature paints a positive picture of IS-based productivity gains overall, at least at firm level and national level." Nevertheless, he points out "[…] that IS researchers have not fully managed to identify and explain the economic relevance of IS" (Schryen 2013, 147). In particular inconclusive and conflicting findings in IS business value research, e.g., on the relation between IS investments and productivity, are outlined (Schryen 2013). He summarizes the identified business value of IT research gaps in several potential research questions:

1) "*How can we yield a comprehensive, consistent and precise understanding of the multifaceted construct 'IS business value'?*" (Schryen 2013, 151)

2) "*How can the assessment of (internal and competitive) business value account for the context of evaluation, and in particular the firm, industry and country environment and the preferences of evaluators?*" (Schryen 2013, 152)

3) "*How can total IS investments be disaggregated conceptually and empirically such that the impact of different types of investments on the economic performance of a firm can be determined?*" (Schryen 2013, 153-154)

4) "*How can the disaggregation of total IS investments account for synergies and complementarities of IS assets?*" (Schryen 2013, 154)

5) "*How, why and when do IS assets, IS capabilities and socio-organisational capabilities affect each other and jointly create internal value?*" (Schryen 2013, 156)

6) "*How, why and when do IS assets, IS capabilities and socio-organisational capabilities jointly create competitive value, thus performing a value creation process?*" (Schryen 2013, 157)

The identified research gaps on business value of mobile IT address topics that in the broader scope of IS research are also discussed by Schryen (2013) in the above listed questions 2), 5), and 6) on IS business value creation and assessment.

The specific characteristics (e.g., ubiquitous connectivity, device portability) and benefits of mobile IT use (e.g., location-independence, real-time support) compared to stationary IT use (e.g., on personal computers) require to address the identified research gaps with a dedicated method considering these specifics. In sections 5.2.1 and 5.2.2, these specifics are listed as derived from an in-depth literature analysis. As illustrated in these sections, there are consumer IT specifics among the identified characteristics (e.g., plethora of apps, intuitive use) and benefits (e.g., user experience, innovation potential, ease of learning technology use) that have to be incorporated into the method, to adhere to the research focus set in RQ 2 (see section 1.3).

The need for a mobile IT specific method for productivity-related value added assessment is emphasized by recent publications. For instance, Picoto, Bélanger, and Palma-dos-Reis (2014), Falk and Leist (2014), and Fischer and Smolnik (2014) present in-depth research on benefits resulting from mobile device use and impacts on, e.g., productivity. They do not present procedure models and techniques showing how to conduct assessments. Their work and the performance impacts researched constitute a starting point and provide input which can be leveraged for building a respective method.

6 Assessment of Value Added of Corporate IT Service Use on Mobile Consumer Devices

In this chapter, research question 2 and its sub-questions are addressed:

"*How can the corporate introduction of value-adding IT services for mobile consumer devices be enabled by a method supporting IT departments to assess the value added of the service use ex ante?*"

First, in section 6.1 a summary of the most relevant related work is given, followed by a detailed description of how the ADR methodology has been applied to answer research question 2, in section 6.2. The artifact (IDA method) constituting the result of the ADR activities to answer research question 2 and the BIE cycles to design it are in detail shown in section 6.3. For each BIE phase (consisting of several cycles), the design requirements are illustrated and details on the method and its construction and evaluation presented. Finally, the results are discussed, a conclusion drawn and limitations depicted (sections 6.4 and 6.5).

6.1 Summary of Related Work Relevant for Research Question 2

Business value of IT can be defined as the economic consequences resulting from IS investments (Schryen 2013). This definition focuses on the value added of IT provided to enterprises. Business value of IT – as regarded in this doctoral thesis – not only comprises the positive impacts (benefits) of IS respectively IT use, but also its relation to the negative impacts (e.g., costs) coming with it for companies (Kadyte 2004; Walter/Spitta 2004). The ex ante assessment of the value of IT is challenging as it has to include quantitative and qualitative impacts (Walter/Spitta 2004). Existing approaches for ex ante value IT assessments approaches mainly have limitations to consider qualitative effects and indirect effects (Walter/Spitta 2004). In particular those focused on financial evaluations struggle to measure the qualitative aspects (Löfgren 2006). Process performance can be regarded to be a mediator for the IS impact on firm performance (Schryen 2013). Additionally, in the literature it is stated that the process view is needed to identify value-adding IT mechanisms and to enable value measurement (Mooney/Gurbaxani/Kraemer 1995). Particularly, *productivity* is a widely discussed performance measure for corporate processes (Schryen 2013). Traditionally, productivity is measured through efficiency gains by assuming a constant output quality (Grönroos/Ojasalo 2004). This traditional concept is problematic for measuring the productivity of service processes because it does not account for quality changes, as it might be in service processes (McLaughlin/Coffey 1990; Grönroos/Ojasalo 2004). Therefore, productivity of service processes in specific has to be assessed by focusing on efficiency (quantitative) and effectiveness (qualitative) impacts (Grönroos/Ojasalo 2004). Thereby, a technique to support the assessment of hardly quantifiable benefits is the subjective productivity measurement approach (Torkzadeh/Doll 1999; Lynch/Riedel 2001; Kemppilä/Lönnqvist 2003; Vuolle et al. 2008).

Focusing on mobile IT, several specific characteristics and resulting benefits have been identified in the literature, which have to be considered when assessing its value added to corporations. These characteristics are supposed to mainly have a positive or negative impact for enterprise use. Several of these characteristics found in the related body of literature have been rated to be specific for mobile consumer IT. A detailed overview on the mobile IT characteristics is presented in section 5.2.1. The mobile IT characteristics are further supposed to enable enhanced support for specific corporate tasks. A plethora of potential *benefits and process performance impacts of mobile (consumer) IT* use, enable these task improvements. This set of tasks as well as the mentioned benefits and the resulting performance impacts are shown in section 5.2.2. The performance impacts on corporate processes through mobile technology use can be divided into efficiency and effectiveness effects (Basole 2004; Barnes/Scornavacca/Innes 2006). Employee satisfaction can be regarded to be a third dimension of performance impact (Harter/Schmidt/Keyes 2003; Basole 2004; Sheng/Nah/Siau 2005; Hess/Jung 2012; Pousttchi/Becker 2012), indirectly affecting process productivity through efficiency or effectiveness impacts. Employee satisfaction increase can be expected to have specific relation to the corporate use of consumer IT (Niehaves/Köffer/Ortbach 2012; Junglas/Harris 2013). Efficiency impacts can further be sub-divided into effects resulting from reduction of task idle time, task execution time, or task input costs (to a certain extent supported by Segev 2003; Gruhn/Köhler 2007; Botzenhardt/Pousttchi 2008; Falk/Leist 2014).

The investment (CAPEX) and running (OPEX) *costs resulting from mobile enterprise service use* along the service lifecycle can be measure based on the TCO framework (Wiggers/Kok/de Boer-de Wit 2004b; Pousttchi/Becker 2012). The model presented by Kohlborn, Korthaus, and Rosemann (2009) can be taken as a baseline to capture the full service lifecycle. Examples of typical costs of the corporate mobile IT use are listed in section 5.2.3. In total, for the adoption and use of mobile IT in enterprises there are several potential obstacles that have to be addressed. These obstacles can come from technology-, employee-, organizational-, or environmental-related factors (see, e.g., Basole 2005a; Basole 2007b; Chen/Nath 2008). Details on potential obstacles are discussed in section 5.2.4.

Finally, *frameworks* found in the body of literature with potential support for assessment of productivity-related value added, in the service analysis stage of the mobile enterprise service use, have been analyzed and compared. For this purpose, a set of criteria was derived from the identified problem statement (see section 1.2) and applied. Thereby, neither any framework could be identified offering techniques for the assessment (determination, illustration, and quantification) of the value added of mobile enterprise service use, nor any framework holistically considering mobile consumer IT specifics.

The discovered limitations of the evaluated approaches depict existing research gaps on business value of mobile IT. Details on the conducted analysis, the detailed evaluation criteria, specific framework limitations, and all identified research gaps can be found in section 5.2.5.

6.2 Details of Applied ADR Methodology

A method has been constructed in this thesis to enable the corporate introduction of value-adding IT services for mobile consumer devices. The constructed IDA method, according to Kohlborn, Korthaus, and Rosemann's (2009) service lifecycle model, focuses on the support of the "*service analysis*" stage (see Figure 23).

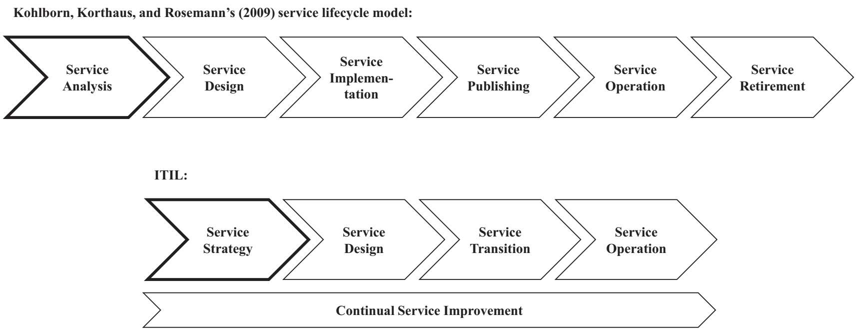


Figure 23: Service lifecycle classification of IDA method scope
Source: Own illustration

Taking ITIL (IT Infrastructure Library), a framework widely applied in practice, as the baseline, the IDA method supports the service lifecycle phase "*service strategy*" (see

Figure 23). In ITIL (Kresse/Bause 2012) as well as in Kohlborn, Korthaus, and Rosemann's (2009) model the outcome of the initial lifecycle phase (service analysis respectively service strategy) are IT service ideas to be provided.

As stated in Hevner et al. (2004, 79): "Methods define processes. They provide guidance on how to solve problems, that is, how to search the solution space." In Braun et al. (2005, 1296), by referring to Lorenz (1995), a method is defined through "[…] a process which is planned and systematic in terms of its means and purpose, and which leads to technical skill in resolving theoretical and practical tasks." Both definitions focus on processes provided by a method for the purpose of solving problems. The IDA method constructed in this doctoral thesis at its core has a procedure model that supports IT departments to address problems related to value creation & assessment, collaboration between IT and business departments, and required quickness of IT service introduction. In sections 6.3.1.1 and 6.3.2.1, these problems and how they guided the method design are described in detail. Braun et al. list different attributes of a method, extracted from literature:

- *Goal orientation:* "Methods are goal-oriented. They stipulate rules on how to proceed or act in order to achieve defined goals or solve problems." (Braun et al. 2005, 1296)

- *Systematic approach:* "If methods are to deliver rules on how to act and instructions on how to solve problems or achieve goals, then they must possess a systematic structure in order to enable the deduction of concrete work steps or tasks for achieving goals." (Braun et al. 2005, 1296)

- *Principles:* "Many method specifications are closely related to design principles, i.e. general construction guidelines and/or strategies." (Braun et al. 2005, 1296-1297)

- *Repeatability:* "In the literature, some authors call for methods to be intersubjectively repeatable." (Braun et al. 2005, 1297)

As mentioned in Braun et al. (2005), elements of a method are described by Gutzwiller (1994). Gutzwiller (1994) names the following elements to constitute a method:

- *Activity / procedure model:* “Activities are construction tasks which create certain results, i.e. which create certain specification documents. A procedure model is created by virtue of the fact that activities are performed in a specific order.” (Braun et al. 2005, 1297)

- *Role:* “Activities are performed by roles (e.g. people, job descriptions or organization units).” (Braun et al. 2005, 1297)

- *Specification document:* “Results are recorded in previously defined and structured specification documents.” (Braun et al. 2005, 1297)

- *Technique:* “Techniques are understood to mean detailed instructions for the development of a certain type of specification documents.”(Braun et al. 2005, 1297)

- *Tool:* “Tools can be used to support the application of one or more techniques.” (Braun et al. 2005, 1297)

- *Meta model:* “The meta model specifies the conceptual data model of the results, thereby guaranteeing the consistency of the entire method.” (Braun et al. 2005, 1297)

A procedure model and techniques constitute the core of the designed IDA method. The procedure model has two layers on which processes and process steps are defined. As part of the model, necessary roles have been defined to conduct these process steps. Techniques, as part of a method, provide details and procedures on how to perform major process steps (Brinkkemper 1996). The constructed techniques provide detailed procedures to enable IT departments to identify tasks, define service ideas, and assess value added of mobile enterprise service use on consumer devices, during the service analysis stage. The IDA method has several techniques and a tool to support the application of these techniques. The results of the application of the method and its techniques can be documented in a predefined template. A specific meta model to provide a conceptual data model was not developed within the method design.

The method constructed has been designed according to the *action design research* process depicted in Sein et al. (2011) – described in section 2.2.3. A graphical overview of the applied research methodology is provided in Figure 7 in section 2.3. The first part, namely the problem formulation, was carried out iteratively in several steps. Design goals guiding *phase I* (BIE cycles 1 and 2), in which the IDA method prototype was constructed and evaluated, were derived from a single (pilot) case study on the effects of mobile consumer device use on corporate information management (see chapter 4). Thereby, challenges were extracted from expert interviews and documents analysis. A sub set of these challenges guided the prototype design at a selected business company. The first and second BIE cycle were jointly executed together with a large multinational corporation. The initial action research project team consisted of employees covering functional areas such as IT strategy, IT architecture, and IT processes. The team was complemented by an external IT consultant specialized on mobile enterprise topics. Requirements derived from the challenges extracted from the single (pilot) case study were refined and extended together with the project team. The motivation of the partner company participating in the action research project and the research focus both aimed to construct an artifact to support the introduction of mobile enterprise services for consumer devices. The overlapping design goals – discussed in section 6.3.1.1 – thereby allowed the application of an action research-based approach.

In the *first BIE cycle*, the artifact was iteratively developed and evaluated throughout five workshops jointly held with the project team, supported by separate working sessions with selected team members, expert interviews, and literature analysis. According to Davison, Martinsons, and Kock (2004), action research may start theory-free but it is mentioned that theory is required to guide researchers. In the action research project, throughout the workshops, a procedure model and tool-supported techniques were built and evaluated. Thereby, ITIL (Office of Government Commerce 2007; Kresse/Bause 2012), an IT service management framework, was used as a baseline to guide the development of the model.

The method prototype was finally evaluated in the *second BIE cycle*, by applying it at the AR partner in a field study with a selected sales department. The method was applied through an IT department's employee that not participated in the prototype construction, supported by members of the initial project team. After method application, client managers and internal IT experts that participated in the field study were asked to give feedback on the helpfulness (how design goals are met), understandability (comprehensiveness of method description), and applicability of the method prototype. The gathered feedback and observations made throughout the field study gave input for the redesign of the method prototype and its design goals.

In *phase II* (BIE cycles 3 to 5) of the ADR process, the prototype has been reworked and the final IDA method designed. The *third BIE cycle* was motivated by the evaluation insights collected in BIE cycle 2. Findings of additional, multiple case studies on the effect of mobile consumer device use on IT departments (see section 4.3) and findings extracted from a literature review on business value of (mobile) IT (see sections 5.1 and 5.2) enriched the evaluation insights to rework the design goals (problem formulation) and the method. In the third BIE cycle, selected concepts and approaches taken from theory were leveraged to refine the IDA method. In this BIE cycle, the AR partner was not involved into the method construction. Before applying the method for a second time in BIE cycle 4, the method was evaluated by expert interviews based on a method walk-through in BIE cycle 3. The method walk-through was done with one expert having academic background and three experts with IT consulting expertise. After each session, feedback was – as possible and feasible in the available time frame – incorporated into the method design, presented to the next expert. After the four expert interviews were conducted, the feedback and observations noted were analyzed and, if feasible, used to update the IDA method and to refine the design goals (problem formulation). Only some selected topics that were identified in the expert interviews were kept open to be evaluated in the second field study.

In the *fourth BIE cycle*, the IDA method was for a second time applied at the AR partner and the same sales department in a field study (like in the first BIE cycle). In comparison to the first field study, this time the method was applied by the author of this doctoral thesis. After the field study, the results of its application were presented to three internal IT experts of the AR partner that already participated in the first field study (prototype application and evaluation). According to the same set of evaluation criteria (presented in section 6.3.2.3), feedback, improvement ideas, and observations were gathered through interviews from these experts, after a method walk-through and presentation of the results of the second field study.

Finally, in the *fifth BIE cycle*, last insights gathered form selected literature sources and the insights from the field study evaluation at the action research partner have been used to adjust and finalize the IDA method. Insights gathered throughout the ADR process have been used to refine the design goals (problem formulation). The author of this doctoral thesis has evaluated the final design through feature-based evaluation regarding attributes and elements (features) a method should possess (Fettke/Loos 2003).

In parallel to the iteratively conducted problem formulation and BIE cycles, reflection on the design and extraction of learnings from the artifact evaluation have been continuously carried out (reflection and learning). The learnings have been leveraged to design an IDA method not only helpful for the business company the action research was conducted with but also for companies across industries. Therefore, the learnings have been used to create a method design that constitutes a general solution concept for the problems addressed through the design goals (formalization of learning).

The *quality of the action design research* conducted in this doctoral thesis to address research question 2 (and its sub-questions) in terms of the rigor of the research process can be assessed by evaluating it against the seven principles defined by Sein et al. (2011):

Problem formulation: Sein et al.'s (2011) principle 1 ("practice-inspired research") and principle 2 ("theory-ingrained artifact") ask to ground the problem formulation in practice and / or theory. The design goals guiding the IDA method design across several cycles were iteratively derived from and refined through practical and theoretical sources. Input from practice came from multiple case studies conducted on mobile consumer device use, requirements the project team compiled in the initial action research project, and insights gathered from method application and expert interviews. Theoretical input came from the research gaps found for business value of mobile IT.

Building, intervention, and evaluation – BIE: The mutual influence between the artifact and the organizational context, as demanded by Sein et al.'s (2011) principle 3 ("reciprocal shaping"), was adhered to in the ADR activities through tightly involving a business company into selected BIE activities. Principle 4 ("mutually influential roles"), asking for mutual learning among researchers and practitioners, was considered through tight collaboration throughout these BIE activities and the exchange of selected artifact construction and evaluation documentation and tools (Sein et al. 2011). Thirdly, principle 5 ("authentic and concurrent evaluation") was inherently considered by the iterative nature of research carried out in several BIE cycles with interwoven build and evaluation activities (Sein et al. 2011).

Reflection and learning: The iterative nature of the BIE cycles carried out as well contributed to Sein et al.'s (2011) principle 6 ("guided emergence"), asking for an ongoing shaping of the artifact through organizational use, participants, perspectives, and evaluation insights. Possible redesign tasks for the method or even its design goals were continuously gathered and, if possible and feasible, incorporated. Lists with redesign tasks were maintained across the BIE cycles. For each possible redesign task, details were listed on how it was considered (or why not) and what purpose the redesign task was supposed to address.

Formalization of learning: Principle 7 ("generalized outcomes") puts up the final goal of creating general solution concepts that not only can be effectively applied at the business company participating in the ADR activities (Sein et al. 2011). In phase I, a prototype was built that was even then supposed to be generally applicable to business companies. Nevertheless, this prototype possessed some specifics of the AR partner, e.g., on naming conventions of the roles, TCO benchmarks compiled, the procedure model documentation, or integration into existing IT service management processes within the company. In phase II, when the method prototype has been reworked, it has been the goal to eliminate AR partner specifics and to build a method that can generally be applied and is documented company neutrally.

6.3 Results of Method Construction and Evaluation

In two phases and in total five cycles, a method which enables the corporate introduction of value-adding IT services for mobile consumer devices has been constructed. The method enables the service introduction not only through capabilities to define concrete value-adding service ideas for tasks identified to benefit from mobilization but mainly through capabilities to determine, illustrate, and quantify the value added of the service use. Thereby, mobile enterprise services with a high value added can be selected and then implemented. The method has been built and evaluated in an action research setting based on design principles. As the final method focuses on supporting the identification, definition, and assessment steps, the method has finally been named "*IDA method*". The two BIE phases are presented in the following by giving an overview of the respective design requirements and the conducted BIE steps, carried out to iteratively construct the method. Thereby, the focus is put on the final version (referred to as "final IDA method" or just "IDA method"). The method prototype is described in a compressed format.

6.3.1 Phase I: IDA Method Prototype

As depicted in the next section, this initial version of the IDA method not only focuses on supporting the assessment of value added. Its design had a wider focus and acted as the baseline and starting point for the iterative construction of the final IDA method. Its construction, application, and evaluation were important sources for the formulation of the final design goals and key pillars of the final IDA method. Therefore, this method version can be regarded to have prototype character for the method design.

6.3.1.1 Design Requirements for IDA Method Prototype

The initial set of design goals that guided the design of the IDA method prototype was on the one hand derived from the initial results of the *pilot case study* (PCS) on mobile consumer device use, gathered in the first round of the pilot case study analysis. This case study was in a second round extended by additional expert interviews and analysis of documents and constitutes one of the four cases analyzed to answer research question 1 (in chapter 4). In this single (pilot) case study, challenges created through the use of mobile consumer devices for corporate IT departments were analyzed. The most complex challenges were identified for the introduction of mobile enterprise services. The identified issues in the first round of analysis with supposedly direct impact on mobile enterprise service introductions were multi-layered. Based on these identified issues, the following challenges were formulated as input to build the initial set of design goals:

- Missing enterprise-grade licensing models for corporate app use on mobile consumer devices (PCS-1)
- Weak IT governance on mobile application deployment (PCS-2)
- Complex application development for heterogeneous mobile devices (PCS-3)
- Frequent mobile consumer device OS updates (PCS-4)
- Tedious corporate IT service introduction processes (PCS-5)
- Difficult assessment of benefits, such as image gains or productivity increase, of mobile consumer device and therefore mobile app use (PCS-6)

Details on the challenges extracted from the single (pilot) case study on mobile consumer device use in a business company can be found in Weiß and Leimeister (2013a). The design goals for the construction of the method prototype were complemented by the following specific *action research project requirements* (ARPR), the project team put up in the action research project (to build the prototype):

- Increasing productivity or reducing costs through mobile enterprise services (ARPR-1)
- Positioning the IT as a value-adding service partner for business units and taking over the role of innovation driver (ARPR-2)
- Standardization of the technical architecture and introduction process of mobile enterprise services (ARPR-3)
- Considering different classifications of transmitted and processed data while developing the framework (ARPR-4)

The consolidated set of design goals for the IDA method prototype derived from the project requirements of the AR partner and the challenges for introduction of mobile enterprise services identified through the pilot case study is listed below:

1. *Governance:* Increase of IT governance on mobile service introduction in a consumer technology driven ecosystem (derived from pilot case study & action research project requirements: PCS-2, ARPR-2).
2. *Flexibility:* Handling the high change rate of the mobile consumer device ecosystem (derived from pilot case study: PCS-4).
3. *Standardization:* Reduction of complexity through the use of standard design and process concepts (derived from pilot case study & action research project requirements: PCS-3, ARPR-3).
4. *Efficiency:* Enabling a time- and cost-efficient introduction of mobile enterprise services (derived from pilot case study & action research project requirements: PCS-5, ARPR-1).
5. *Effectiveness:* Identifying and designing secure and value-adding (meaning higher productivity (lower TCO, higher sales) or higher service quality) mobile enterprise services (derived from pilot case study & action research project requirements: PCS-6, ARPR-1, ARPR-2, ARPR-4).

The challenge concerning the missing enterprise-grade licensing models (PCS-1) extracted from the pilot case study was not considered for the initial set of design goals as it was believed that it could be hardly solved through the to be developed method. Both, the research focus and the goals motivating the AR partner to participate in this action research project, aimed to support the introduction of IT services for mobile consumer devices such as iOS or Android-based smartphones or tablets. Thereby, legacy enterprise devices such as the BlackBerry were not explicitly excluded, but the main interest was deploying mobile devices mainly focused on the consumer market.

6.3.1.2 IDA Method Prototype Details

After defining the design goals for the method construction, within the action research setting, an *architecture model of a mobile enterprise service* was defined. The service architecture was derived from the hourglass model for IT service structures (depicted in Wiggers/Kok/de Boer-de Wit 2004a, 39) to enable a comprehensive service description and to guide the method construction process (see Figure 24).

Business Knowledge-Based IT Service Components	**Additional Service Components**
	Mobile Application Maintenance
Support Components	**Mobile Technology Operations**
Product Components	**Mobile Technology Stack**
	Mobile Application Component
	Infrastructure Components

Figure 24: Mobile enterprise service architecture defined in BIE cycle 1
Source: Own illustration (derived from Wiggers/Kok/de Boer-de Wit 2004a, 39)

Product components, depicted here as the mobile technology stack, comprise infrastructure components and the mobile application component. Infrastructure components such as the mobile device management system[33], mobile devices (incl. OS), network access components and middleware & backend systems support the provision of a mobile application based service. To operate the components of the mobile technology stack, support components (including a 1st level user support) complement a mobile enterprise service. Moreover, business knowledge-based IT service components are required to provide mobile application maintenance as well as additional service components like end-user training.

[33] A mobile device management service is an enabling infrastructure service for other services deployed on mobile devices but also depicts a mobile enterprise service on its own, providing corporate data such as PIM data onto the device.

After defining the service architecture, the major processes of the procedure model were formulated (see Figure 25). The introduction of IT services for mobile consumer devices was thereby designed to start with a "*use case screening*" process. Second, the "*service assessment*" has to be carried out for the selected use cases. Finally, in the "*service implementation*", selected services are implemented and added to the company's IT service portfolio based on the conducted assessment. The three-phase procedure / process model was developed in alignment with the service strategy, service design, and service transition processes of the ITIL v3 framework (Office of Government Commerce 2007). The ITIL process framework thereby acted as a benchmark for defining these three mobile service introduction phases. Finally, the procedure model was extended by a so-called *continuous improvement process* (CIP). Based on company-internal triggers (e.g., changes of operational structure, feedback from conducted service introductions) or external triggers (e.g., availability of new mobile OS release with new features), changes to the procedure model, role assignments, techniques, or tools are initiated. In particular, due to the high change rate in the mobile consumer ecosystem, regularly screening for these triggers and, if necessary, adjusting method components and possibly iterate back in ongoing service introduction projects to an earlier process stage, was considered to be a necessity.

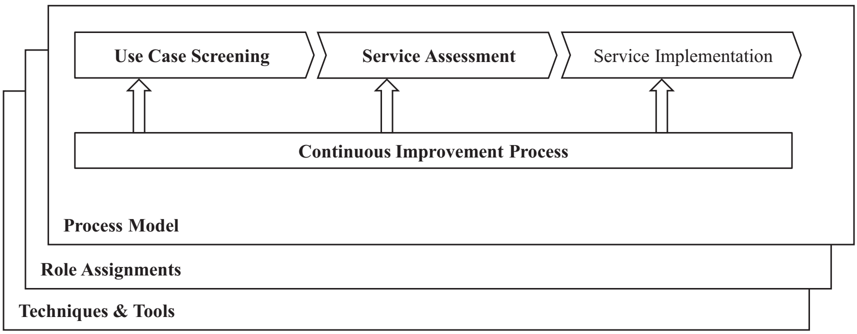


Figure 25: Overview of IDA method prototype
Source: Own illustration

For use case screening, service assessment, and the continuous improvement process detailed process steps, along with corresponding role assignments and techniques with tool-support, were defined within the action research project. A major finding of the project was that the service implementation must be done according to the predefined company process (and its variations) for implementing IT services. The respective corporate process steps were not adjusted within the project. Moreover, the outputs of the service assessment process were designed to fit into the structure and input requirements of the company's service implementation process. This did not apply for the use case screening, service assessment, and continuous improvement processes. There were no or at least only abstract specifications for these processes.

As shown in the following, the method prototype has to be applied by an "*IT project manager*" (PM) together with the "*mobile enterprise expert*" (MEE) with the goal of defining a service roadmap for a selected "*business department*" (BD). The MEE is a role with in-depth knowledge on mobile (consumer) technology. Within the company participating in the action research project the MEE role has not yet been implemented as a separate function.

Process steps are illustrated in the following based on the key aspects of the *business process modeling notation* (see, e.g., White 2004; Allweyer 2010). It has to be noted that the business process modelling notation has been applied in a simplified approach (e.g., without the use of lanes) with the main purpose to provide a structure to illustrate the different process steps of the IDA method prototype. Role assignments to the process steps are depicted in RACI matrix notation (see, e.g., Jacka/Keller 2009). In the *RACI matrix notation* "R" shows who is responsible for a certain task, "A" who is accountable, "C" who must be consulted, and "I" who has to be informed (Jacka/Keller 2009). It has to be noted that in the prototype the "C" is used to show who can be consulted and not that this person has to be consulted to be able to move on. Process step names are abbreviated in the RACI matrix if space restrictions forced so.

Use case screening

In Figure 26 and Table 8, the use case screening steps and the corresponding role assignments are shown. The process starts with the PM contacting the BD to trigger the collection of required information for the department's processes (e.g., sales).

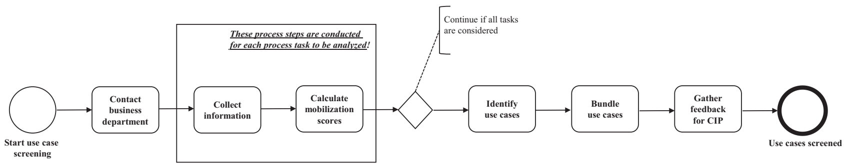


Figure 26: Process steps of use case screening process (prototype)
Source: Own illustration

Information is thereby collected for the activities of the processes (referred to as "tasks" in the following). So-called *mobilization scores* are then calculated for these tasks based on the information collected. The mobilization scores depict an abstract way to quantify the potential value added resulting from supporting a task within a corporate process with mobile IT. Next, after all information has been collected and all scores calculated, only for the tasks with highest potential to create a value added, use cases are identified and, if possible, bundled.

For detailed guidance on how to conduct a structured use case screening based on the calculation of mobilization scores, a technique was developed (referred to as "*use case screening technique*" in this thesis). The application of the technique is to a certain extent supported by a Microsoft Excel-based tool, called "*use case screening tool*" (UCST). The technique comprises details for the major steps of the use case screening: collect information, calculate mobilization scores, identify use cases, and bundle use cases. First of all, the use case screening technique provides guidance on which information has to be collected for the tasks to be analyzed, based on a predefined questions incorporated into the UCST. Secondly, the technique – supported by the tool – defines how to calculate the mobilization scores for the analyzed tasks, based on the collected information. In total a maximum score of 13 (on a scale starting with 0) can be reached, calculated across a set of task characteristics (depicted below). Thirdly, the technique specifies how to select tasks to be further screened for mobile enterprise use cases and how to build use cases for, based on the calculated scores. Thereby, based on the characteristics that created the scores and a list of predefined questions (e.g., asking for problems, challenges and optimization potentials), use cases are supposed to be identified. Finally, guidance is provided on how to select use cases for bundling, based on their functional scope and possible go live dates.

The mobilization scores are calculated in the use case screening technique and tool across eight selected task characteristics and predefined related questions. Task characteristics considered therefore are:

- *Workforce mobility profile* (primary factor): Do the involved employees spend more than two hours of working time away from their permanent or temporary office desk (e.g., employees have multiple meetings per week or travel multiple times per month)? (no = 0, yes = 1, yes – high = 2)

- *Media breaks* (driver): Are there any media breaks within the task (e.g., employees transfer data noted on paper into digital media or audio data into a database system)? (no = 0, yes= 1, yes – high = 2)

- *Degree of collaboration* (driver): Do the involved employees collaborate with other employees on a weekly basis (e.g., employees jointly modify or update files)? (no = 0, yes = 1, yes – high = 2)

- *Flexibility requirements* (driver): Can weekly tasks change unforeseen for the involved employees (e.g., employees' operations schedules changes frequently or the nature of task to be conducted)? (no = 0, yes = 1, yes – high = 2)

- *Information needs* (driver): Do involved employees require specific up-to-date information to conduct their work (e.g., employees need the current monitoring data or the latest business data)? (no = 0, yes = 1, yes – high = 2)

- *Lead time* (multiplicator): How long is the average task lead time? (no = 0, yes = 1)

- *Number of employees* (multiplicator): How many employees are conducting the task? (no = 0, yes = 1)

- *Repetition rate* (multiplicator): How often is the task repeated per week? (no = 0, yes = 1)

Throughout the main part of the use case screening process, as depicted in Table 8, the PM is responsible to apply the method.

Roles / Steps	**Contact BD**	**Collect information**	**Calculate scores**	**Identify use cases**	**Bundle use cases**	**Gather feedback**
MEE		C	C	C	C	R, A
PM	R, A	R	R	R	R	
BD		A	A	A	A	

Table 8: Role assignments of use case screening process (prototype)
Source: Own illustration

The BD is accountable for providing the needed information, calculation of the scores, and to identify and bundle use cases. Thereby, the MEE is consulted if mobile technology expertise is required by the PM or the BD. Finally, the MEE is responsible and accountable for gathering any feedback for the CIP on possible improvements or necessary adjustments, e.g., to the process steps, role assignments, or the associated use case screening technique and tool.

Service assessment

During the service assessment process, the use cases identified are transformed into holistic service ideas (see Figure 27 for the process steps and Table 9 for the role assignments). Each single or bundled use case, which is finally being formulated in the use case screening, depicts the core of one mobile enterprise service idea and needs to be assessed. Therefore in a first process step, in the Excel-based "*service assessment tool*" (SAT) detailed requirements are to be collected for each mobile enterprise service idea. The gathered data is mainly needed to propose an ideal service architecture for the use cases respectively service ideas and to calculate TCO for it. The service architecture is generated in the SAT based on the collected data. The architecture proposals compiled by the tool have to be manually checked for feasibility and adjusted, if required (in the verification step).

After the service architectures have been generated and verified, the company-internal IT service catalogue (including offerings of existing suppliers) is checked for mobile enterprise services that could support the service ideas with their proposed architectures. For service ideas for which no existing service can be identified in the catalogue, apps respectively services are searched for externally on the mobile enterprise market. If an app or service is found, the SAT has to be adjusted for. The SAT has predefined cost benchmarks for the different architecture components included, to automate the calculation of TCO (as far as feasible). In case existing apps or services are identified, these benchmarks have to be updated respectively with the actual cost figures for the cost calculation of the respective service ideas. In a next step, TCO calculations are generated in the SAT.

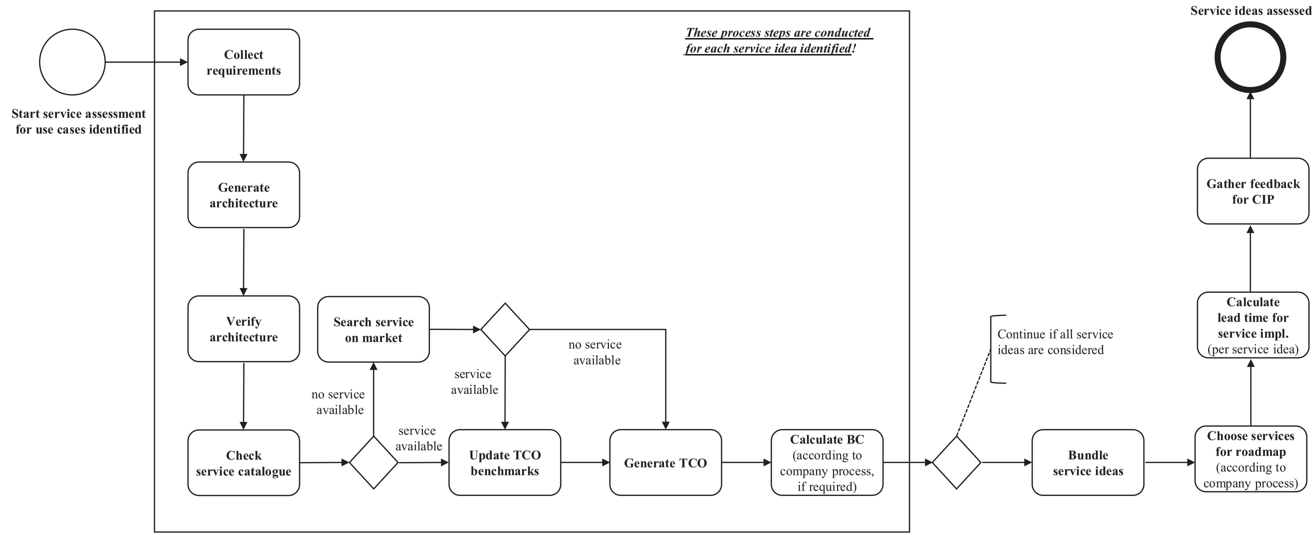


Figure 27: **Process steps of service assessment process (prototype)**[34]
Source. Own illustration

[34] impl. = implementation

In addition to the TCO assessment, service ideas have to be assessed in the tool for their potential benefits in three dimensions, which were defined in the action research project as follows:

- *Productivity:* Potential to increase efficiency with processes or to eliminate individual process steps entirely
- *Employee satisfaction:* Impact on how employees perceive the business department or the whole company
- *Reputation:* Impact on the external image of the business unit or the whole company

In the SAT, the expected effect of the service ideas in these three dimensions has to be rated as “none”, “low”, “medium”, or “high”. The benefits assessments are part of the process step to generate the TCO. This step in earlier versions of the method prototype was called “Generate KPIs” to show that cost and benefits KPIs for value assessment are to be compiled. As the focus of this step and the technique & tool-support is mainly on finally generating TCO calculations, the step was renamed to highlight this focus. If a holistic business case calculation shall be conducted in a next process step, monetary benefits such as those, e.g., coming from efficiency gains, have to be considered and can be inserted into the SAT. The benefits assessment are only partially supported by the tool by providing placeholders to have the benefits rated and inserted. Further tool-support, like for the TCO calculations, is not provided.

At the AR company, the need to calculate a business case depended on the type of service innovation the service idea depicted. Specific steps modeled into the prototype to consider these steps at the AR company have been left out in the illustrated process model in Figure 27. The need for and specifics of BC (business case) calculations in turn can vary according to the organization applying the method (prototype) and would therefore have to be adjusted to the given company specifics.

The service assessment tool has a built-in logic which primarily aims to automate (as far as feasible) service architecture proposals and TCO calculations, for defined use cases respectively service ideas. The logic behind the tool is referred to as the “*service assessment technique*” in this thesis. As discussed above, it mainly comprises support for the following steps of the service assessment process: collect requirements, generate architecture, generate TCO, and (partially) calculate BC. Other steps are only to a low degree supported by the technique and the tool.

A first characteristic of the associated technique and tool is to enable the collection of requirements, based on predefined questions. Secondly, through the service assessment technique and tool, product components of the mobile technology stack are proposed to generate service architectures (see Figure 24), as far as feasible automatically determined based on the gathered service requirements. The technique uses predefined rule sets to suggest the ideal mobile technology stack. Other service architecture components are directly set based on choices made to the predefined questions on the service requirements for training and support levels. As far as feasible, concrete commercial product suggestions were included into the rule sets, e.g., for MDM or VPN systems, to foster the standardization of introduced services.

As an exemplary illustration, the rule set that proposes the use of a mobile application component based on HTML technology ("web app") in the technology stack are shown in Figure 28. If the update frequency of the app is supposed to be high (e.g., at least once a month), the OS focus includes more than two different systems, the cost sensitivity regarding the service to be introduced is high, or the time-to-market (introduction time) shall be short, then a web app is proposed (provided there are no other restricting requirements set).

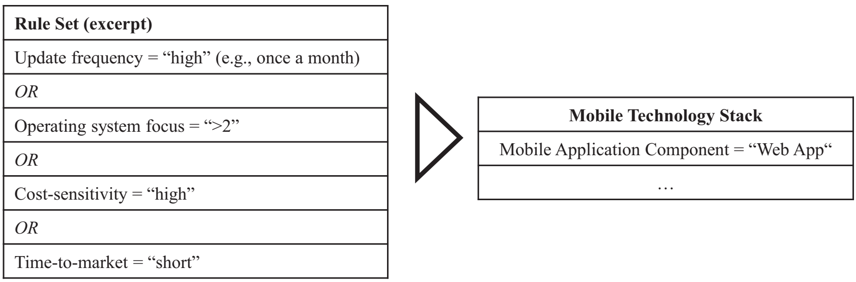


Figure 28: **Illustration of mobile technology stack proposals (prototype)**
Source: Own illustration

Thirdly, through the technique and the service assessment tool, TCO figures are calculated for predefined service architecture components. There are for instance a set of TCO benchmarks for CAPEX and OPEX of different types of custom-developed apps, with different architecture types (e.g., web, hybrid, native[35]) and varying degree of complexity (without, with single, or with multiple backend system access). The benchmarks included in the SAT do not include all required cost components. Some costs have to be manually calculated and entered into the tool such as training costs or costs for implementation of new backend systems. Moreover, project or other transition costs for the introduction of the potential mobile enterprise service are not considered in the technique and tool. Additionally, as discussed, any made TCO benchmark adjustments according to identified apps or services that could be deployed, are considered for the TCO calculations in the SAT. Finally, the technique and tool, enable the assessment of benefits provided by the service ideas and the calculation of a business case by providing the respective space holders to rate the impact and to insert the required data. IT service providers and internal experts of the AR company were consulted and interviewed to support the AR project team in defining the rule sets for the architecture proposals and the TCO benchmarks for the architecture components (incorporated into the service assessment technique and tool). Additionally, specific literature was analyzed on the one hand to define the rule sets (see IBM Software Group 2012; Icenium 2012; Good 2013; IBM 2013; Korf/Oksman 2013; MobileIron 2013; SAP 2013) and on the other hand to determine selected cost benchmarks (see Zarnekow/Brenner 2005; Blüml/Frank 2013).

The service assessment technique and in particular the rule sets and cost benchmarks possess company specifics of the AR partner. Before applying the method prototype in another corporate setting, especially these rules and benchmarks as well as the tool would need to be checked for necessary adjustments.

After all service ideas have been considered and processed from requirements collection to the generation of TCO and the evaluation of benefits (and if required to BC calculation), service ideas are tried to be bundled. Thereby the mobile application architecture can be adjusted, if required because of the bundling. Based on the assessments, service ideas are finally selected and put onto a service roadmap for implementation, according to the company process. In the action research project, company-specific process steps were included into the process model that again were left out in the presentation of the prototype here. As one of the last steps in the service assessment, the lead time for service implementation has to be estimated. If the expected lead time exceeds a certain threshold, there is, e.g., the option to adapt company-internal processes for faster cycle time. In the action research project the threshold was put to three to six months. The

[35] Details on different app architectures can be found in IBM Software Group (2012).

threshold was set according to the expected release cycles of mobile operating systems. Specific optimization guidelines for service implementation process steps were proposed as part of the action research project, focusing, e.g., on the customization of documents and templates or the elimination of process steps.

Finally, as in the use case screening process, feedback on possible improvements or necessary adjustments e.g., to the process steps, role assignments, or the associated technique & tool is gathered. In the action research project it was evaluated how the outcomes of the service assessment process fit into the exiting implementation process (and its variations) for IT services within the AR company. If the method (prototype) shall be used in different organizations, these companies would have to analyze the fit of the service assessment outcomes to the required input of their company-specific service implementation processes. Necessary adjustments on the process or method side would have to be done.

Roles / Steps	**Collect requirements**	**Generate architecture**	**Verify architecture**	**Check catalogue**	**Search on market**	**Update benchmarks**
MEE	C	C	R		R	C
PM	R	R, A	A	R, A	A	R, A
BD	A					
further roles				according to company specifics		
Roles / Steps	**Generate TCO**	**Calculate BC**	**Bundle services**	**Choose services**	**Calculate impl. time**	**Gather feedback**
MEE	C	C	C			R, A
PM	R, A	R	R	R	R, A	
BD		A	A	A		
further roles		according to company specifics		according to company specifics	according to company specifics	

Table 9 **Role assignments of service assessment process (prototype)**
Source: Own illustration

As shown in Table 9, the PM is mainly responsible and to a large extent accountable for conducting the service assessment steps and applying the technique and tool. The PM thereby can consult the MEE, if needed, for collecting the service requirements, generating the service architecture in the SAT, for the steps concerned with TCO & BC calculations, and for the service bundling. The MEE itself is supposed to be responsible for verifying the generated mobile service architecture for feasibility and to adjust it in the SAT, if required. Additionally, the MEE has to search for external apps or services available, if no internal service covers the service idea scope and architecture. The MEE also gathers the final feedback for the CIP. The BD in particular is supposed to hold accountable and to provide important input for collecting requirements, calculating business cases, and service bundling. The BD also is accountable for the final service roadmap. As depicted in Table 9, choosing services for the roadmap, calculating business cases and implementation times, and checking service catalogues may require further roles to be involved (e.g., procurement, suppliers) and may vary in detail. For these steps the role assignments may potentially need to be adjusted for company specifics.

Continuous improvement process

In the CIP, changes mainly to the process model, techniques, or tools of the method are identified, evaluated and, if feasible, implemented. A continuous improvement process was designed to incorporate necessary changes into the method, caused by specific events. Thereby, it shall also be accounted for the high change rate of the mobile ecosystem.

Origin	Trigger	Category	Affected Item
internal	changes of operational structure (processes)	process model	process steps
internal	changes of organizational structure (roles)	process model	RACI matrix
internal: use case screening	identification of additional task characteristics	technique & tool	use case screening technique and tool
external	availability of new mobile operating system release	technique & tool	service assessment technique and tool, e.g., rule sets
…	…	…	…

Table 10: Excerpt of trigger list of CIP (prototype)
Source: Own illustration

The CIP (Figure 29) is mainly steered and conducted by the MEE. By actively screening every three months or passively waiting for so-called *triggers*, the MEE is responsible and accountable to identify possible necessary changes to the method. Triggers depict company-internal or external events that may justify an update of the method. In the following, an exemplary excerpt from the set of triggers is listed in Table 10. In total, a set of 19 triggers was defined in the action research project.

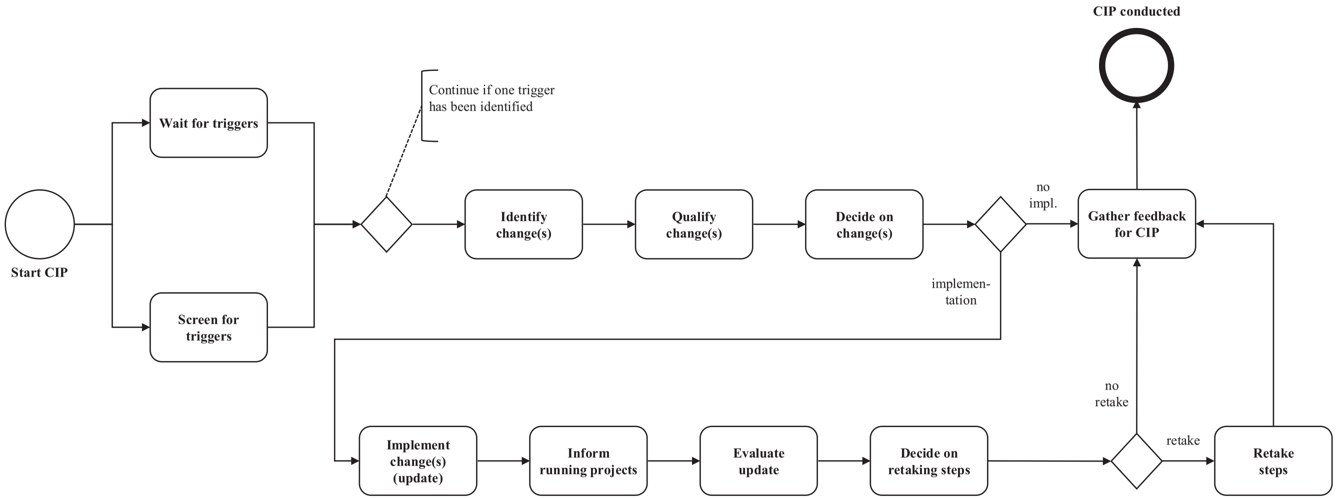


Figure 29: **Process steps of continuous improvement process (prototype)**
Source: Own illustration

For instance, changes of corporate processes at the company may lead to adjustments of the process steps of the method. Changes of the roles in the organizational structure may affect the RACI matrix assignments. Further company-internal triggers may come from applying the method. The identification of additional important task characteristics for the mobilization score, during the use case screening process, should be incorporated into the use case screening technique and tool. An external trigger can result from the availability of a new mobile operating system release with new capabilities, making it necessary to adjust the rule sets for architecture proposals of the service assessment technique and tool.

If a trigger is identified by the MEE, he or she qualifies how the change(s) should be implemented and finally decides whether it should be done. If the MEE decides on incorporating the change(s) into the method, he or she is responsible to carry out any change(s) and to inform running projects that apply the method on the deployed updates. Whether the updated method version shall be used in the running project has to be decided by the PM together with the BD. If the project is already in the implementation stage (or beyond), according to the company specifics, other roles than the PM might be responsible to evaluate and decide upon. The BD representative holds accountable for the final evaluation of the updated method and the decision on possibly retaking any process steps of the project.

Roles / Steps	**Wait for triggers**	**Screen for triggers**	**Identify change(s)**	**Qualify change(s)**	**Decide on change(s)**	**Implement change(s)**
MEE	R, A	R, A	R, A	R, A	R, A	R, A
PM						
BD						
further roles						

Roles / Steps	**Inform running projects**	**Evaluate update**	**Decide on retaking steps**	**Retake steps**	**Gather feedback**
MEE	R, A	C	C	C	R, A
PM		R (before impl.)	R (before impl.)	R (before impl.)	
BD		A	R, A	R, A	
further roles		according to company specifics	according to company specifics	according to company specifics	

Table 11: Role assignments of CIP (prototype)
Source: Own illustration

Finally, continuously feedback on possible adjustments of the CIP itself is gathered. As for the other processes, final feedback on possible process adjustments depicts a possible trigger for continuous method updates. Details on responsibility and accountability and on who is supposed to be consulted in case are shown in Table 11.

Note: The illustration of the IDA method prototype, on purpose, is missing details, e.g., of the service assessment technique and tool. In particular, the rule sets to generate service architectures and the TCO benchmarks are not or only exemplary shown. As these elements of the technique have not been considered for the final IDA method, for reason of complexity reduction, they have only been described on an abstract level. The same applies for other elements of the prototype which have been skipped in the next BIE cycles, such as the process optimization guidelines or the triggers of the CIP. Moreover, for anonymity reasons and to abstract the illustration, the steps of the service assessment process model were depicted on a slightly simplified and aggregated level. Moreover some other slight adaptions, e.g., related to the role naming, were applied to anonymize the illustration of the prototype and its company specifics.

6.3.1.3 BIE Cycle 1: Workshops

The action research project to design the method prototype was carried out at a large multinational company. It took about three months and was finished in 2013. The AR project team held *five major workshops* to jointly work on the design goals and the method design. These workshops were supplemented by separate working sessions, partially held through conference calls. The project team which jointly constructed and evaluated the prototype and its components throughout the workshops together with the author of this thesis was made up of experts on topics such as IT strategy, IT architecture, IT processes, and mobile enterprise – coming from the internal IT department, supplemented by an external consultant. Thereby, the author of this thesis was in an active and steering role. Depending on the scope, not all team members participated in all workshops and working sessions. Additionally, if required, expert interviews were conducted and relevant literature screened.

Evaluation was conducted in an action research setting based on workshops and working sessions, through gathering feedback of the project team on the current status of the method (Fettke/Loos 2003; 2004). Feedback and insights gathered were thereby iteratively incorporated into the method design. In the following, no further build and evaluation details of BIE cycle 1 will be presented and discussed.

6.3.1.4 BIE Cycle 2: Field Study 1

The IDA method prototype – after being constructed in the action research project – was applied and evaluated in a *field study at a selected sales department* of the AR partner. The field study was conducted in 2013. Its evaluation based on expert interviews was finished in 2014.

Note: This field study is referred to as "*field study 1*" in this thesis, as a second field study as well was conducted to evaluate the final IDA method (referred to as "*field study 2*").

Applying the IDA method prototype in BIE cycle 1

In the field study, the application of the IDA method prototype was steered by an IT project manager (PM) from the AR company, who was not involved in the method construction. The mobile enterprise expert (MEE) role was shared amongst to employees from the company's IT department, who both participated in the prototype construction. The sales department (BD) was represented by two client managers. The author of this thesis, who also participated in the action research project, passively participated in the field study to support the method application in case of unclear topics arising.

Note: During filed study 1 some last, minor build activities were conducted, concerning the service assessment tool. In the following no details on these refinements will be presented.

Use case screening (in field study 1)

In the field study, initially the PM got in touch with the two BD client managers. In a next step, the required information was collected from the client managers steered by the PM, supported by the MEE. Information collection was done in two workshops (over web and audio conference) separately with each client manager. The MEE part was in each workshop taken over by a different IT department representative. In these workshops, the BD representatives listed the tasks of a client manager in the specific sales department. For these tasks, the questionnaire incorporated into the UCST was filled in. For the workshop with the second client manager, tasks listed in the workshop with the first client manager were used as input. For each client manager, based on the specific data provided, in the UCST mobilization scores were calculated for the client manager's tasks. In the end, for each task the two scores were summed up to build a final mobilization score per client manager task. Because they had the highest scores, the following three tasks were selected (from a total of ten) for use case screening:

- Solution development, including business opportunity analysis (6)
- Business development (8)
- Accounts receivable management (7)

In a third workshop, together with both BD client managers, the PM, and one MEE (who already participated in one of the initial workshops) mobile enterprise use cases were built for the selected (highest ranked) tasks. The number in brackets behind the selected tasks in the list above depicts the number of use cases that were jointly identified. The use cases then were bundled by the PM and one MEE (not the one participating in the third workshop) as follows:

UC-1) Data exchange (support for tasks: solution development, business development, and accounts receivable management)

UC-2) Creation of documentation (support for tasks: solution development and business development)

UC-3) Read / write customer data for corporate legacy CRM (support for tasks: business development and accounts receivable management)

UC-4) Read / write customer data for CRM (support for tasks: business development and accounts receivable management)

UC-5) Real-time collaboration (support for tasks: solution development, business development, and accounts receivable management)

In the field study, the identified and bundled use cases were used as input for the next step of the prototype process model, namely the service assessment.

Service assessment (in field study 1)

The service assessment in the field study started with the definition of requirements for the five service ideas derived from the identified use case bundles. The collecting of requirements was done together by the PM and the two MEEs. All gathered requirements were inserted into the SAT. The input for the SAT mainly came from the representatives of the IT department participating at the field study (PM, MEEs) and not from the BD representatives. BD client managers could not provide details on the mainly IT-related questions in the SAT. One of the two MEEs then finalized the SAT fillings. Only this IT department representative from then on supported the field study as (single) MEE.

Finally, service architectures were generated in the SAT for the five mobile enterprise service ideas, derived from the use case (UC) bundles UC-1 to UC-5. The MEE verified the generated architectures and iteratively did some modifications, e.g., based on adjustments of selected requirements, e.g., related to required APIs (application programming interfaces) or the use of personal devices – with support from the author of this thesis. Mobile services that can be provided over standardized apps that – at least partially – could cover the functional scope of the service ideas were searched externally by the MEE. A detailed requirement analysis was thereby not conducted and an internal search in existing service catalogues was not done. The service idea based on use case UC-1 was seen to potentially be supported with the Copiun app and the use case UC-2 with the Penultimate app. For the service ideas based on the use cases UC-3 and UC-4 the Salesforce Touch app was found to be an alternative. The service idea derived from UC-5 could benefit from a variety of apps such as those from Yammer, Lync, or WebEx. The TCO for the five service ideas were generated in the SAT (with a three-year focus). If feasible, they were manually adjusted by the MEE, e.g., for the case that a standard app should be used or for shared costs amongst the service ideas – with support from the author of this thesis. Additionally, the benefits possibly provided through the five service ideas were rated. Further business case calculations were not conducted in the field study. The assessed benefits (productivity, employee satisfaction, and external reputation increase) are listed in Table 12.

Service ideas / Assessments	**Productivity**	**Employee satisfaction**	**External reputation**
Data exchange	medium	high	low
Creation of documentation	low	medium	low
Read & write for legacy CRM	high	high	high
Read & write for CRM	high	high	high
Real-time collaboration	low	high	none

Table 12: Benefits assessment in field study 1 (prototype)
Source: Own illustration

The MEE also bundled the five service ideas, derived from the use case bundles, into the following three final service ideas (SVs) because of their overlap:

SV-1) Mobile CRM access (from UC-3 and UC-4)

SV-2) Mobile file access (from UC-1 and UC-2)

SV-3) Mobile video conferencing / collaboration (from UC-5)

The TCO figures are not presented in this section because they were not comprehensively compiled for the three final service ideas in the field study and quality checks for the adequateness of the so far conducted calculations not finalized. So for instance manual cost calculations should have been done for the initial service idea "creation of documentation" because a new backend system and a new middleware were required according to the SAT architecture proposal. Additionally, shared costs (device and MDM costs) among service ideas were so far not adequately considered for the final TCO calculations. It also was not evaluated how many new smartphones had to be acquired (no additional smartphone purchase was assumed). Moreover, other steps of the service assessment process were not conducted or only partially started because of internal reprioritizations in the IT department at the AR partner that did not allow the field study to be fully finalized.

Continuous improvement process (in field study 1)

The continuous improvement process was not considered in the field study due to the reprioritization of the topic in the IT department of the AR company at the end of the method application. However, during the field study feedback and observations in particular on the SAT implementation were gathered and iteratively incorporated in the tool through one of the participants of the action research project (external consultant).

Evaluating the IDA method prototype in BIE cycle 2

As partially reported above, the method prototype could not be applied in full scope in the field study at the AR company. In the following, not all deviations from the predefined scope will be discussed, only major aspects. In particular, the CIP and the last process steps of the service assessment were not conducted because of resource constraints at the IT department of the AR company (resulting from an internal reprioritization of the topic). Nevertheless, the use case screening and service assessment techniques were applied nearly in full scope. However, the execution of the process steps (in RACI terms) more or less varied – depending on the step – to the predefined role assignments of the method. A major deviation thereby was the more intense involvement of the MEE role into the use case screening and service assessment. Additionally, there were some minor deviations in the application of the predefined techniques. For instance, in the use case screening the BD representatives did not initially list the BD processes and involved roles. The BD representatives, both client managers at the sales department, "just" listed their tasks (not those of any other roles in the sales department). Furthermore, the two-step calculation of the mobilization scores from two separate sources was not predefined in this way in the method and was applied because of time constraints of the field study participants. In the service assessment stage, the detailed service requirements could not be gathered from the BD, but mainly had to be compiled by the PM and MEEs themselves because of their mostly technical background.

The application of the method prototype was evaluated based on the feedback of the involved PM, MEEs, and BD client managers. The feedback was gathered through questionnaire-based interviews on the use case screening and service assessment steps. The answers collected were of qualitative nature, not rated on a scale, and mainly focused on gathering potential points for improvement. As the CIP was not conducted in the field study, no according real feedback could be gathered.

In the interviews, feedback was collected on the *understandability / comprehensibility* and *applicability* of the method prototype (Wurhofer et al. 2009; Urbach/Würz 2012), as far as applied. Thereby, the BD representatives could only give limited feedback on the service assessment process, as they were involved only initially. It has to also be considered that one of the MEEs was only partially involved in the service assessment. The understandability of the use case screening was mainly rated positively by the field study participants. The feedback of the participants further indicated that the service assessment can be regarded to be only partially comprehensible. In three feedback interviews, the lack of comprehensibility of SAT elements was mentioned. For instance, one interviewee stated that the architecture generation and the logic of how the TCO benchmarks were extracted are difficult to understand. Another interviewee pointed out that there are no details presented on how to calculate the potential increase of productivity, external image, and internal satisfaction resulting from service ideas. Regarding the applicability the use case screening was seen to be mainly applicable on the one hand and the service assessment on the other hand, with limitations, only partially. For instance, four interviewees gave critical feedback on the role assignments in the service assessment process model. Thereby, two interviewees in particular wondered whether the MEE should be more involved. Moreover, in one interview the applicability of the SAT was seen to be limited because of the higher real-world complexity that cannot be modeled into the tool. One interviewee also stated that it was challenging to get the required info from the BD in that short of a time and that quantification of value added in Euro is difficult in the service assessment process.

The MEEs and PM were additionally asked on how the method prototype (as far as applied) contributed to the *fulfillment of the design goals* on governance, standardization, efficiency, and effectiveness – put up at the beginning of the action research project (see section 6.3.1.1). It has to be noted that no feedback was gathered on the design goal on handling of high change rate in the mobile ecosystem, as this would have been mainly achieved through the CIP. The sum of feedback gathered from the interviews with the PM and the MEEs on the achievement of the design goals on governance, standardization, and efficiency support showed a positive picture. A reduction of complexity, e.g., was seen (by two interviewees) to be created by the rule-based architecture proposals. A positive efficiency impact was, e.g., reported (by one interviewee) to be supported through the SAT by creating a first cost calculation. Additionally, one expert mentioned that no additional costs occur if done through web session and that from start to end the use case screening process just took about four weeks, even despite of high mobility of client managers. Even if positively rated in the feedback, the achievement of IT governance through the method application has to be questioned, because the sales department – as reported above – started an own initiative to introduce a mobile app. Feedback on the design goal focused on the identification of secure and value-adding services (effectiveness goal) gave a mainly positive but more differentiated picture. For instance, one interviewee stated that this goal would have been reached through scores (identification and prioritization of value-adding services) and architecture proposals (that considered security requirements). Another interviewee saw this goal to only be partially reached and mentioned that it is still difficult to determine the value added of a mobile app / service. This interviewee saw the score to be a first but still too abstract approach.

Potential IDA method enhancements identified in BIE cycle 2

From the feedback provided in the expert interviews, fields for improvements were derived and formulated. In the following, only enhancement ideas identified repeatedly in one interview or across feedback interviews are presented and discussed:

- *BIE-2-1 “Provide more briefing and documentation”:* Provide more briefing, information, and documentation for the involved roles, e.g., on process steps, method focus, terms used, use case examples, input-output relationships, roles of the participants in the workshops, tool use, or TCO benchmarks. A standard set of processes could be used as input for the use case screening process. A standard presentation and presentation templates would also be useful. Transparency could be increased and video trainings and more explanations provided. Additionally, compile a simplified method documentation for BD and company-internal boards.

- *BIE-2-2 “Absorb BD ideas”:* Method should be flexible to absorb BD ideas outside of the current method scope, for instance apps personally used by client managers. Apps personally used by BD representatives to support their business activities could depict “quick wins” for use case screening.

- *BIE-2-3 “Have single on-site workshops”:* Use case screening is even more efficient if BD is in the same room as PM. All participants should be in the same room and the workshop should not be split up.

- *BIE-2-4 ”Have more MEE involvement”:* The PM often does not have the required expertise to guide through the method application. Therefore, the MEE should be a more active part of the use case screening and should steer the service assessment, if required knowledge-wise.

- *BIE-2-5 “Improve SAT user interface”:* Have a better user interface for the service assessment tool. A web based service assessment tool could be provided.

- *BIE-2-6 “Enhance value added assessments”:* More details on the assessment of potential value added of service ideas should be provided. Additionally, value added assessments could be (partially) done by mobilization scores.

- *BIE-2-7 “No technical requirements collection with BD”:* Collecting technical requirements cannot / shall not be done with the BD, but with the IT department.

How the above depicted areas for improvement and others identified in the field study have been considered for the final IDA method is presented in the section 6.3.2.

6.3.2 Phase II: Final IDA Method

In phase II of the ADR process, based on an adjusted set of design goals and the initial method prototype, the final IDA method has been built, applied, and evaluated. Build and evaluation activities were iterated several times across several BIE cycles.

6.3.2.1 Design Requirements for Final IDA Method

The requirements for the design of the IDA method have been formulated on two levels. First, there are *attributes* and *elements* that a method needs to comprise. Those listed in Braun et al. (2005) have guided the design activities presented in the following: a method shall be goal-oriented, have a systematic approach, provide principles, and be repeatable – as described in detail in section 6.2. Referring to Gutzwiller (1994), Braun et al. (2005) illustrate the elements a method should offer, similar to those discussed by Brinkkemper (1996). It should provide a procedure model that describes the order in which activities are to be performed and the roles that create the desired results. Details on how these results are compiled and documented in a specification document are described by virtue of techniques. They further propose that a meta model should be designed to specify the underlying data model.

For the action design research carried out within this doctoral thesis, to design a method to support IDA steps for the introduction of IT services for mobile consumer devices, the attributes and elements a method shall possess (listed in Braun et al. 2005) have provided a framework to guide the final method design. However, building a conceptual data model (meta model) has not been considered as a requirement for the method design, as no information system modeling or implementation shall be directly supported through the method. As stated in Braun et al. (2005), methods have to be goal-oriented and to address selected problems. In this thesis, requirements for the method design derived from the specific problems to be solved are referred to as design goals. Compared to the general requirements for method design derived from Braun et al. (2005), *design goals* are specific to the problem-solving focus of the to be designed method. For the final IDA method, the design goals have been compiled iteratively throughout the BIE cycles.

The final set of design goals for the IDA method is anchored in the initial, broad set that guided the method prototype design. The scope of the final method design has been sharpened to mainly focus on enabling the *introduction of value-adding mobile enterprise services*, through capabilities to assess productivity-related value added (part of design goal 5 of prototype; derived from pilot case study and requirements of action research project). There are several reasons that have motivated this narrowed focus.

One reason is the need to provide techniques to assess value added of corporate mobile IT use, identified in the body of *literature*. Findings extracted from literature show that it is not only important but also challenging to identify processes and tasks which benefit from mobile IT support (Gebauer/Shaw/Zhao 2002; van der Heijden/Valiente 2002b; Deibert/Rothlauf 2006; Deibert/Heinzl/Rothlauf 2008; Picoto/Palma-dos-Reis/Bélanger 2010; Gröger et al. 2013) as well as to measure and quantify tangible and intangible benefits and the resulting value added of mobile enterprise service use ex ante (Kadyte 2004; Löfgren 2006; Leskinen 2008; Balocco/Mogre/Toletti 2009; Peltomäki/Hallikainen/Tuunainen 2009; Pousttchi/Becker 2012; Falk/Leist 2014; Fischer/Smolnik 2014). Literature analysis indicates that both steps are crucial to enable the mobile enterprise service use. An evaluation and comparison of existing frameworks has revealed that there is no approach which offers techniques to determine and illustrate nor to quantify value added of mobile enterprise service use in general, and also none considering mobile consumer IT specifics. Details on the problem statement, the evaluation of frameworks and the literature analyzed can be found in sections 1.2 and 5.2.5.

Further motivation for refocusing of the design goals comes from the multiple *case studies* on the impacts of mobile consumer device use for IT departments (see chapter 4). Amongst all four case studies, assessment of value added has been finally extracted as a service analysis challenge, possibly hindering the introduction of mobile enterprise services on consumer devices (see section 4.3). This challenge is the only one for which no existing countermeasures could be identified in the case study analysis.

The *feedback to the method prototype application* is a third reason for putting value added and its assessment as the major focus of the IDA method design. The prototype focused mainly on a detailed calculation of possible TCO and less detailed on benefits provided by service ideas. A more detailed technique to assess the value added is required as part of a method to support mobile enterprise service introductions (see section 6.3.1.4).

This all has resulted in putting up two primary goals for the final IDA method design, contributing to the overarching goal of enabling IT departments to introduce value-adding IT services for mobile consumer devices:

DG I *Enable IT departments to define potentially value-adding service ideas for tasks identified to benefit from IT service support on mobile consumer devices*.

DG II *Enable IT departments to determine and illustrate the multidimensional productivity-related value added of IT services use on mobile consumer devices ex ante. First abstract quantifications shall be provided, enabling later monetary value added assessments*.

Both primary design goals can be regarded to be twofold. In chronological order, the first goal addresses Ia) the identification of suitable tasks and Ib) the definition of value-adding service ideas for these tasks. The second goal focuses on IIa) determination & illustration of value added and IIb) the quantification of it.

Design goal (DG) II mainly addresses the research gaps identified for the assessment of value added of the mobile (consumer) IT use. Design goal I reflects required initial steps to enable the introduction of mobile enterprise services, at companies that do not know yet for which purpose mobile consumer IT should be best deployed to provide benefits. In that sense, design goal I can be regarded to address pre-assessment capabilities a method should offer.

Besides these two primary goals, two secondary goals have been compiled for the method, based on the initial set of design goals (of the prototype) and additional sources. One of the specific requirements the project team put up in the initial action research project to build the method prototype, was asking to position the IT as a value-adding service partner for business units and taking over the role of innovation driver (ARPR-2; resulting in design goal 1 of the prototype). This input from the AR partner is a major source motivating the following final design goal:

DG III *Support a tight collaboration between IT and business departments – steered by the IT – during the service analysis phase of IT service introductions for mobile consumer devices*.

The significance of design goal III was further supported by the findings of the multiple case studies carried out on the impacts of mobile consumer device use. Problems regarding the cooperation of IT and business departments at mobile enterprise service introductions have been identified at two of the four case studies conducted. In three of the four case studies, it has been extracted that it can be challenging to have support of all relevant stakeholders for mobile enterprise service introductions. As those challenges have not been identified at all four case studies, they are not listed in section 4.3. Although only partially identified in the multi-case study analysis, these findings provide evidence for the importance of a tight collaboration between IT and business departments for mobile enterprise service introductions.

Design goal IV of the final IDA method has been derived from design goal 4 of the method prototype, but with a focus only on time-efficient introduction of mobile enterprise services:

DG IV *Support IT departments to quickly conduct service analysis to determine which IT service for mobile consumer devices should be introduced*.

Moreover, the findings of the multi-case study analysis on impacts of mobile consumer device use for IT departments provide evidence to support design goal IV. In three of the four case studies, a lengthy introduction of mobile enterprise services can be observed and high time pressure for such kind of service introductions. As those challenges have not been identified at all four case studies, again they are not listed in section 4.3. The importance of design goal IV is also supported by insights from the field study carried out with the method prototype. It was observed that the whole service analysis process steered by the IT department took relatively long and that the business unit started an initiative for mobile enterprise service introduction on their own.

Final wording of the design goals (depicted above) has been impacted and shaped based on the evaluation of the method and its design goals, throughout BIE cycles 3 to 5. Details on the iterative rephrasing of the design goals I to IV can be extracted from the sections 6.3.2.3, 6.3.2.4 and 6.3.2.5.

Note: Design goals 2 and 3 of the method prototype have not been considered for the final IDA method design as they were rated to not focus on the service analysis stage of the service lifecycle model, but rather on service design, implementation, or operation (see Kohlborn/Korthaus/Rosemann 2009).

6.3.2.2 IDA Method Details

An overview of the *elements of IDA method* is shown in Figure 30. At its core, it has a procedure model with three main processes focused on "identification of tasks to be mobilized", "definition of mobile enterprise service ideas", and "assessment of value added of service ideas" – triggered by an initial phase for the "preparation of method application".

For all process steps of the procedure model, role assignments are provided describing which roles should conduct the steps. Moreover, for the three major processes, techniques instruct on how to execute the crucial steps of the model – supported by an Excel-based tool. The results of the application of the techniques and the method are then captured in a predefined specification document.

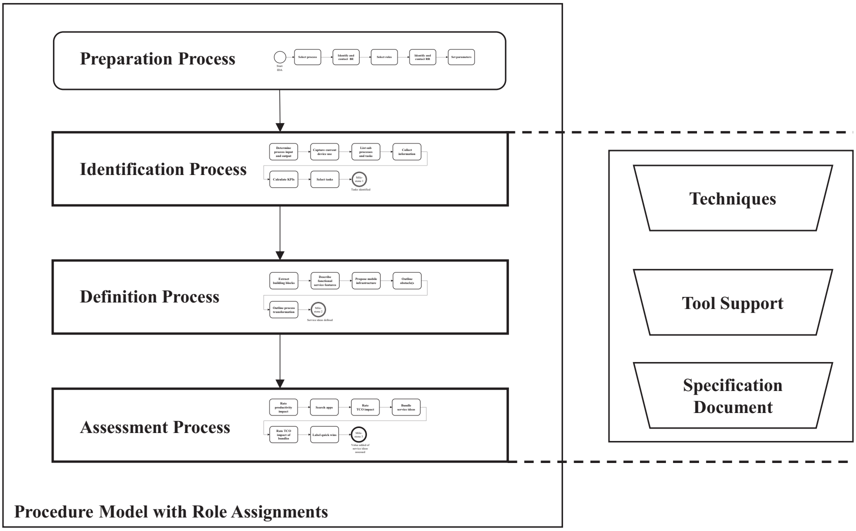


Figure 30: Overview of IDA method and its elements[36]
Source: Own illustration

In the following, details of the IDA method such as the process steps of the procedure model and the corresponding tool-supported techniques, as well as the existing theories that informed their design are depicted. A simplified approach similar to, and derived from, the basic elements of the business process modeling notation (see, e.g., White 2004; Allweyer 2010) is taken for the visualization of the process steps.

Preparation process: preparation of method application

The steps of the "preparation process" are depicted in Figure 31. The preparation process and further method application is steered by the mobile enterprise expert (MEE) role.

[36] Role assignments are not illustrated in the figure.

This role needs to be familiar with the IDA method, the mobile enterprise market, and mobile technologies.

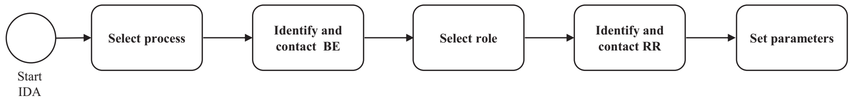


Figure 31: Overview of preparation process steps (final IDA method)
Source: Own illustration

Details on the preparation steps are listed and discussed below:

- *Select process:* Initially, the IT department (represented by the MEE) has to identify which process shall be analyzed. Baseline for selection should be a corporate process map. A process shall be defined on a top-level, like “sales”, “field service”, “maintenance”, or “marketing”. Ideally the IT department selects processes in close alignment with business departments. (done by MEE with business departments)

- *Identify and contact BE:* For the selected process, a business department executive (BE), who is responsible to decide upon the introduction of IT services and willing to participate has to be identified and contacted. If not possible, the method application for the corresponding process stops here. (done by MEE)

- *Select role:* For the selected process, the role (employee type) to be analyzed has to be identified and selected. The mobility profile and unproductive time roles are having can guide the role selection. Only roles that are more than eight hours per week, approximately 1/5 of their working time, away from their desk are considered to possibly have a high mobilization potential and should be selected for analysis (see Scherz 2007, for details on workforce mobility). (done by MEE with BE)

- *Identify and contact RR:* For the role, selected employees (role representatives, RRs) suitable and willing to participate in the method application have to be identified and contacted. It has to be initially decided how many RRs shall be involved. On the one hand, involving not more than three RRs can increase efficiency of the method application and reduce its complexity. On the other hand, including more RRs (e.g., by using the predefined questionnaires) could increase the quality of the collected data. In the identification and assessment process, the questionnaires could be sent to a plethora of RRs. The results could be consolidated and finally discussed with the BE. (done by MEE with BE)

- *Set parameters:* Finally, parameters relevant for the method application have to be set: “quick win TCO margin”, “TCO calculation time frame”, “TCO levels (low, medium, high)”. Additionally, the parameter “maximum number of tasks to be selected” has to be set. It shall reduce the complexity of the method application and enable quickness of the identification process by limiting the number of tasks to be analyzed. (done by MEE with BE)

Note: The application of the IDA method is designed for the analysis of one corporate process and one corresponding role. If more than one corporate process is to be analyzed, the method has to be applied a second time; if more than one role is to be analyzed, slight adjustments to the method have to be applied.

How to use the IDA tool

In Figure 32, a screenshot from the IDA tool-support for the preparation phase, which is focused on capturing the parameters to be set, is shown. The required parameters have to be inserted into the designated cells of the Excel-based tool.

Adjustments of IDA method application if more than one role is to be analyzed

If more than one role shall be analyzed, more than one role has to be selected in the “select role“ step. For each role selected, RRs have to be identified and contacted. For each role analyzed, a different instance of the IDA tool has to be used.

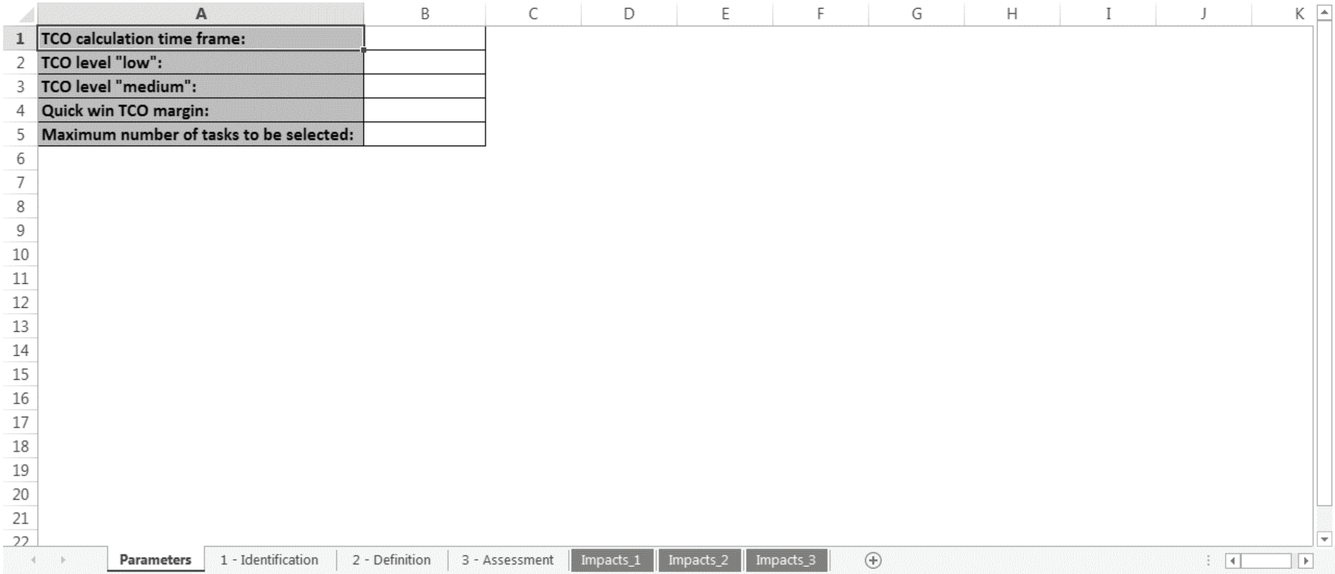


Figure 32: **IDA tool – support of preparation process (final IDA method)**
Source: Screenshot from IDA tool of final method version

Identification process: identification of tasks to be mobilized

The goal of the second process of the procedure model, the "*identification process*" (see Figure 33) is to identify tasks – of the analyzed role in the selected process – for which it is feasible in terms of value provision to support them with IT services on mobile consumer devices.

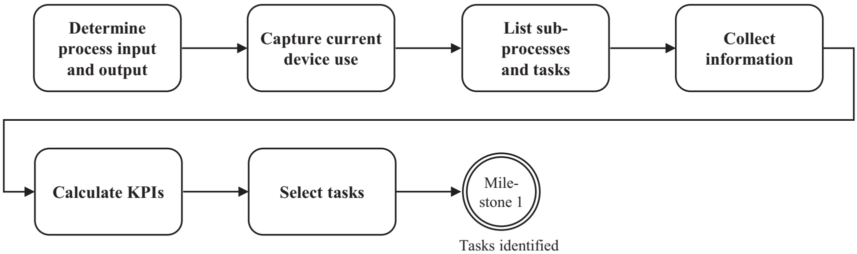


Figure 33: Overview of identification process steps (final IDA method)
Source: Own illustration

The identification process is enabled by a corresponding technique ("*identification technique*") which is supported by the so-called *IDA tool*. The technique defines which information has to be collected in the process, how this information is used to calculate so-called KPI scores, and how tasks are finally selected based upon the scorings.

Details on the identification steps and technique are listed and discussed below:

- *Determine process input and output:* Initially, the output and input elements of the analyzed process have to be determined and described. Examples for process output and input elements for the analyzed process should be provided to support this step. In- and output elements have to be considered in the later assessment steps. (done by MEE with RRs or MEE with RRs and BE)

- *Capture current device use:* For the role analyzed, the current use of mobile devices (smartphones and tablets) must be captured. The current device use is considered in the step of calculating KPIs. (done by MEE with RRs or MEE with RRs and BE)

- *List sub-processes and tasks:* All sub-processes and subordinate tasks conducted by the role (RR) in the selected process have to be listed jointly with all RRs, ideally in one session. A task should be defined on a level where it cannot be decomposed into further steps and where it is executed by individuals (Gruhn/Köhler/Klawes 2005; Mladenova et al. 2011). If there is no sub-process level, only tasks are listed. Additionally, provide examples to the RRs for process specific tasks to ease the listing of tasks such as “meeting at customer site“ or “RFP[37] preparation“ for the sales process. (done by MEE with RRs or MEE with RRs and BE)

- *Collect information:* On the process, task, and role level details on relevant characteristics have to be collected to enable the calculation of KPIs (step “calculate KPIs”) that guide the later task selection (step “select tasks”). These KPIs on pre-assess the potential to increase the specific task and process productivity through mobile enterprise service use. Ideally, if possible in one joint on-site workshop, this information is collected together with the RRs and the BE. In total, it is a plus for all information gathering if the BE has an overview on all employees of the role. During data collection it has to be emphasized that the average case shall be reported. If RRs are very mobile, the predefined questionnaire can be used. Examples in the questionnaire and the IDA tool should as much as possible be adjusted to the corresponding process and role. Nevertheless, the information collected through questionnaires should be discussed with RRs / BE for validation and explanation purposes. For the workshops for data gathering, if they are done without questionnaire support, at least half a day should be reserved. (done by MEE with RRs or MEE with RRs and BE)

- *Calculate KPIs:* For each task listed, five KPIs are calculated in total:

    - *Role Productivity Potential (RPP):* The RPP depicts the potential to increase task productivity through mobile enterprise service use because of the specific nature of the role. It is calculated based on the information collected regarding:

        - Mobility profile: Do the employees spend more than eight hours of working time per week away from their permanent or temporary office desk (e.g., have multiple meetings or are travelling regularly) or even at least four days a week? (no = 0, yes – “more than eight hours” = 2, yes – “at least four days” = 4)

[37] RFP = request for proposal

- Idle time: Do the employees have idle time during the week where they are not conducting any task due to external circumstances (e.g., travelling) – is it even more than one hour each day of idle time in average? (no = 0, yes = 1, yes – "more than one hour each day" = 2)

- Number of employees: Are there more than 100 employees of the analyzed role in the analyzed process or even at least 1000 employees? (no = 0, yes – "more than 100" = 1, yes – "at least 1000" = 2)

⇨ Maximum RPP scoring to be reached: 8

- *Task Process Productivity Impact (TPPI):* The TPPI depicts the absolute impact of the task productivity on the process productivity (efficiency and effectiveness). It is calculated based on the information collected regarding:

  - Productivity impact: How is the importance of the analyzed task for the productivity (more or better output, less input) of the analyzed process? (none = 0, low = 1, medium = 2, high = 3)

  ⇨ Maximum TPPI scoring to be reached: 3

- *Structural Task Productivity Potential (STPP):* The STPP depicts the potential to increase task productivity through mobile enterprise service use because of structural task characteristics. It is calculated based on the information collected regarding:

  - Task frequency: Is the task conducted at least once per day or even more than ten times per day (in average)? (no = 0, yes – "once per day" = 1, yes – "more than ten times" = 2)

  - Task duration: Does the one-time execution of the task take more than four hours or even more than one day (in average)? (no = 0, yes – "more than four hours" = 1, yes – "more than one day" = 2)

  ⇨ Maximum STPP scoring to be reached: 4

- *Functional Task Productivity Potential (FTPP):* The FTPP depicts the potential to increase task productivity through mobile enterprise service use because of functional mobile technology benefits. The FTPP score has for sub-scores which are calculated on:

  - *Internal collaboration demand:* Do the involved employees need to remotely collaborate with other employees (e.g., jointly modify or update files) to conduct the task, NOT FULLY supported with mobile devices within the task, yet? (no = 0, yes = 1)

  - *External communication demand:* Do the involved employees need to remotely communicate with (potential) customers or vendors (e.g., for complaint handling) to conduct the task, NOT FULLY supported with mobile devices within the task, yet? (no = 0, yes = 1)

  - *Information access demand:* Do employees require specific information (e.g., latest business data) to conduct the task, NOT FULLY supported with mobile devices within the task, yet? (no = 0, yes = 1)

  - *Data capturing & storage demand:* Do employees require to capture and store specific data (e.g., photos of specific items) to conduct the task, NOT FULLY supported with mobile devices within the task, yet? (no = 0, yes = 1)

  For all sub-scores, if the specific (internal collaboration, external communication, information access, or data capturing & storage) demand is existent the following additional information is used to calculate the final scores:

  - <u>Unpredictability:</u> … without knowing when exactly or what demand will arise? (no = 0, yes = 1)

  - <u>Time-criticality:</u> ... with high urgency in case? (no = 0, yes = 1)

  - <u>Context-sensitivity:</u> ... depending on a specific context? (no = 0, yes = 1)

- Media breaks: … with any media breaks? (no = 0, yes = 1)

- Use of legacy devices: … with the use of any legacy devices? (no = 0, yes = 1)

⇨ Maximum sub scoring to be reached: 6

⇨ Maximum FTPP scoring to be reached: 24 (if all sub-scores reach the maximum value)

Note: For internal collaboration and / or external communication demands there might also be a specific information access and / or data capturing & storage demand. In this case, the demands are considered only for calculating the information access and / or data capturing & storage demand scorings. They are not considered for calculating internal collaboration and / or external communication demand scorings.

- *Obstacle Level (OL):* The OL depicts the relative degree of obstacles that have to be considered when implementing and operating a mobile enterprise service, which is calculated based on the information collected regarding:

  - Legacy enterprise applications: Is the task conducted with the use of legacy enterprise applications for which no mobile app is existing? (no = 0, yes = 1, yes – "makes the use of mobile enterprise services impossible" = STOP)

  - Mobile network connectivity: Is the task conducted at least partially without mobile network (e.g., 3G, 4G, WLAN) connectivity? (no = 0, yes = 1, yes – "makes the use of mobile enterprise services impossible" = STOP)

  - Power supply: Is there no access to power supply for more than one day within the task? (no = 0, yes = 1, yes – "makes the use of mobile enterprise services impossible" = STOP)

  - Content creation: Is content creation a part of the task? (no = 0, yes = 1, yes – "makes the use of mobile enterprise services impossible" = STOP)

- <u>Employee characteristics:</u> Are there any employee characteristics potentially depicting an obstacle for mobile device use within this task (e.g., related to staff IT affinity)? (no = 0, yes = 1, yes – "makes the use of mobile enterprise services impossible" = STOP)

- <u>Organizational characteristics:</u> Are there any organizational aspects potentially depicting an obstacle for mobile device use within this task (e.g., security concerns)? (no = 0, yes = 1, yes – "makes the use of mobile enterprise services impossible" = STOP)

- <u>Environmental characteristics:</u> Are there any external aspects potentially depicting an obstacle for mobile device use within this task (e.g., legislation-related)? (no = 0, yes = 1, yes – "makes the use of mobile enterprise services impossible" = STOP)

⇨ Maximum OL scoring to be reached: (-) 7

These KPIs show how feasible it is to support selected tasks with mobile enterprise services and are calculated based on the information collected in the previous process step. Thereby, the first four KPIs have a positive impact and the OL KPI a negative one. For reduction of complexity for decision taking and improved comprehensibility, the KPI scorings are categorized into "low" (score ≤ 1/3 of maximum value), "medium", (score ≤ 2/3 of maximum value), and "high" (score > 2/3 of maximum value). If for one OL criterion the STOP value is returned, then the task is supposed to be not eligible for mobilization. (done by MEE)

- *Select tasks:* Based on these KPIs and a custom-developed logic, tasks which are expected to benefit most from mobilization are selected for building service ideas for in the definition process. Select tasks according to 1) RPP, 2) TPPI, 3) STPP, 4) FTPP, 5) OL. The numbers show the priority of the KPI for task selection. So, first of all the tasks are sorted according to RPP scoring, second they are sorted for TPPI scoring etc. According to the parameter "maximum number of tasks to be selected" initially set, a limited number of tasks has to be selected. (done by MEE with BE)

Note: It has to be considered that the calculation of the FTPP KPI scoring and the corresponding rule to select tasks upon will differ depending on the role's current use of mobile devices (smartphones and / or tablets). In this case, if the analyzed role already uses mobile devices for work, for the overall FTPP scoring only the score of the highest scoring sub-score (demand) is taken into account. If no mobile devices are used, then the overall FTPP scoring is calculated as the sum of all sub-scores. This adjustment of KPI calculation and task selection is built upon the assumption that when there already is mobile device use at the analyzed role, general benefits of mobile device use are already gained and "only" specific enhancements provide real value added.

How to use the IDA tool

Insert the data collected in the first two process steps (on process input & output and current device use) into the sheet "1 - Identification" of the IDA tool (see Figure 35). For each task listed, copy and paste the framed block, where the data for the TPPI, STPP, FTPP, and OL KPIs have to be inserted, as a next step and include for each block the corresponding task and sub-process name (see Figure 34).

In a next step, for each task the collected data has to be transferred into the sheet "1 - Identification" of the IDA tool, to calculate the five KPIs (see Figure 35 for an excerpt of RPP data input). All data should come from a joint workshop with the RRs and ideally the BE. If it comes from a questionnaire remotely filled in by RRs then the answers can be merged and the average score inserted. For unclear cases a call can be set up with the BE and selected RRs. The tool then automatically calculates and categorizes the KPI scores (into low, medium , high), that manifest the baseline to select tasks.

Adjustments of IDA method application if more than one role is to be analyzed

If more than one role shall be analyzed, then all major steps (from capturing device use to KPI calculation) have to be separately conducted for each role. Thereby, the TPPI input (in the data collection step) should only come from the BE, to make it comparable across roles analyzed. If the mobile device use is varying across analyzed roles, it has to be agreed on one way to calculate the overall FTPP score: sum of scoring or highest demand scoring. The IDA tool has to be adjusted respectively. Moreover, the following KPI decision chain has to be applied for the final task selection: 1) TPPI, 2) RPP, 3) STPP, 4) FTPP, 5) OL.

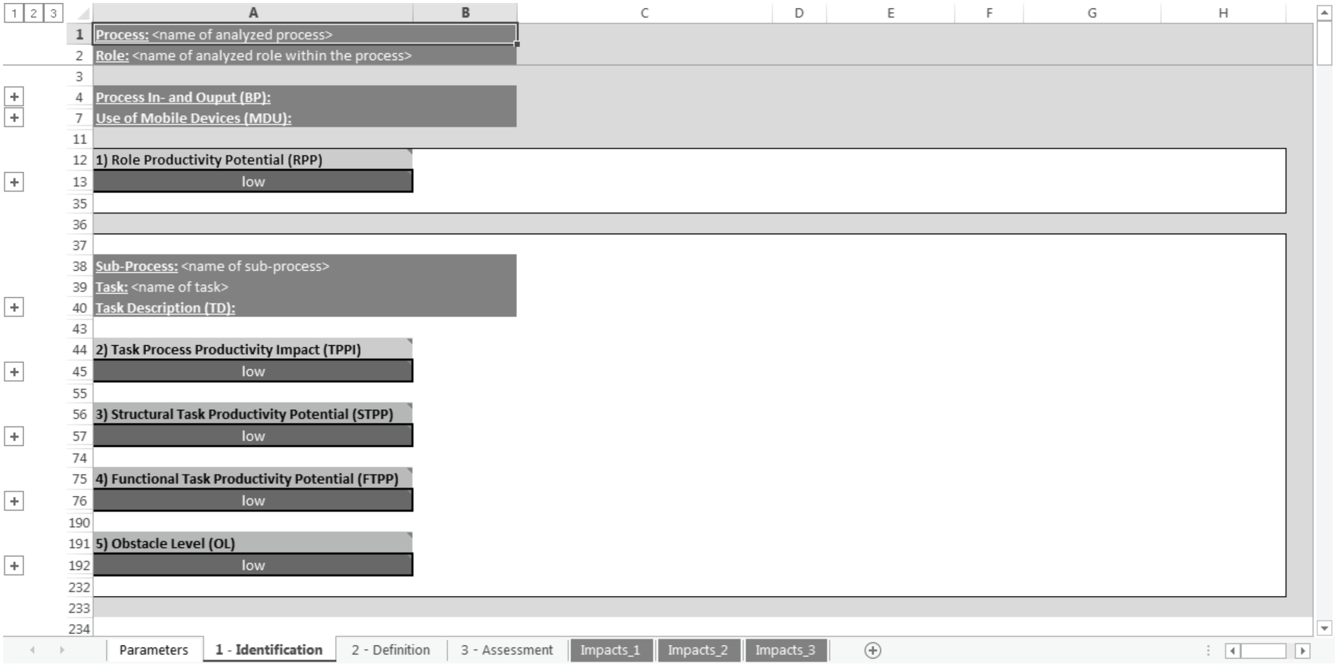


Figure 34: **IDA tool – task KPI blocks (final IDA method)**
Source: Screenshot from IDA tool of final method version

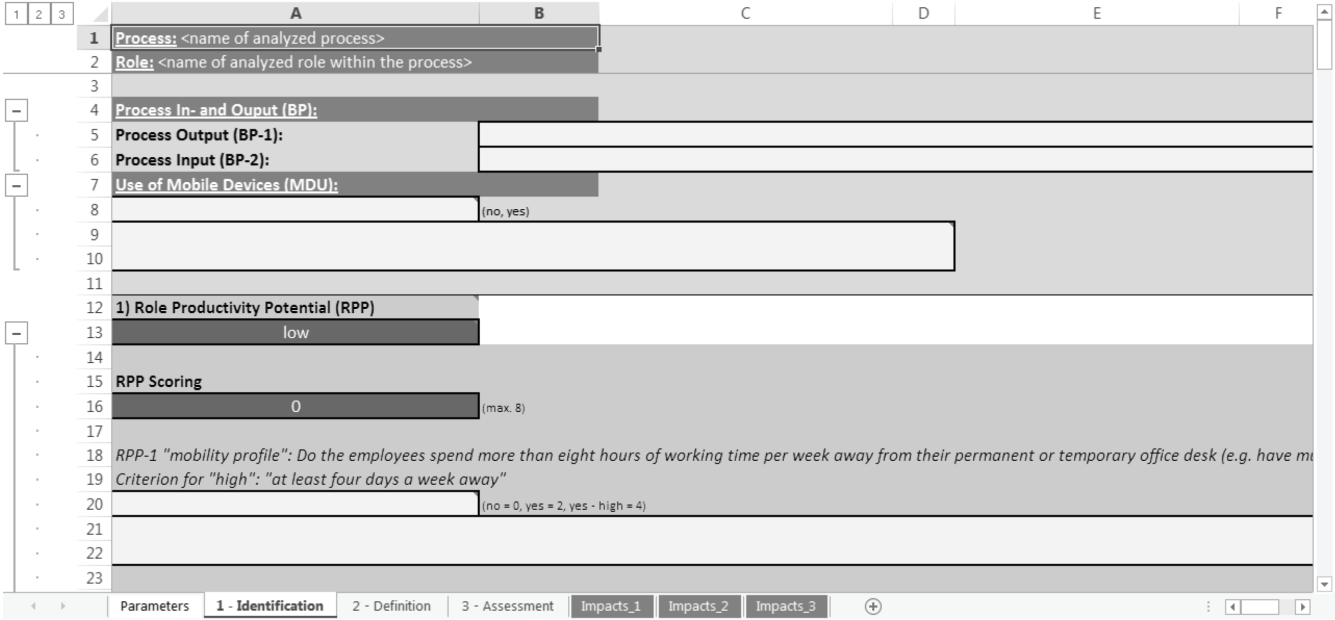


Figure 35: **IDA tool – data input for KPI scorings (final IDA method)**
Source: Screenshot from IDA tool of final method version

Grounding of the design of the identification process and technique in existing theory

The task-technology fit (TTF) concept (see, e.g., Gebauer/Shaw/Gribbins 2004; Yuan et al. 2010; Zhang et al. 2011) is exploited within the identification technique. In the TTF concept, functions of mobile work support and characteristics of tasks showing that it is beneficial to support selected tasks with mobile technology are considered to determine the perceived usefulness of mobile enterprise service use (Yuan et al. 2010). As part of the identification technique, specific task characteristics which are modeled into various KPIs are used to identify tasks that should be supported by mobile work functions for internal collaboration, external communication, information access, and / or data capturing & storage. Task characteristics showing that there is employee demand for specific mobile work functions are modeled into the FTPP KPI of the identification technique. As part of this KPI, it is considered whether the employee demand for mobile IT support implies further specifics such as time-criticality, context-sensitivity, or, e.g., media breaks – derived from functional benefits provided by mobile IT. Additionally, the importance of the task for the process productivity (TPPI), characteristics of the role conducting the task (RPP) and of the task structure (TPPI), as well as potential obstacles for mobile IT use the task possesses (OL) are considered to decide upon the suitability for task mobilization. Summarizing the presented details of the identification technique, it can be stated that the KPIs show 1) whether it is beneficial to support the task with mobile enterprise services in general, and 2) which mobile work function is best suited.

The task characteristics, screened to calculate the score referred to as "Functional Task Productivity Potential" (FTPP), are based on the elements of the mobilization score concept of the IDA method prototype. They have been refined and finally designed based on findings extracted from the existing body of literature. In section 5.2.2 – derived from literature – the different types of corporate tasks that are supposed to benefit most from mobile work functions are listed. In this section additionally, mobile (consumer) IT benefits that can result in performance impacts for corporate processes are illustrated based on literature analysis. The depicted types of tasks (derived from mobile work functions) and the functional benefits of mobile IT use constitute the theoretical foundation the FTPP KPI is derived and built upon.

Moreover, several publications on the corporate mobile IT use were screened to refine the identification process. In particular, the elaborations of Schmidt-Eisenlohr (2010), Scherz (2007), Sheng, Nah, and Siau (2005), and Strategic Growth Concepts (2012) inspired the final design of the elements of the FTPP KPI.

The “Obstacle Level” (OL) score as well is grounded in existing theory, as shown in the section 5.2.4. Four dimensions are discussed in this section related to technology, employees, organization, and environment. Especially, obstacles resulting from mobile technology characteristics, as discussed in section 5.2.1, have been derived from the body of literature and incorporated into the OL KPI: legacy enterprise applications, mobile network connectivity, power supply, and content creation. Finally, all obstacles compiled to constitute this KPI have been cross-checked for further additions against the challenges of mobile consumer device use, found through case study analysis (see section 4.3).

The “Role Productivity Potential” (RPP) and the “Structural Task Productivity Potential” (STPP) to a strong degree have been derived from the mobilization score concept of the prototype. Nevertheless, the significance of the elements of these KPIs is also supported by or discussed in existing literature[38]: mobility profile, e.g., by Scherz (2007), number of employees and task frequency, e.g., by Mladenova et al. (2011), idle time, e.g., by Lembach and Lane (2013), and task duration, e.g., by Gebauer, Shaw, and Zhao (2003)[39].

Definition process: definition of mobile enterprise service ideas

The “*definition process*” (see Figure 36) aims at defining mobile enterprise service ideas for the corporate use of mobile consumer devices, e.g., based on iOS and Android, for the tasks identified before.

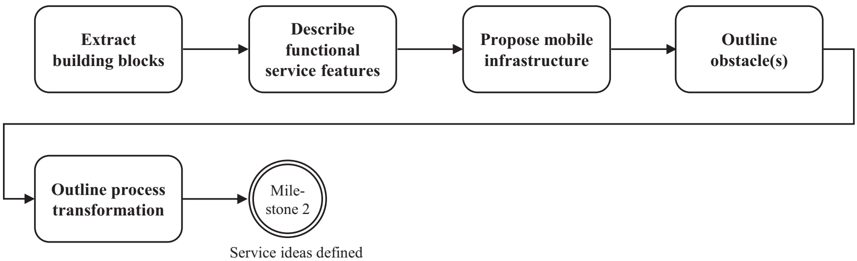


Figure 36: Overview of definition process steps (final IDA method)
Source: Own illustration

[38] For each topic only one article is referenced as an a example.
[39] Task duration can be regarded to be related to „transaction volume“ variable discussed in this article.

A corresponding technique ("*definition technique*"), supported by and described in detail in the IDA tool provides guidance on how to carry out the steps to define mobile enterprise service ideas based on extracted service idea building blocks.

Details on the definition steps and technique are listed and discussed below:

- *Extract building blocks:* For each identified task, existing employee demands gathered in the identification process (with positive calculated sub-scores) are extracted. From the KPIs calculated in the identification process, it can be derived for which specific mobile work function there is an existing employee demand. Mobile IT support for these demands is supposed to increase the process productivity. These demands are referred to as possible "building blocks" for service ideas (e.g., internal collaboration or external communication demand). They depict the baseline to build mobile enterprise service ideas. (done by MEE)

- *Describe functional service features:* For each extracted building block a service idea (e.g., mobile collaboration service) is built by describing its features. If there is a functional overlap more than one building block is clustered into one service idea. As part of the functional service description include references to the supported tasks and building blocks. The activity of detailing service ideas is supported by details and problems gathered in the identification process. Thereby, the sub items used to calculate the final sub-scores (e.g., context-sensitivity) and the collected information for these are used to detail the functional service idea description. Role representatives and business department executives could be involved into this step to leverage their role and process- / task-specific know-how. (done by MEE or MEE with RRs and BE)

- *Propose mobile infrastructure:* For each service idea, the mobile infrastructure (including device types and app architecture) to be used is proposed. This step is done based on the MEE's expertise and the insights gathered in the identification process. (done by MEE)

- *Outline obstacle(s):* The potential obstacles to be faced when implementing and operating the service ideas (and possible countermeasures) are outlined based on the insights gathered in the identification process. (done by MEE)

- *Outline process transformation:* It has to be finally outlined whether a business process reengineering (BPR) or "just" business process improvement (BPI) is required to implement the service idea. If the MEE does not have enough knowledge on the company's internal processes, the RR and BE roles should be involved. (done by MEE with RRs and BE)

How to use the IDA tool

The framed block of the sheet "2 - Definition" (Figure 37) of the IDA tool has to be copied and pasted for each service idea defined in the process. The details compiled in the single definition steps of the process have to be inserted into the respective fields (which are hidden in Figure 37).

Adjustments of IDA method application if more than one role is to be analyzed

- No adjustments required

Grounding of the design of the definition process and technique in existing theory

The definition technique follows Ulwick's (2002; 2005; 2009) outcome-driven innovation (ODI) approach. In the ODI approach, qualified experts (not customers) define the best solutions, based on extracted customer desires (Fähling/Leimeister/Krcmar 2011). This paradigm is applied as part of the technique in which the mobile enterprise expert defines service ideas based on the tasks and employee demands for specific mobile work functions identified in the identification process. The service ideas are built over so-called building blocks, which have been derived from mobile work functions compiled through literature analysis (see description of identification technique and section 5.2.2). Furthermore, the concept of process transformation (BPI / BPR) referred to in the last step of the definition process has been discovered in Pousttchi and Becker (2012).

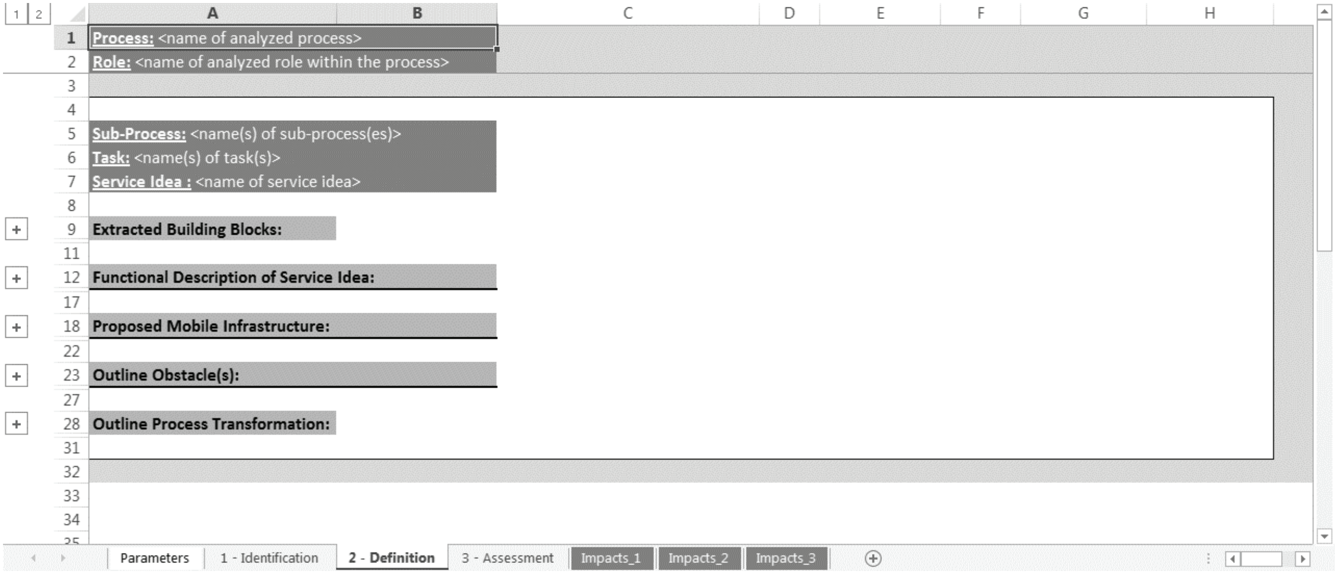


Figure 37: **IDA tool – idea definition blocks (final IDA method)**
Source: Screenshot from IDA tool of final method version

Assessment process: assessment of value added of service ideas

In the "*assessment process*" (see Figure 38) the value added is determined, illustrated in detail, and quantified on an abstract level. First, the productivity impacts are assessed through ratings of the corresponding RR. Second, TCO impact is assessed for service ideas and potential service idea bundles through the MEE.

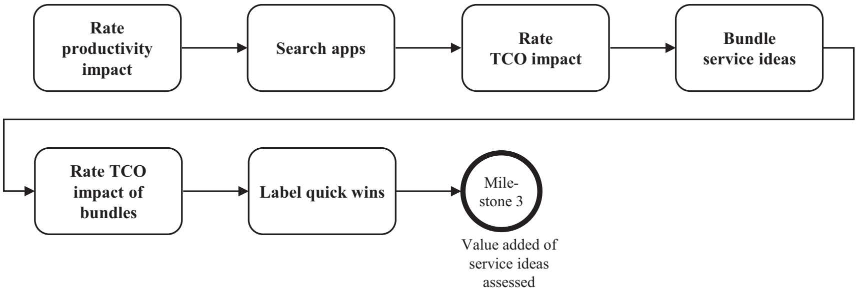


Figure 38: **Overview of assessment process steps (final IDA method)**
Source: Own illustration

Like the identification and the definition processes, the assessment process is supported by the IDA tool and a corresponding technique ("*assessment technique*"). The assessment technique is twofold, mainly enabling and detailing how on the one hand the productivity and on the other hand the TCO impacts are rated to quantify the value added of service ideas.

Details on the assessment steps and technique are listed and discussed below:

- *Rate productivity impact:* For each service idea the potential to increase the productivity of the corresponding process by task mobilization is rated by the RR, steered through the MEE. A final score is calculated, which quantifies the expected productivity impact. The expected productivity increase that the presented service idea will have on the process is rated and described, based on the process output and input elements (determined in the identification process) in the following dimensions:

    - <u>Efficiency:</u> The expected efficiency impacts have to be rated in the following sub-dimensions:

        - Reduced idle time (none = 0, low = 1, medium = 2, high = 3)

- Reduced execution time (none = 0, low = 1, medium = 2, high = 3)
- Reduced input costs (none = 0, low = 1, medium = 2, high = 3)

It is assumed that a reduction of idle time positively affects the execution time of the task, which in turn should positively affect the task's input costs.

- Effectiveness: Additionally, the expected effectiveness impact has to be rated. It is captured through the higher process output quality expected (none = 0, low = 2, medium = 4, high = 6). It is assumed that an increase of effectiveness can have a positive impact on efficiency (idle time, execution time, and / or input costs).
- Employee satisfaction: Finally, the expected employee satisfaction impact has to be rated (none = 0, low = 1, medium = 2, high = 3). It is assumed that an increase of employee satisfaction can have a positive impact on effectiveness and / or efficiency (idle time, execution time, and / or input costs).

⇨ The ratings are transformed into scores. For efficiency impact, a maximum score of 9; for effectiveness impact, a maximum score of 6; and for employee satisfaction impact, a maximum score of 3 can be achieved. In total, for the expected productivity impact, a maximum summed up score of 18 can be reached. As illustrated, efficiency gains have received the highest weight in the scoring, as it is expected that companies focus mainly on direct efficiency impacts.

If a positive effect is rated, the RRs or BE have to describe where they expect the effect to result from and exactly how they think it will affect the process. The ratings and descriptions are challenged by the MEE, based on predefined productivity impacts for service idea categories, described and listed in the IDA tool. These pre-modeled impacts additionally can be used to support the RRs or the BE in conducting the productivity ratings. Finally, processes have to be listed that might be affected positively or negatively by the service idea (mainly in terms of productivity impact). The productivity ratings can also be supported by a questionnaire, which has to be remotely filled in, but a workshop / call is required to challenge and finalize the ratings. Half a day workshop should be reserved if the productivity ratings are conducted without questionnaire support. (done by MEE with RRs or MEE with RRs with BE)

Note: All predefined productivity impacts are listed in the Appendix of this thesis.

- *Search apps:* In a next step, existing apps that can support one or more service ideas have to be searched. This is done through market research but also by asking participating RRs on apps (to be) used. Ideas with existing apps can potentially be faster implemented. The pricing details of existing apps can also be used in the next step, for TCO calculations. (done by MEE and MEE with RR)

- *Rate TCO impact:* The TCO impacts of the defined service ideas have to be rated by the MEE, based on existing expertise or market research. The TCO ratings are structured by the stages of the service lifecycle: analysis, design, implementation, publishing, operation, retirement – according to the TCO time frame initially set. To support the TCO ratings the following details on possible service lifecycle cost components are provided in the IDA tool:

    - Costs of service analysis: Project costs for IDA method application

    - Costs of service design: Project costs for service specification

    - Costs of service implementation: Costs for pilot testing, project & asset costs for service development

    - Costs of service publishing: Project costs for introduction of the service, costs for change management & communication measures

    - Costs of service operation: Costs for technical operation and support of the service, costs for technical maintenance of the service

    - Costs of service retirement: Costs for hardware disposals

  For TCO ratings concerning adjustments to the existing IT infrastructure, the MEE has to consult the corresponding internal IT experts (ITE role). Based on the initial parameter settings, the expected TCO are classified into low, medium, or high. (done by MEE with ITE)

- *Bundle service ideas:* Service ideas can be bundled ("one service, one app"), e.g., if apps are existing supporting several of the service ideas or if there is a major overlap in the cost blocks of their TCO ratings. Reasons for bundling have to be documented. Bundling opportunities are to be discussed and aligned with the BE. (done by MEE with BE)

- *Rate TCO impact of bundles:* For the service idea bundles holistic TCO ratings are conducted and classified (low, medium, or high). Comparing the TCO rating of a bundle to the sum of the TCO ratings of the single service ideas bundled shows potential cost synergies. (done by MEE)

  Note: No dedicated productivity ratings are not conducted for service idea bundles, rather the ratings of the single service ideas (which are bundled) are aggregated and presented.

- *Label quick wins:* Finally, single service ideas or bundles are labeled as quick wins if the estimated TCO are below the initially set TCO quick win margin and an app is existing. Quick wins depict service ideas to potentially start implementation with because of the low financial effort required and the existence of a mobile app for implementing the service idea. (done by MEE)

How to use the IDA tool

For each service idea to be assessed in the IDA tool, the corresponding framed block of sheet "3 - Assessment" (see Figure 39) has to be copied and pasted. In a next step, a workshop ideally with the RRs and the BE has to be held to make them rate the productivity impacts of the service ideas and ask them about existing apps. Details on existing apps and single scores have to be inserted into the IDA tool as well as details on where the specific effect is expected to result from and how it will affect the process (see Figure 40). In the IDA tool then the single efficiency, effectiveness, and employee satisfaction scores are aggregated into a so-called process productivity impact scoring.

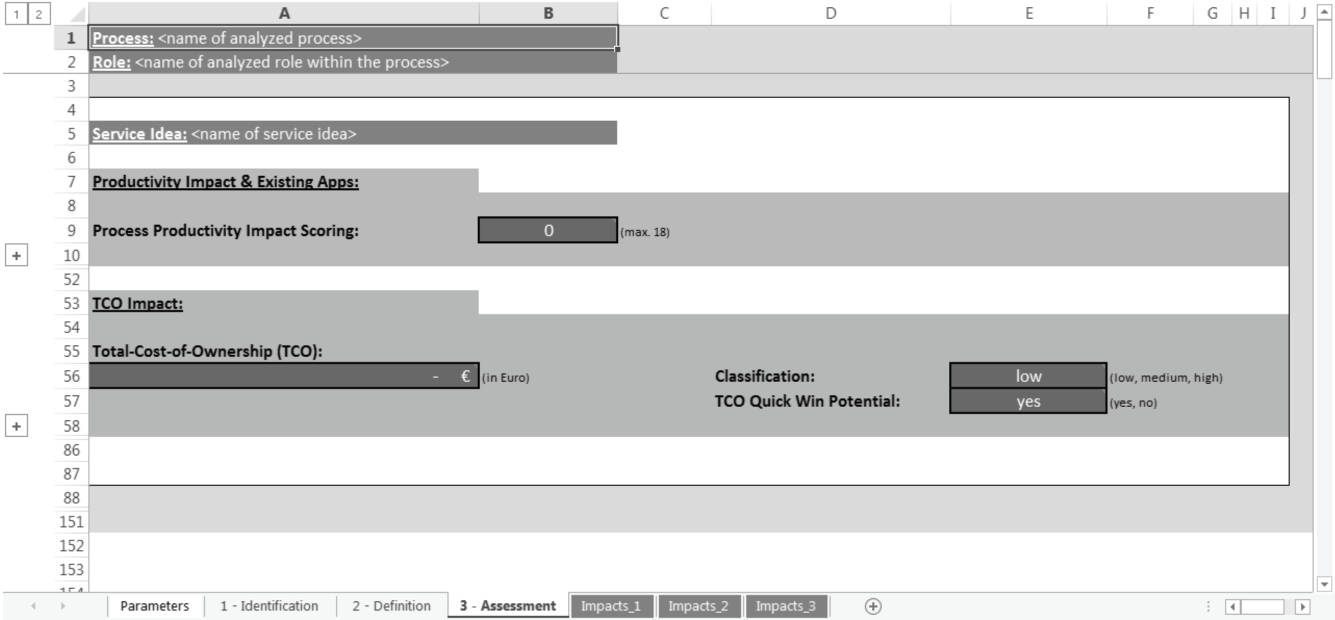


Figure 39: **IDA tool – idea assessment blocks (final IDA method)**
Source: Screenshot from IDA tool of final method version

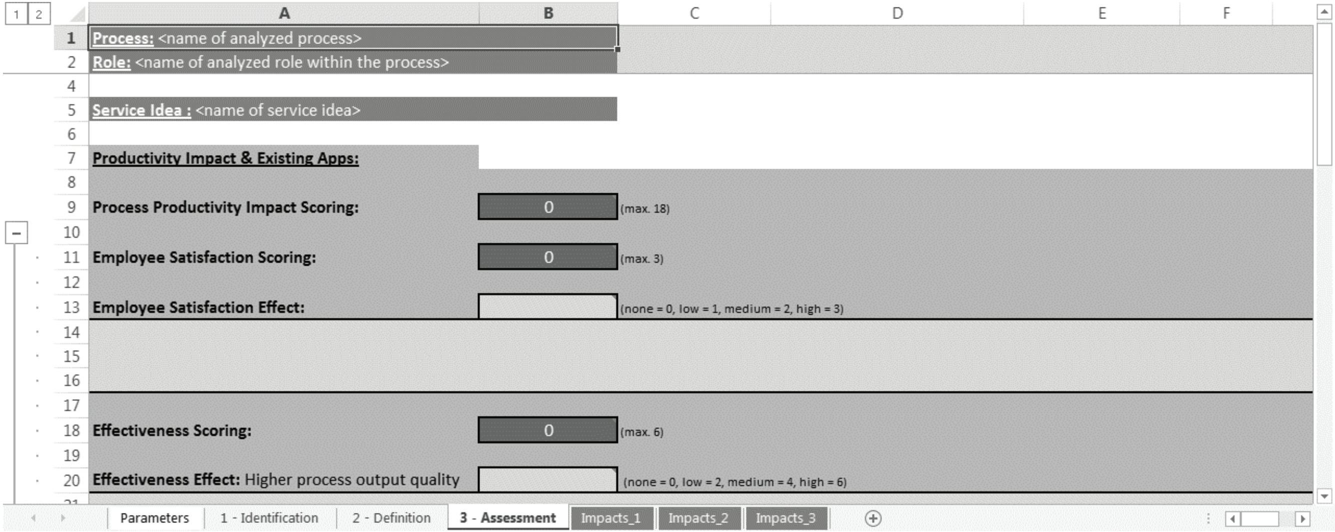


Figure 40: **IDA tool – data input for productivity ratings (final IDA method)**
Source: Screenshot from IDA tool of final method version

If the predefined questionnaire is used to collect the productivity ratings, the average of the answers can be inserted. Unclear cases and additional possible productivity impacts can be discussed and clarified with the BE and selected RRs in a joint call. To challenge or support the assessments done by the RR / BE roles the MEE can look into the "Impacts_1" sheet of the IDA tool (see Figure 41). In this sheet the four potential building blocks (and their sub-dimensions) are listed, including a reference into the sheet "Impacts_2". Based on the building blocks (and their sub-dimensions) the service idea is addressing, in "Impacts_2" predefined potential benefits and productivity impacts to expect from the service idea can be looked up (see Figure 42 for an excerpt). There are task-related impacts and impacts that possibly apply for all service ideas / tasks (see an example for both in Figure 42). Benefits and productivity impacts which are supposed to be not task-specific are believed to potentially apply for all defined service ideas, independently of the building blocks they were built upon. In "Impacts_2" additionally the mobile IT characteristics are listed which are supposed to create the specific benefit and productivity impacts. Moreover, technology characteristics possibly depicting an obstacle to leverage this specific benefit are as well outlined. In sheet "Impacts_3", for the predefined productivity impact dimensions identified in "Impacts_2", examples of concrete work-specific productivity impacts are provided (see Figure 43). As mentioned, the insights gathered though the predefined impacts and relations can be used to challenge or support the productivity ratings of the RR / BE.

Note: The details of the "Impacts" sheets of the IDA tool are listed in the Appendix of this thesis.

The use of the "Impacts" sheets shall be illustrated by an example. If a service idea is defined upon the building block "internal collaboration demand" and an existing "unpredictability" of this demand, then by using sheet "Impacts_1" the reference "1" for further look up in "Impacts_2" can be identified (see Figure 41). This reference suggests that the benefit "location-independent data capturing, access, storage, exchange & editing (e.g., at home, when travelling, in hotels)" and the productivity impacts of "reduced execution time, reduced idle time, higher perceived process output quality" can be expected from the built service idea. The mobile IT characteristics supposed to create the benefit of location-independence are mainly device portability, ubiquitous connectivity, and the personal employee use of enhanced devices (see Figure 42). Thereby, the personal employee use of enhanced devices is assumed to be linked to mobile consumer devices. Technology characteristics possibly depicting an obstacle for location-independence could be the limited mobile network coverage, limited battery capacity, limited use of input devices, and small screen size. In addition, e.g., the non-task-specific benefit of “less training for technology use required for data capturing, access, storage, exchange & editing” can be expected to come up. This benefit is believed to mainly result from the characteristic that mobile technology from the consumer market is personally used by employees. Looking into “Impacts_3” one can spot concrete examples for work-specific productivity impacts. Predefined examples leading to reduced idle listed are an increased work capability while not at desk, increased work capability from home, increased work capability after office hours, and an increased work capability while travelling.

Next, the TCO calculations for the service ideas are inserted by the MEE into the IDA tool as detailed as possible (see Figure 44). For service idea bundles, the corresponding framed blocked, reserved for in the IDA tool, is copied and pasted as often as required. Single service idea productivity impacts are inserted as previously rated and aggregated to a bundled score by the tool. TCO calculations for the bundles are carried out and inserted. Also reasons for bundling and existing apps to implement the service idea bundles are entered into the tool. If more or less than three service ideas shall be bundled the reserved framed block of sheet “3 - Assessment” of the IDA tool has to be adjusted respectively.

Note: For the sake of reducing the complexity of illustrations, no screenshots and further details on IDA tool-support of productivity and TCO ratings for bundles are depicted.

Adjustments of IDA method application if more than one role is to be analyzed

If service ideas for more than one role are to be analyzed, productivity ratings have to be finally done by the BE to make ratings comparable across roles, based on the illustrations of the RR. Moreover, bundling of service ideas is only done for service ideas within one role.

	A	B
1	Task Characteristics "FTPP items" / Building Blocks	Leading to Benefits / Productivity Impacts (used as a reference in "Impacts_2")
2	1) internal collaboration demand	1
3	a) unpredictable	1
4	b) time-critical	2
5	c) context-sensitive	3
6	d) media breaks	5
7	e) use of legacy devices	4
8	2) external communication demand	1
9	a) unpredictable	1
10	b) time-critical	2
11	c) context-sensitive	3
12	d) media breaks	5
13	e) use of legacy devices	4
14	3) information access demand	1
15	a) unpredictable	1
16	b) time-critical	2
17	c) context-sensitive	3
18	d) media breaks	5
19	e) use of legacy devices	4
20	4) data capturing & storage demand	1,3
21	a) unpredictable	1
22	b) time-critical	2
23	c) context-sensitive	3

Parameters | 1 - Identification | 2 - Definition | 3 - Assessment | Impacts_1 | Impacts_2 | Impacts_3

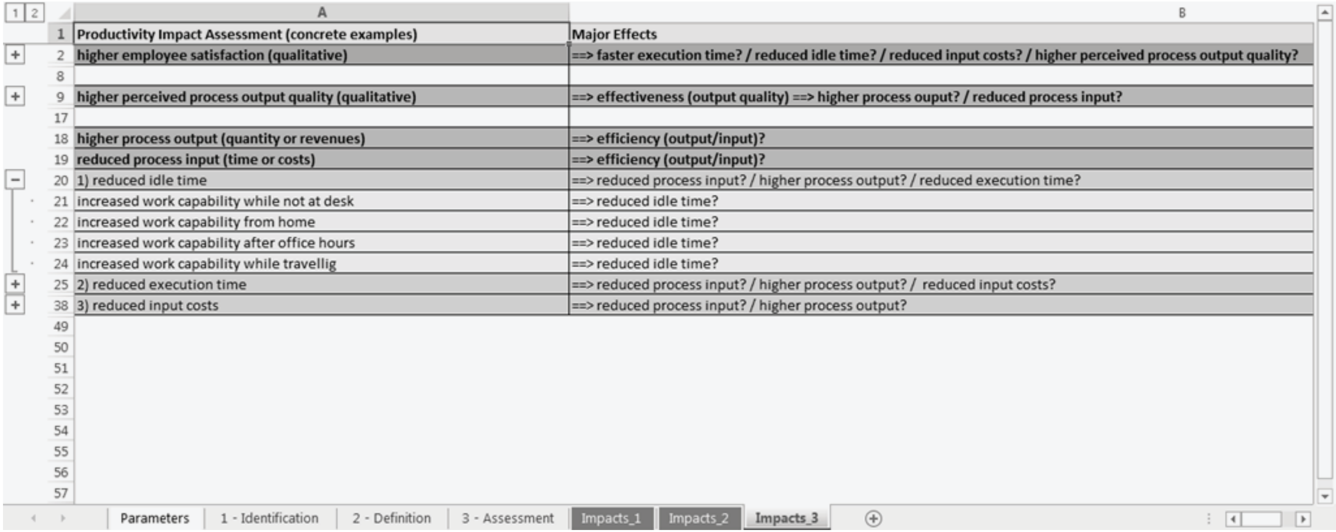
Figure 41: **IDA tool – Impacts_1 (final IDA method)**
Source: Screenshot from IDA tool of final method version

No	Benefits to be Expected	Major Productivity Impacts to be Expected	Mobile Technology Characteristics Creating Benefits / Impacts	Task or Non-Task-Specific
1	+ **location-independent** data capturing, access, storage, exchange & editing (e.g. at home, when travelling, in hotels) ==> data capturing is more location-independent as before!	==> reduced execution time, reduced idle time, higher perceived process output quality	MAINLY: device portability (size), ubiquitous connectivity, personal employee use of enhanced devices AND: **higher tablet battery capacity, larger tablet screen size (compared to smartphone),** sensors & interfaces (e.g. camera, location, BT and others like RFID), multi-media use BUT: limited mobile network coverage , limited battery capacity, limited use of input devices (e.g. mouse), small screen size	**functional / task-specific:** to be applied only to corresponding service ideas
8	+ **less training for technology use required** for data capturing, access, storage, exchange & editing	==> reduced execution time, higher employee satisfaction	MAINLY: personal employee use of enhanced devices	**non-functional / non-task-specific:** to be applied to all service ideas

underlined: characteristics of consumer devices
***bold:** characteristics of tablets*

Parameters | 1 - Identification | 2 - Definition | 3 - Assessment | Impacts_1 | Impacts_2 | Impacts_3

Figure 42: **IDA tool – Impacts_2 (final IDA method)**
Source: Screenshot from IDA tool of final method version



	A	B
1	**Productivity Impact Assessment (concrete examples)**	Major Effects
2	**higher employee satisfaction (qualitative)**	**==> faster execution time? / reduced idle time? / reduced input costs? / higher perceived process output quality?**
8		
9	**higher perceived process output quality (qualitative)**	**==> effectiveness (output quality) ==> higher process ouput? / reduced process input?**
17		
18	**higher process output (quantity or revenues)**	**==> efficiency (output/input)?**
19	**reduced process input (time or costs)**	**==> efficiency (output/input)?**
20	1) reduced idle time	==> reduced process input? / higher process output? / reduced execution time?
21	increased work capability while not at desk	==> reduced idle time?
22	increased work capability from home	==> reduced idle time?
23	increased work capability after office hours	==> reduced idle time?
24	increased work capability while travellig	==> reduced idle time?
25	2) reduced execution time	==> reduced process input? / higher process output? / reduced input costs?
38	3) reduced input costs	==> reduced process input? / higher process output?
49		
50		
51		
52		
53		
54		
55		
56		
57		

Figure 43: **IDA tool – Impacts_3 (final IDA method)**
Source: Screenshot from IDA tool of final method version

Figure 44: **IDA tool – data input for TCO ratings (final IDA method)**
Source: Screenshot from IDA tool of final method version

Grounding of the design of the assessment process and technique in existing theory

As summarized in section 6.1, process performance can be regarded to be a mediator for the IS impact on firm performance (see Schryen 2013). Moreover, the process view is described to be needed to identify value-adding IT mechanisms and to enable value measurement, as outlined by Mooney, Gurbaxani, and Kraemer (1995). For assessing the value of mobile IT use, a process-related view is proposed and applied in several publications (Valiente/van der Heijden 2002; Segev 2003; Gumpp/Pousttchi 2005; Mladenova et al. 2011).

Productivity, in particular, is a widely discussed performance measure for corporate processes (see Schryen 2013) and corporate mobile IT use[40] (see, .e.g., Gumpp/Pousttchi 2005; Pousttchi/Thurnher 2006; Pousttchi/Becker 2012; Fischer/Smolnik 2014). It is traditionally measured through efficiency gains, by assuming a constant output quality (as described by Grönroos/Ojasalo 2004). For measuring the productivity of service processes, this traditional concept is problematic because it does not account for quality changes (see McLaughlin/Coffey 1990; Grönroos/Ojasalo 2004). The concept of service productivity presented by Grönroos and Ojasalo (2004) considers this challenge. It has been taken as the baseline to derive the dimensions for capturing the expected productivity impact of service ideas, used in the assessment technique of the IDA method. The authors not only use quantitative (efficiency) but also qualitative (effectiveness) dimensions within their definition of the service productivity concept. For the assessment technique, employee satisfaction has been added as a third dimension to assess value added, to compile a productivity concept considering an additional, specific impact that consumer technology is supposed to have. Capacity efficiency, as described by Grönroos and Ojasalo (2004), has not been considered in this thesis to analyze productivity respectively performance impacts of mobile enterprise service use.

For assessing process productivity, where there are scenarios particularly in the area of service processes in which it is not easy to quantify inputs and outputs or where collection of required measurement data is difficult, subjective productivity measurements can be used (Kemppilä/Lönnqvist 2003; Vuolle et al. 2008). Especially, for assessing the intangible benefits of mobile (consumer) IT use (Leskinen 2008; Peltomäki/Hallikainen/Tuunainen 2009), including employee satisfaction (see, e.g., Sheng/Nah/Siau 2005; Niehaves/Köffer/Ortbach 2012; Pousttchi/Becker 2012; Junglas/Harris 2013), this approach can be applied. In the assessment technique of the

[40] Some cited articles refer to "efficiency" and not directly to "productivity" impacts.

IDA method, this concept is leveraged to rate productivity impacts based on personnel subjective assessments (see, e.g., Torkzadeh/Doll 1999; Lynch/Riedel 2001; Kemppilä/Lönnqvist 2003; Vuolle et al. 2008). To support these ratings, a set of predefined benefits and the resulting productivity impacts that can be expected from the mobile (consumer) device use are provided as part of the assessment technique (see illustration of "Impact" sheets of the IDA tool above). A specific sub set of these is consumer IT-specific, such as productivity impacts coming from benefits like the use of innovative technology, positive device and app user experience, and less training required for technology use. Other benefits listed, such as having less paper-based work and media breaks, are described as being enhanced by specific consumer IT characteristics like, e.g., the plethora of existing apps or the use of enhanced sensors.

The rating of efficiency gains in the service assessment technique is broken down into ratings of reduced idle time, execution time, and input costs. This classification, the assessment of productivity impacts of the mobile IT use in the dimensions efficiency, effectiveness, plus employee satisfaction, and to a certain extent the dependencies between these dimensions (and existing sub-dimensions) are supported by the body of literature, as described in section 5.2.2. Moreover, the "Impacts_1", "Impacts_2", and "Impacts_3" sheets of the IDA tool are derived from or supported by findings extracted from literature. Mobile IT characteristics (see section 5.2.1) and performance impacts of mobile IT use (see section 5.2.2) used to build the sheets are grounded in theory.

Using a scoring technique for value assessments of mobile IT use, as done for the productivity ratings, is also applied in other publications. For instance, Schmidt-Eisenlohr (2010) uses a scoring technique to assess and comparing the value of different scenarios of mobile technology use.

Finally, the cost ratings are structured by two existing concepts: the TCO concept, described in by Wiggers, Kok, and de-Boer-de Wit (2004b), and the service lifecycle model of Kohlborn, Korthaus, and Rosemann's (2009). Moreover, the design of the predefined cost components, included in the service assessment technique, has been motivated by the publications discussed in section 5.2.3.

6.3.2.3 BIE Cycle 3: Expert Interviews

A major rework of the IDA method prototype was conducted in BIE cycle 3. Input mainly came from the field study evaluation of the method prototype (see section 6.3.1.4) and the analysis of the existing body of literature (see chapters 3 and 5 for an overview of the literature reviews conducted in this thesis). The reworked IDA method was evaluated in BIE cycle 3 based on a series of expert interviews.

Building the IDA method in BIE cycle 3 (before expert interviews)

The rework of the prototype into the final IDA method was carried out by the author of this doctoral thesis. The project team of the initial action research project (to design the prototype) was not involved in the building activities anymore. The baseline for the method rework was the analysis of selected publications from the related body of literature (see chapters 3 and 5 for an overview on the literature reviews conducted) – based on refined design goals. Literature analysis provided valuable insights to redesign the method's procedure model and tool-based techniques.

The key pillars of the IDA method rework are its newly designed procedure model, the adjusted role assignments, and the reshaped techniques – based on its prototype and the analyzed literature. Major differences to the initial prototype are the left out CIP, the skipped automatic service architecture & TCO generation, and the missing focus on service implementation. Leaving out these aspects mainly was due to the narrowed focus to service analysis support (with no focus on service design or further implementation steps) and the aim to reduce the complexity of the IDA method. Particularly, the automatic service architecture and TCO generation were skipped because they possessed company specifics of the AR partner that restricted generalizability. Moreover, the underlying TCO benchmarks and rules for architecture generation hardly could have been universally applied across time and service ideas analyzed. The use case screening and service assessment processes and techniques of the prototype constituted the baseline to design the final IDA method process steps and techniques.

In the following, details on further, major redesign activities, initially applied in BIE cycle 3 to transform the IDA method prototype into the final IDA method, are listed and discussed. They are mainly derived from literature analysis, observations gathered during the method application in field study 1, and / or feedback extracted from the interviews held after field study 1:

- **Adjust task characteristics used in technique of task selection**

  Redesign task 1: Align the technique to identify and select tasks for mobilization with the TTF concept as described, e.g., in Gebauer, Shaw, and Gribbins (2004), Yuan et al. (2010), or Zhang et al. (2011). (Source: literature analysis)

➔ *Resulting design change 1:* The technique to identify and select tasks for mobilization (finally referred to as identification technique) was refined to stronger exploit the idea of the TTF concept.

Redesign task 2: The mobile technology characteristics, resulting performance impacts, and potential obstacles for the corporate mobile IT use identified in the body of literature should be used to rework the task characteristics screened in the identification technique. (Source: literature analysis)

➔ *Resulting design change 2:* The task characteristics incorporated into the identification technique were reworked based on the findings extracted from literature (see sections 5.2.1, 5.2.2, and 5.2.4).

Redesign task 3: Asking for "how important" the respective task is for value creation could enhance the technique to identify tasks for mobilization. (Source: field study 1 observations)

➔ *Resulting design change 3:* A KPI asking for the significance of the productivity impact of the task on the respective process was added to the identification technique.

- **Provide a customer-oriented technique for service idea description**

  Redesign task 1: Provide a detailed technique to compile and describe mobile enterprise service ideas based on mobile work functions and the resulting benefits provided by mobile (consumer) IT, extracted from literature. (Source: literature analysis; for mobile work functions and benefits)

  ➔ *Resulting design change 1:* Based on the mobile work functions and functional benefits of mobile technology use, a technique to build service ideas was defined, referred to as definition technique.

  Redesign task 2: Align the method's process model[41] with the outcome-driven innovation (ODI) approach from Ulwick (2002; 2005; 2009). (Source: literature analysis – from publications additionally screened beyond the structured literature reviews conducted)

[41] In the prototype, the method's procedure model was referenced to be a "process model". Wording has changed in phase II of the ADR approach.

➔ *Resulting design change 2:* ODI paradigm from Ulwick (2002; 2005; 2009) was applied, so that the service designer extracts the needs of internal customers (the business department representatives) and defines mobile enterprise service ideas, based on the designed definition technique.

- **Enhance the technique for value added assessments**

Redesign task 1: More details on the assessment of potential value added of service ideas should be provided. Additionally, value added assessments could be (partially) done by mobilization scores. A detailed technique on how to assess and quantify the value added provided by a service (defined as productivity, employee satisfaction, external image impacts in the prototype) is needed. (Sources: field study 1 interviews / BIE-2-6, field study 1 observations)

➔ *Resulting design change 1:* A new technique (finally referred to assessment technique) was defined, including a scoring logic to assess the productivity impact of service ideas rated by the RRs.

Redesign task 2: Apply the service productivity concept from Grönroos and Ojasalo (2004) as the baseline to assess and quantify performance impacts of mobile enterprise service use. (Source: literature analysis)

➔ *Resulting redesign change 2:* In the assessment technique, service ideas are rated in productivity dimensions derived from the service productivity concept from Grönroos and Ojasalo (2004). On the top-level, these dimensions are efficiency and effectiveness impacts.

Redesign task 3: Value assessments should be reworked and aligned with the performance and productivity impacts, extracted from the literature review to possibly result from mobile IT use. (Source: literature analysis)

➔ *Resulting redesign change 3:* Value assessments were reworked based on findings from the literature analysis. Potential benefits and predefined productivity impacts, possibly resulting from mobile enterprise service ideas, defined for selected tasks, are modeled into the assessment technique and the "Impacts" sheets of the IDA tool.

- **Have more MEE involvement**

  Redesign task: The PM often does not have the required expertise to guide through the method application. Therefore, the MEE should be a more active part of the use case screening and should steer the service assessment, if required knowledge-wise. (Sources: field study 1 interviews / BIE-2-4, field study 1 observations)

  ➔ *Resulting design change:* MEE and PM roles have been merged into the "service designer" (SD) role, representing a mobile enterprise expert taking over the project lead and steering of the method application.

  Note: The SD role was later renamed into "mobile enterprise expert". See details presented at the end of this section.

- **Involve BD role representatives**

  Redesign task: It is good to ask exemplary roles in the use case screening process to gather their insights from their daily operations. More should be asked. (Sources: field study 1 interviews, field study 1 observations)

  ➔ *Resulting design change:* A new role "role representative" was defined and included into the procedure model.

- **Involve central BD representative**

  Redesign task: Involve a central contact person of the business department who has the overview of the requirements. (Source: field study 1 observations)

  ➔ *Resulting design change:* New role "business department executive" was defined and included into the procedure model.

  Note: By defining a RR and BE role, the only roughly defined BD role of the prototype was split up into two roles.

- **Absorb BD ideas**

  Redesign task: Method should be flexible to absorb BD ideas outside of the current method scope, for instance apps personally used by client managers. Apps personally used by BD representatives to support their business activities could depict “quick wins” for use case screening. (Sources: field study 1 interviews / BIE-2-2, field study 1 observations)

➔ *Resulting design change:* Step “search apps”, focusing on identifying apps personally (to be) used by BD role representatives, was included in the assessment process.

The above listed redesign tasks, mostly derived from the feedback interviews & observations of field study 1 and literature analysis, were considered for the method rework. Besides those listed, there are other redesign tasks which were applied but not listed. Moreover, there is feedback and there are possible improvements mentioned in the prototype field study evaluation that were not incorporated into the method. In the following only the enhancements identified repeatedly in the feedback interviews conducted in field study 1 (see section 6.3.1.4) but not considered for rework are shortly discussed:

- The importance to provide more briefing, documentation, or explanations, e.g., for PM and BD roles and in particular to have examples for processes and use cases (enhancement BIE-2-1) was assumed to be reduced because of the newly set up SD (MEE) role, the reduced complexity of the method’s processes, and the constructed questionnaires. In particular, the introduction of the SD (MEE) role, who is supposed to be familiar with the mobile enterprise market & technologies and the IDA method, reduces the need to provide briefing material and examples for the PM role. Moreover, additional information and input material for the PM, BD, or company-internal boards, besides a standard method presentation and templates to present the results of method application, were not created in BIE cycle 3.

- Feedback related to the SAT (enhancement BIE-2-5 and partly BIE-2-1) was not considered because this tool, with its automatic architecture and TCO proposals, is not part of the reworked method anymore.

- The possible improvement of not collecting technical requirements together with the BD (enhancement BIE-2-7) was of no further importance to the method redesign as no detailed technical specification has to be created in the reworked method.

- The feedback on having all participants in the same room and to not split up the workshop for use case screening (enhancement BIE-2-3) was not further addressed in the BIE cycle 3 but in BIE cycle 5.

Building the IDA method in BIE cycle 3 (between expert interviews)

Further adjustments to the IDA method design in BIE cycle were carried out between the expert interviews, for instance, to incorporate selected feedback. The updated version of the IDA method was then used for the method walk-through in the next interview. An overview on selected major design adjustments applied in the series of expert interviews is listed below:

- **Update KPI logic of identification technique**

  Redesign task 1: Rephrase the wording of selected KPIs to better reflect their scope. (Source: expert interviews)

  ➔ *Resulting design change 1:* The wording of the KPIs – finally referred to as STPP, FTPP, and TPPI – was updated.

  Redesign task 2: Introduce a decision rule to select tasks upon. (Source: expert interviews)

  ➔ *Resulting design change 2:* A respective decision rule for selecting tasks was introduced.

  Redesign task 3: Include scores for all KPIs of the identification technique. (Source: expert interviews)

  ➔ *Resulting design change 3:* Scores were included for all KPIs.

- **Update productivity rating logic of assessment technique**

  Redesign task: For the productivity ratings, a focus should be put on process and not on task productivity. (Source: expert interview observations)

  ➔ *Resulting design change:* Process (and not task) productivity impacts were used as the baseline in the assessment technique to assess and compare service ideas.

- **Change SD role name to "mobile enterprise expert"**

  Redesign task: Role service designer should be renamed because service design is out of scope for the method. (Source: expert interview observations)

  ➔ *Resulting design change:* SD was renamed to mobile enterprise expert (MEE).

Besides those exemplary adjustments listed above, there were other minor updates done between the expert interviews not mentioned here.

Evaluating the IDA method in BIE cycle 3

In the evaluation stage of BIE cycle 3, experts on topics such as *value of IT*, *service productivity*, and *mobile enterprise* were interviewed. The first expert consulted has an academic background with his research activities and doctoral thesis focused on value of IT and service productivity. Through the academic background and post-doctoral activities in a start-up that exploits mobile technology as a major customer channel, the expert as well possesses knowledge on mobile IT services. The other three experts are IT consultants with one of them having participated in the initial prototype construction project, one only having few knowledge on the prototype from applying it partially in a consulting project, and one not being familiar with the details of the prototype at all. These three experts have knowledge in the mobile enterprise field and the provision of value added with IT services on mobile devices and its assessment, mainly through consulting projects.

In a walk-through with selected documentation on the method and its techniques & tools, the IDA method was presented to the experts in separate sessions. After each session, led by questionnaire, the expert was asked to provide feedback and potential improvement ideas in the areas of understandability, helpfulness, applicability, generalizability, interoperability, consistency, and completeness. The expert interviews were held via telephone calls, supported by a web conferencing session to present selected documentation.

Helpfulness (derived from Wurhofer et al. 2009)
The method effectively addresses and supports the design goals that were set up.
Applicability (derived from Wurhofer et al. 2009; Urbach/Würz 2012)
The method and its techniques can be applied in an organizational environment as defined.

Understandability (derived from Wurhofer et al. 2009; Urbach/Würz 2012)
The wording and notation of the method steps and its design goals are clearly understandable.
Consistency (derived from Wurhofer et al. 2009)
The method design is consistent with existing best practices or theory.
Interoperability (derived from Urbach/Würz 2012)
The method and its process steps are compatible to processes for service introduction and in particular to processes coming after the service analysis / strategy phase in business companies.
Generalizability (derived from Hevner et al. 2004)
The method can be applied across all industries and companies in the same way.
Completeness (derived from Wurhofer et al. 2009; Urbach/Würz 2012)
The method and its process steps and sub-steps are complete, compared to approaches from practice or theory.

Table 13: Evaluation criteria for IDA method design
Source: Own illustration

In all feedback categories (evaluation criteria), the interviewees were asked to rate the method, its processes, and / or its predefined design goals on a five-point Likert scale ("1" = low, "5" = high). To ease the feedback process "1" and "2" feedback values were introduced to mean that the criterion is not fulfilled. On the other hand the values "4" and "5" were introduced to mean that the criterion is fulfilled (with "optimization potential" or "with no optimization potential"). The used evaluation criteria were mainly derived from sources of the existing body of literature and are summarized in Table 13. The experts were asked to provide any feedback on potential improvements of the IDA method. In the feedback process, the Likert scale was not used to derive any statistical analysis. It was used rather to structure the interviewees' responses and to get feedback easily on the fulfillment of the evaluation criteria.

In the following, the feedback on the ratings is discussed in the different evaluation criteria. Additionally, feedback on the comparison of the IDA method prototype and the reworked IDA method is presented.

Note: The IDA method version evaluated in BIE cycle 3 had minor differences to the final version, presented in section 6.3.2.2. These differences mainly related to the details of the KPI logic used in the identification technique, inclusion of the step to outline process transformation in definition process, moving of the step to determine process in- and output into identification process, use of questionnaires, or the adjustment of selected process steps (“propose device type(s)”, “outline obstacle(s)”, “label quick wins”). All major changes applied after BIE cycle 3 can be found in sections 6.3.2.4 and 6.3.2.5.

Helpfulness of reworked IDA method: The helpfulness of the reworked IDA method had to be judged according to the four design goals. In BIE cycle 3 the wording of the design goals was different to the final one presented in section 6.3.2.1. The initial scope of the method design for BIE cycle 3 was to enable IT departments to introduce IT services for mobile consumer devices with a method supporting:

- Provision of value added through mobile enterprise service use and quantification of it (primary design goals)
- IT business alignment steered by the IT department (secondary design goal)
- Fast service introduction process (secondary design goal)

Summarizing the results of the expert interview-based evaluation, the helpfulness to reach the set design goals was in total positively rated across all goals. There was no expert who rated any of the design goals not to be fulfilled (no “1” or “2” ratings).

The design goal that addresses the “provision of value added” was seen by all experts to be reached. One interviewee, e.g., outlined that the method ensures that those services ideas most reasonable get introduced. Regarding the design goal on “quantification of value added” three of the four interviewees saw the goal to be fulfilled. Only one was unsure about it (“3” rating) because of the high number of parameters to be approximated in the assessment process, the challenge to conduct a detailed cost estimation, the challenge to estimate productivity impacts (especially when there is no monetary output), and the missing value added quantification across processes. Nevertheless, the expert outlined the structured explanation of areas of value added as an advantage provided by the method regarding the “quantification of value added”. Another interviewee mentioned that the scorings do well support the quantification goal.

The goal addressing “IT business alignment (steered by the IT department)” was rated by two experts to be reached. One could not rate this goal and one expert was unsure about it (“3” rating). A drawback mentioned thereby was the missing transparency in the method walk-through on what the involved roles are supposed to do during method application. However, the simultaneous involvement of the BE and RR roles was seen by another expert interviewed as an advantage supporting IT business alignment.

Finally, the goal focused on "fast service introduction" was seen by all interviewees to be reached. To support this judgment one expert outlined the concrete results created in through the method as an advantage.

Consistency of reworked IDA method: Regarding consistency, the expert from academia was asked to rate the consistency of the reworked IDA method and its processes with existing literature. The others were asked to rate the consistency with existing practical best practices. The feedback of all interviewees indicated consistency with literature and practice. Only the academic expert gave some literature references for further consistency checks. Moreover, one of the other experts mentioned that there still is no standard on how to introduce mobile services.

Interoperability of reworked IDA method: The interoperability of the reworked IDA method was confirmed by three of the four interviewed experts. Thereby, one expert outlined the compatibility with the ITIL framework to be an advantage of the method. One expert stated to not be able to rate this criteria.

Completeness of reworked IDA method: The completeness of the reworked IDA method was confirmed by all interviewed experts.

Applicability of reworked IDA method: Feedback questions on applicability were focused on the four processes of the reworked IDA method. Thereby the applicability of the preparation and definition processes was confirmed by all four interviewed experts. The identification and assessment processes were rated by three experts to be applicable. The one expert unsure about the applicability of the identification process ("3" rating) based the judgment on missing or insufficient rules to decide upon which task to select in the process. The existing challenge to do a detailed value added quantification (because of too much time needed for or because of the problem of getting the required data for) was rated to be a drawback of the assessment process ("3" rating).

Generalizability of reworked IDA method: All interviewees rated the reworked IDA method and its four processes to be generalizable.

Understandability of reworked IDA method: Regarding understandability, the four design goals and the four processes of the reworked IDA method had to be judged by the experts. The design goals on “quantification of value added” and “fast service introduction” were rated by all interviewees to be understandable. The design goals on “provision” of value added” and “IT business alignment (steered by the IT department)” were rated by three interviewees to be understandable. Only one interviewee was unsure about their understandability (“3” rating). For the interviewee the term “provision” was seen to be not suitable to express what is meant by the respective design goal. The same wording conflict was reported by the interviewee for the term “IT business alignment”. This term was stated to be focused on alignment of IT goals with business objectives.

In contrast to the design goals, the method’s processes (preparation to assessment) were seen by all experts to be understandable.

Comparison of reworked IDA method to method prototype: Profound feedback on the comparison of the method prototype and its reworked version could only be given by the interviewed expert who participated in the action research project to build the prototype. For method comparison again a five-point Likert scale was used (“1” = reworked method is worse, “3” = no difference, “5” = reworked method is better). The understandability, helpfulness regarding “provision of value added” and “quantification of value added”, applicability, generalizability, and completeness of the reworked IDA method was rated by this expert to be better than of the prototype.

The understandability was rated higher because of a shifting of steps into the tools that in the reworked method better describe what shall be done. Additionally, the less complex and therefore better understandable processes were seen to enhance the reworked method’s understandability. Helpfulness for “provision of value added” was seen to be higher because of more helpfulness of the results for the further use. The “quantification of value added” was even seen to be not supported in the prototype. An applicability advantage of the reworked method was stated because of the clearer focus on one process and interviewing of role representatives who are really conducting the tasks (compared to interviewing business representatives before). An increase in generalizability was reported due to fewer AR company specifics in the reworked method. In the prototype there were specifics of the AR partner, such as the TCO benchmarks, that were incorporated. Even if the technology standardization is less supported by the reworked IDA method, the expert rated it to be more complete than the prototype. The expert mentioned that in the prototype important aspects such as the value added consideration were missing.

The helpfulness regarding “IT business alignment” and “fast service introduction”, interoperability, and consistency was rated to be comparable between the two versions of the IDA method.

Potential IDA method enhancements identified in BIE cycle 3

In BIE cycle 3, possible enhancements for the IDA method rework were gathered from the interviewed experts. In the following, only possible enhancements are presented that were identified repeatedly in one interview or across several interviews:

- *BIE-3-1 “Check and explain roles”:* Check whether further roles are required in the preparation step (e.g., Finance), better explain the BE role, and give a detailed description of the duties of the BE role and its business impact.

- *BIE-3-2 “Rephrase quantification design goal”:* Because it is difficult to quantify monetary, rephrase the primary design goal which focuses on “quantification of value added”, e.g., to aim for illustration and identification of value added.

- *BIE-3-3 “Rephrase business alignment design goal”:* Avoid the use of the term “IT business alignment” within the respective design goal. It can be misleading and has a potentially different meaning than what shall be addressed in the design goal.

- *BIE-3-4 “Formulate method application requirements”:* Formulate requirements for method application. Requirements, e.g., such as that roles to be analyzed have to execute their task in a comparable manner, or that ITIL processes have to be in place within the company, or that roles have to be defined within the company.

- *BIE-3-5 “Define and explain value added”:* Thoroughly define and explain the term “value added”. Possibly consider Irani (2002) and Mitra, Sambamurthy, and Westerman (2011).

- *BIE-3-6 “Explain use of predefined impacts”:* Explain the use of the predefined value added / productivity impacts (of the IDA tool).

How the above illustrated enhancement ideas and others identified in the expert interviews were considered for the IDA method rework, is discussed in the next section (6.3.2.4).

6.3.2.4 BIE Cycle 4: Field Study 2

The IDA method was reworked in several steps, in BIE cycle 4. A first refinement was done before field study 2 was conducted, a second one was carried out while the method was applied. The IDA method was evaluated in BIE cycle 4 based on this field study and feedback interviews.

Building the IDA method in BIE cycle 4 (before field study 2)

In BIE cycle 4, the IDA method was initially refined based on evaluation results and insights extracted from further literature analysis. For this refinement, only redesign tasks which were rated by the author of this thesis to be of particular importance at this stage were applied. A selection of major redesign tasks carried out in BIE cycle 4 are the following ones:

- **Include step to capture current mobile device use**

  Redesign task: The current mobile device use ("mobile devices used or not used, yet?") of the analyzed role should be considered in the identification process. (no specific source)

  ➔ *Resulting design change:* A step to capture the current mobile device use was included into the identification process.

- **Update KPI logic of identification technique**

  Redesign task 1: The task characteristics "mobility profile" and "unproductive time" (later referred to as "idle time") should build a separate KPI because they are role-specific. At this stage of the method construction process, both characteristics were included in other KPIs and not merged into one. (Source: expert interview observations)

  ➔ *Resulting design change 1:* The RPP KPI was introduced into the KPI logic of the identification technique, comprising "unproductive time" and "mobility profile".

  Redesign task 2: Include new FTPP item "data capturing & storage" into FTPP scoring logic. The need for this specific FTPP item was derived from several related publications (see section 5.2.2 for details). (Source: literature analysis)

➔ *Resulting design change 2:* The FTPP KPI was respectively updated.

Redesign task 3: The fact that the employees "remotely" collaborate or interact with customers should be included in the corresponding FTPP items. The need for this adjustment was derived from Köhler and Gruhn (2004b). (Source: literature analysis)

➔ *Resulting design change 3:* "Remotely" was included in the FTPP items "collaboration demand" and "customer interaction demand".

Redesign task 4: Current mobile device use should to be considered in the later step of compiling the FTPP in the "calculate KPIs" step. (Source: no specific source)

➔ *Resulting design change 4:* The calculation of the FTPP score varies depending on the current mobile device use, as described in section 6.3.2.2 (see description of step "calculate KPIs").

Redesign task 5: The dimensions and sub-dimensions of the FTPP KPI have to be aligned with findings of the literature analysis on performance impacts of mobile (consumer) IT use, presented in section 5.2.2. (Source: literature analysis)

➔ *Resulting design change 5:* The FTPP KPI dimensions and sub-dimensions were respectively re-arranged to reflect the findings of the literature analysis (and conform with the ones finally used in the IDA method, presented in section 6.3.2.2).

- **Update productivity rating logic of assessment technique**

  Redesign task: More examples for productivity impacts extracted from literature could be added to the examples in "Impacts_3" sheet. (Source: literature analysis)

  ➔ *Resulting design change:* Sheet "Impacts_3" was updated respectively.

- **Include step to outline process transformation in definition process**

  Redesign task: Include a step to decide whether the service idea constitutes a business process improvement (BPI) or business process reengineering (BPR) in the definition process of the method. The concept of BPI / BPR was discovered in Pousttchi and Becker (2012). (Source: literature analysis)

➔ *Resulting design change:* In the definition process, a step to outline the type of process transformation (BPI or BPR) was included.

- **Move step to determine process in- and output into identification process**

  Redesign task: Determine process in- and outputs already in the identification steps since both are required to conduct the KPI ratings. (Source: expert interview observations)

  ➔ *Resulting design change:* Step to determine process input and output was moved into the identification process.

- **Formulate method application requirements**

  Redesign task: Formulate requirements for method application. Requirements, e.g., such as that roles to be analyzed have to execute their task in a comparable manner, or that ITIL processes have to be in place within the company, or that roles have to be defined within the company. (Source: expert interviews / BIE-3-4)

  ➔ *Resulting design change:* Limitations and requirements were formulated and inserted into the so-called IDA method description document.

  Note: The IDA method description document has been built and enhanced throughout the BIE cycles to act as a manual for the IDA method application.

- **Define and explain value added**

  Redesign task: Thoroughly define and explain the term “value added”. Possibly consider Irani (2002) and Mitra, Sambamurthy, and Westerman,(2011). (Source: expert interviews / BIE-3-5)

  ➔ *Resulting design change:* A respective definition of value added was included into the IDA method description.

- **Explain use of predefined impacts**

  Redesign task: Explain the use of the predefined value added / productivity impacts (of the IDA tool). (Source: expert interviews / BIE-3-6)

➔ *Resulting design change:* An explanation on how to use the predefined value added / productivity impacts in the IDA method and its tool was included in the IDA method description.

- **Rephrase provision of value added design goal (no. 1)**

  Redesign task: In the wording of the design goal focused on "provision of value added" both terms "provision" and "value added" have to be checked for their consistency and meaningfulness. (Source: expert interviews)

  ➔ *Resulting design change:* The meanings of the terms "value added" and "provision" were checked. As a result of this check, the term "value added" was kept and further used. The term "provision" was eliminated from the wording and the design goal in general was rephrased.

- **Rephrase quantification design goal (no. 2)**

  Redesign task: Because it is difficult to quantify monetary, rephrase the primary design goal which focuses on "quantification of value added", e.g., to mainly aim for determination and illustration of multidimensional value added. (Source: expert interviews / BIE-3-2)

  ➔ *Resulting design change:* The wording of goal was rephrased respectively. The new wording shows that the final monetary quantification is supported through the method but not done as part of the method.

- **Rephrase business alignment design goal (no. 3)**

  Redesign task: Avoid the use of the term "IT business alignment" within the respective design goal. It can be misleading and has a potentially different meaning than what shall be addressed in the design goal. (Source: expert interviews / BIE-3-3)

  ➔ *Resulting design change:* The wording of goal was rephrased respectively. The term "alignment" was substituted with the term "collaboration".

- **Rephrase fast service introduction design goal (no. 4)**

  Redesign task: Check the scope of the goal focused on “fast service introduction”. Is it the goal to have a fast service introduction or to have a fast method application? (Source: expert interview observations)

  ➔ *Resulting design change:* The wording of goal was rephrased to show that the focus is on speeding up the service analysis phase.

Besides those redesign tasks discussed above, other refinements were carried out which are not illustrated here. Moreover, the potential enhancement BIE-3-1, identified in the expert interviews (listed in the previous section), is not discussed above and was not considered at this stage of the method design process. It will be referred to and discussed in section 6.3.2.5.

Applying the IDA method in BIE cycle 4

The *second field study* was – as the first field study – conducted at a *selected sales department* of the company participating in the action research project (to build the method prototype). In this field study, the IDA method was applied a second time. The field study and feedback interviews were conducted in 2014.

In this field study, the MEE role, responsible to steer the method application, was taken over by the author of this thesis. This role was initially referred to as service designer (SD) and renamed to mobile enterprise expert (MEE) in BIE cycle 4. The role representatives (RRs) of field study 2 were two client managers form the sales department which already participated in field study 1. For complexity reduction and ease of method application, the business department executive (BE) role was not involved in the second field study. Internal IT experts (ITE role) were involved in the field study to support gathering of required information on the company-internal IT infrastructure.

Note: The version of the IDA method used in field study 2 had minor differences to the final version, presented in section 6.3.2.2. Details on enhancements incorporated into the method design after the filed study, in the final BIE cycle 5, are presented at the beginning of section 6.3.2.5.

Preparation of method application (in field study 2)

The process and role selection was done by the author of this thesis (MEE role). According to field study 1, the sales process was selected for analysis. The preparation phase was simplified by the exclusion of the BE role – no BE had to be contacted. For analysis of role profiles, the same role was selected for further analysis as in field study 1: the client manager (of a selected sales department). The same client managers as in field study 1 were contacted and asked for participation. Finally, the setting of parameters was as well done by the MEE. The following parameters were initially set:

- TCO calculation time frame: three years
- TCO Level "low": 150,000 Euro
- TCO Level "medium": 500,00 Euro
- Quick win TCO margin: 50,000 Euro
- Maximum number of tasks to be selected: 2-3

The "TCO calculation time frame" shows the years TCO of service ideas are estimated for. The "TCO level low" and "TCO level medium" depict the boundaries when the participating company respectively department regard TCO for IT service to be low, medium, or high. On top, the "quick win TCO margin" is defined as the TCO boundary under which TCO for IT services are that low that corporate approval is regarded to be no potential obstacle. The "maximum number of tasks to be selected" restricts the final step in the identification process and shall reduce the complexity and increase the efficiency of the IDA method.

Identification of tasks to be mobilized (in field study 2)

The listing of sub-processes and tasks that client managers conduct in the selected sales department ("list sub-processes and tasks" step) was not repeated in this field study. Rather, the following selection of tasks already listed in the prototype application (field study 1) was used:

- Solution development: Listening to your customer and understanding their business issues / needs and matching that with solutions.

- Business development: Looking for and planning of sales opportunities with a customer. It is a precursor to solutions development. This constitutes listening to the customer for an apparent need. Matching that need to the problem and then moving into solutions development to present a possible cure to the problem.

- Accounts receivable management: Collection of overdue payments from customers. Large multinational customers often use payment services and auditors which inevitably delay the payment process and in the case of inaccurate billing, can cause short pays etc. Often this falls to the company's commercial teams to resolve.

- Expense reporting: Filling of expense reports for sales and travel activities.

- Training: Company uses an online training based on the company's Intranet.

The collection of required information for these tasks ("collect information" step) was supposed to be done via conference calls with the two participating client managers (role representatives). Mainly due to the high mobility and restricted availability of the client managers, the collection step was finally done via Microsoft Excel-based questionnaire (see Figure 45 and Figure 46 for excerpts).

In the questionnaire general data, e.g., related to the analyzed role (e.g., mobility profile or idle time) and data specific to each analyzed task was gathered. The task specific data collected was related to the task importance (regarding productivity) for the process, general task characteristics (task duration and frequency), task-specific potential benefits of mobile technology use (e.g., remote collaboration or information access), and task-specific obstacles for its use (e.g., mobile network coverage or power supply). The questionnaire was also used to get task descriptions listed above as well as the required insights on general data such as process input & output and on current device use ("determine process input and output" and "capture current device use" steps). Thereby, costs for employees and software costs for CRM tools were determined to be the process input and sales of the company's products to be the process output. BYOD tablets and corporate smartphones were reported to be used by client managers. On these devices, e-mail (PIM), expense reporting (corporate selected vendor), and a CRM web tool are mobile services provided.

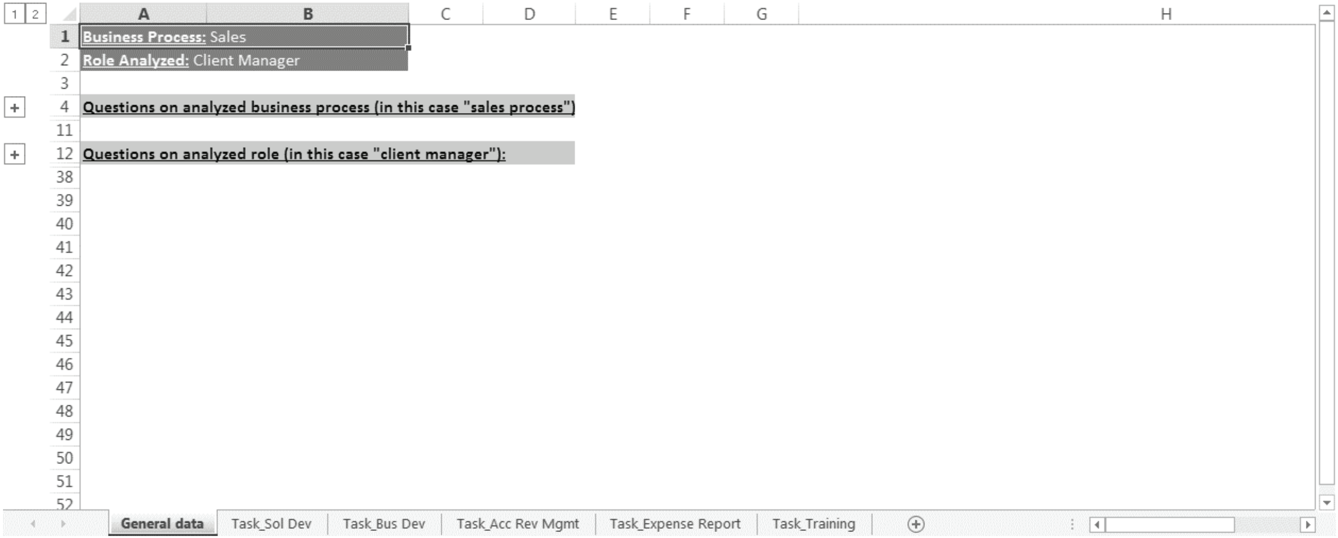


Figure 45: **Questionnaire – collect general data (field study 2)**
Source: Screenshot from questionnaire used in field study 2

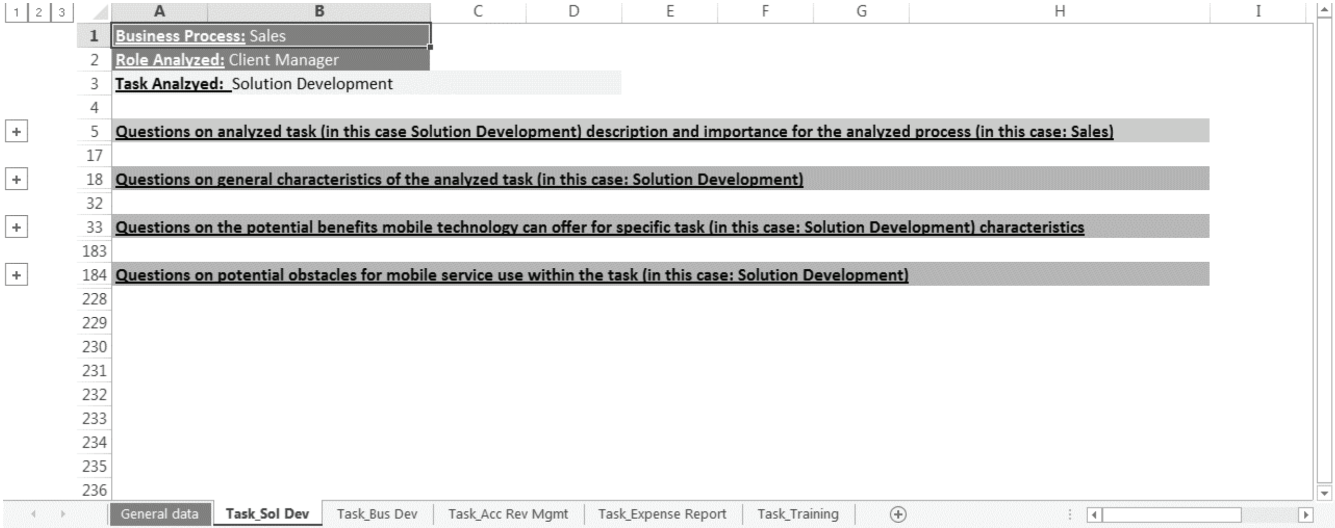


Figure 46: Questionnaire – collect task specific data (field study 2)
Source: Screenshot from questionnaire used in field study 2

Based on the information collected in the questionnaire, scores for the predefined KPIs were calculated in the IDA tool ("calculate KPIs" step) for the five selected client manager tasks (see Figure 47 for the aggregated presentation of the results in the predefined template). For each task, the "RPP (role productivity potential)", "TPPI (task process productivity impact)", "STPP (structural task productivity potential)", "FTPP (functional task productivity potential)", and the "OL (obstacle level)" KPIs built the foundation to select tasks for further in-depth analysis. KPIs derived from role characteristics (RPP) or task characteristics (TPPI, STPP, and FTPP) give an indication to which degree a task conducted by a specific role is suitable regarding the given potential to increase the respective process productivity with mobile service support. Additionally, the OL shows the degree of potential task-related obstacles for mobile service use. All KPIs are divided into "low", "medium", and "high", based on a predefined logic, to reduce the complexity of decision taking.

Task	**RPP**	**TPPI**	**STPP**	**FTPP**	**OL**
Solution development	medium (3 of 8)	high (3 of 3)	high (3 of 4)	high (5 of 6)	high (5 of 7)
Business development	medium (3 of 8)	high (3 of 3)	high (3 of 4)	medium (4 of 6)	medium (3 of 7)
Accounts receivable management	medium (3 of 8)	medium (1,5 of 3)	low (0 of 4)	medium (2/4 of 6)	low (2 of 7)
Expense reporting	medium (3 of 8)	medium (2 of 3)	low (0 of 4)	medium (2/3 of 6)	low (2 of 7)
Training	medium (3 of 8)	medium (2 of 3)	low (0 of 4)	low (1 of 6)	low (1 of 7)

Figure 47: Summary of results of identification process (field study 2)
Source: Excerpt from results documentation of field study 2

In Figure 47, the scorings and related KPIs calculated in field study 2 are shown. As only one role was analyzed, the RPP is the same for all analyzed tasks. Next, based on TPPI, STPP, and FTPP KPIs, the solution development and business development tasks could clearly be selected as ranked top among the five tasks – even at the highest obstacle level. The obstacles identified through the questionnaire were all judged to be manageable. The decision rule for task selection mainly considers the KPIs from "left to right": first RPP values are compared, then TPPI values, etc. As put down in the initial parameter setting (the maximum number of tasks to be selected was set to "2-3") a third task was selected in the identification process. The KPI scorings for the accounts receivable management and expense reporting tasks nearly matched. Therefore to decide upon task selection potential bundling effects of mobile service functions were considered in the FTPP KPI. For accounts receivable management it was expected that a service bundling regarding collaboration (sub-score “2”) and customer interaction (sub-score “2”) demands would be possible. Service bundling opportunities for expense reporting were seen in information access (sub-score “1”) and data capturing & storage (sub-score “2”) demands. Considering these potential bundling effects, the accounts receivable management task scored higher (“4”) than the expense reporting task (“3”).

Note: In field study 2, the rule to categorize KPI scores into “low” slightly varied to the one finally used in the IDA method. KPI scores < 1/3 of possible KPI maximum score were rated to be “low” and not scores ≤ 1/3. This would have changed the score of the FTPP score of accounts receivable management and expense reporting tasks each to low (and not to medium, as depicted in Figure 47). Since the scores of those tasks are higher than the scores of the training task, this would have had no impact on final task selection.

Definition of mobile enterprise service ideas (in field study 2)

In the definition process, mobile enterprise service ideas were defined for the selected tasks, based on the KPI calculation of the identification process. As described earlier in the reworked IDA method, service idea definition comprises the building of the service idea but also the proposal of mobile infrastructure, outlining of obstacles as well as of required process transformations.

An overview of the service ideas that were defined in field study 2 across the three selected tasks and extracted service ideas building blocks is given in Figure 48. In the IDA method, service ideas are built over four different so-called building blocks. Two of these possible building blocks are “collaboration demand” and “customer interaction demand”. The definition of service ideas is supported in the IDA tool by providing a form and instructions for the detailed description of the service ideas.

The mobile collaboration service idea supports solution and business development tasks and addresses collaboration and customer interaction demand. Respectively for the other service ideas, the details can be extracted from Figure 48. The mobile collaboration service shall enable client managers to collaborate with other employees to resolve customer issues. With the support of a mobile shipment tracking service, client managers could more quickly resolve lost or late shipment customer issues. A mobile claim management service would enable client managers to receive customer claims, e.g., on damaged shipments wherever they are and quickly respond to unforeseen customer claims by directly sending a response or informing internal departments that have to further handle the claim. A mobile file storage service would enable client managers to store any data in a central file storage, to access it location-independently or share it with customers or payment providers.

Service Idea	Task(s)	Building Block(s)
Mobile collaboration service - Device: Corporate iPad - Obstacle: Content creation, battery life - BPI	Solution & business development	Collaboration & customer interaction demand
Mobile shipments tracking service - Device: Corporate smartphone - Obstacle: Battery life - BPR?	Solution development	Customer interaction demand
Mobile claim management service - Device: Corporate smartphone - Obstacle: Battery life - BPR?	Solution development	Customer interaction demand
Mobile file storage service - Device: Corporate iPad - Obstacle: Battery life - BPI	Solution development, accounts receivable management	Collaboration & customer interaction demand

Figure 48: Summary of results of definition process (field study 2)
Source: Excerpt from results documentation of field study 2

In the following an example of the detailed service idea definition done in field study 2 is provided for the mobile file storage service idea:

- Functional use cases supported: A mobile file storage service would enable client managers to store any documentation (e.g., product presentations) or accounts receivable data in a central file storage and to access it location-independently, e.g., to present documents to the customer on a mobile device or to discuss accounts receivable data with customer payment approval staff or their 3rd party payment providers. Additionally selected data such as accounts receivable data could be shared with customers or payment providers through the mobile file storage service, which as well would be accessed through a web interface by anybody who is eligible. Compared to accessing data & documentation through e-mail attachments on mobile devices, an app-based mobile file storage provides a more structured, more convenient, and faster file access, even offline. If there is (unforeseen) data & documentation access demand while travelling or at the customer site colleagues can quickly push data (e.g., accounts receivable data) remotely into the mobile file storage so that the customer manager can easily access it. Media breaks are eliminated if all data & documentation required while travelling or while being at the customer is stored into the corresponding online file storage.

- Proposed mobile infrastructure: The mobile file storage service should be provided as a mobile (native or web) app mainly on tablets. Tablets should be used to access and present data, e.g., to customers due to their larger screen size. Before introducing the mobile file storage service an MDM service should be available to provide the required level of security. If data privacy wise the MDM service could also be used on personal employee devices, client managers could also use the mobile file storage service on personal mobile devices. To keep the usability as high as possible no VPN client shall have to be used to connect to the service (other infrastructural components shall provide this capability). The service shall be provided at least for iOS and Android tablets.

- Potential obstacles for mobile service use: The use of tablets would provide longer battery life than using smartphones typically. Additional battery life can easily be provided by using additional external power supplies for mobile devices. The use of tablets also supports better editing of data stored in the file storage on a mobile device.

Assessment of value added of service ideas (in field study 2)

The assessment – like the identification – process was supported through an Excel-based questionnaire (see Figure 49 for excerpt from it on questions on cost effects). It was mainly used to get the productivity ratings of the client managers for the defined service ideas in the predefined assessment dimensions. These dimensions are “employee satisfaction”, “effectiveness”, and “efficiency” effects. Thereby, effectiveness impacts are modeled through process quality effects. Efficiency impacts were modeled through effects on process idle time, execution time, and internal costs. The questionnaire was also used to ask for other processes (besides sales) that might be positively affected by the service idea and to ask for known apps that could support the idea. In addition to the questionnaire fillings (done by one of the client managers), separate calls with each client manager (and e-mail communication) were used to discuss in iterative cycles the productivity ratings and to challenge and complete it, based on predefined potential productivity impacts.

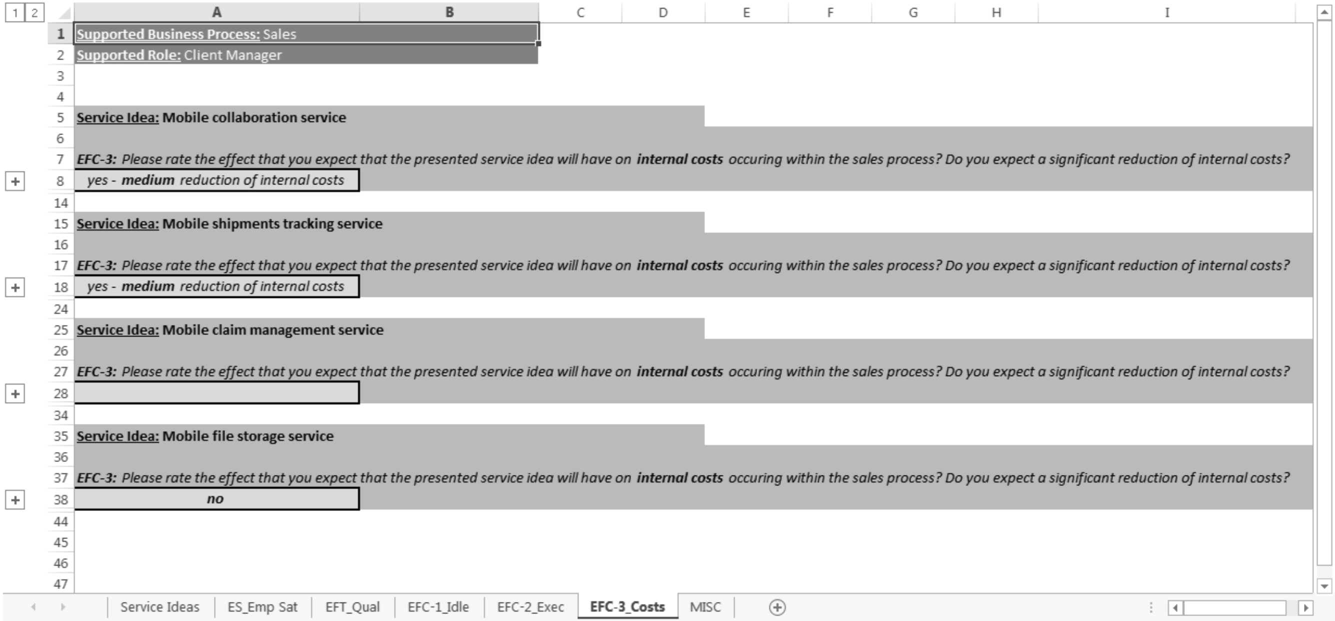


Figure 49: **Questionnaire – rate cost impacts (field study 2)**
Source: Screenshot from questionnaire used in field study 2

The mobile claim management service idea was not further assessed in the process. During the field study, in discussions with the client managers, it became obvious that claim management actually not is a task conducted by the client managers of the selected sales department. Therefore the related service idea was taken out of focus.

Existing apps for the service ideas in focus were not only asked for in the questionnaire but also searched for on the Internet. In a next step, the TCO impacts had to be rated for the service ideas. This was done by the author of the thesis (in his MEE role) supported by an external mobile enterprise expert and internal IT experts (ITE role) of the AR company. An initial TCO calculation was done by the MEE. This calculation was verified, discussed, and adjusted together with the external mobile enterprise expert. Required internal TCO data was requested from the internal IT experts.

<table>
<tr><th>Idea Name</th><th>Productivity</th><th>Side Effects</th><th>TCO</th><th>Quick Win</th><th>Existing Apps</th></tr>
<tr><td rowspan="2">Mobile collaboration service

(bundle potential)</td><td>13
of 18</td><td>expense & sales reporting, ARM</td><td>724,750 €
(high)</td><td>Costs = no
App = yes</td><td rowspan="2">Microsoft Lync (basis for TCO calculation)</td></tr>
<tr><td colspan="2"><u>Productivity impacts:</u>
Reduced idle & execution time and costs plus increase of quality & employee satisfaction</td><td colspan="2"><u>TCO drivers:</u>
Implementation (iPad costs), operation (service fees, rate plan)</td></tr>
<tr><td rowspan="2">Mobile shipments tracking service</td><td>11,5
of 18</td><td>payment</td><td>591,750 €
(high)</td><td>Costs = no
App = no</td><td rowspan="2">Existing apps, but no app across all tracking functions</td></tr>
<tr><td colspan="2"><u>Productivity impacts:</u>
Reduced execution time and costs plus increase of quality & employee satisfaction</td><td colspan="2"><u>TCO drivers:</u>
Implementation (app development), operation (service fees)</td></tr>
<tr><td rowspan="2">Mobile file storage service

(bundle potential)</td><td>12
of 18</td><td>global bid team</td><td>857,610 €
(high)</td><td>Costs = no
App = yes</td><td rowspan="2">Dropbox for business (basis for TCO calculation), Brainloop</td></tr>
<tr><td colspan="2"><u>Productivity impacts:</u>
Reduced idle and execution time plus increase of quality & employee satisfaction</td><td colspan="2"><u>TCO drivers:</u>
Implementation (iPad costs), operation (service fees, rate plan)</td></tr>
</table>

Figure 50: Summary of results of assessment process (field study 2)
Source: Excerpt from results documentation of field study 2

In Figure 50, the results of the assessment process taken from field study 2 are illustrated. For explanation, the details of the assessment of the mobile file storage service idea are explained. From the productivity ratings of the client managers in the predefined productivity dimensions and sub-dimensions, in the IDA tool a score which quantifies the aggregated potential productivity impact of the service idea on the sales process (of the selected department) is calculated. In the case of mobile file storage, this score was

12 (of 18). It was supposed to result from efficiency impacts from reduced idle time and reduced execution time. Additionally, an expected increase of sales quality and employee satisfaction contributed to this score. TCO ratings were as well inserted into the IDA tool, so that finally the value added of the defined service ideas could be compared.

Not depicted in Figure 50 but extracted from the client managers' productivity ratings were the following details, which illustrate in more detail the expected multidimensional benefits of the mobile file storage service idea:

- Reduced idle time: It is highly convenient in circumstances of remote travel, airport use etc. Much is driven by connectivity of the devices. Wifi-enabled devices provide more options on when content can be shared vs. Internet-only devices.
- Reduced execution time: It reduces execution time on responses to customers. It offers the ability to response quickly on or ahead of a deadline, which is valuable to customers and sales teams alike. The service can provide faster access to large data that cannot be sent via mail. Resulting reduction of idle time could lead to reduced execution time (e.g., at sharing of large items).
- Increase of sales quality: It would improve the ability to react quickly and conveniently to customer deadlines. A higher perceived process output quality could also result from the use of the mobile file storage service, as it provides ...
    - better image at customer, because of the use of innovative mobile file storage service (so far limited to e-mail and Sharepoint),
    - higher flexibility as data required location-independently, e.g., at the customer site can be data-size-independent provided by colleagues into the file storage and accessed by client managers,
    - higher flexibility if all required data is without media breaks available in the file storage wherever the client managers are.
- Increase of employee satisfaction: The use of mobile consumer technology, such as an iPad is expected to provide several benefits related to employee satisfaction, such as:

- use of innovative app & device technology,
- use of familiar app & device technology,
- use of app & device technology with high positive user experience,
- use of one device for business and personal purposes – if allowed by the company.

Standard file sharing tools like Dropbox (for business) are existing apps to provide the required functionality. However, security concerns could hinder the use of Dropbox. An option could be Brainloop. Other processes that might be affected by a mobile file storage, identified in the assessment process, are the processes of the AR company's global bid team. For instance, their ability to share and review documents with sales prior to bid submission deadlines could be improved.

The TCO over the next three years were estimated to be about 857,610 Euro. The main cost drivers identified were implementation cost for iPad devices and operational costs for service fees and rate plans. In total, mobile file storage could not be regarded to be a potential quick win. On the one hand, an app is existing, but on the other hand the estimated TCO are above the initially set quick win margin of 50,000 Euro.

In the assessment process as well bundling and TCO ratings for these bundles were conducted. As depicted in Figure 50, the mobile collaboration and mobile file storage service ideas possess bundling potential with both focusing on support of solution development as well as collaboration and customer interaction demand. The total estimated bundle service TCO were 922,860 Euro. Cost synergies of service bundling thereby were identified, e.g., for the iPad or MDM costs.

Note: The presented results of field studies 1 and 2 have been slightly disguised for confidentiality reasons. Mainly, the role names, task names, and service idea details have been slightly adjusted to increase the level of anonymization.

Building the IDA Method in BIE cycle 4 (in field study 2)

While applying the IDA method in field study 2, the method was incrementally adjusted and refined. These incremental build activities were mainly incorporated to increase understandability, applicability, and helpfulness of the method in the field study and resulted from observations gathered by the author of this thesis during method application.

They were directly applied in the field study because they were rated to be necessary for the method design. A selection of major top-level refinements carried out during field study 2 are discussed in the following:

- **Update KPI logic of identification technique**

  Redesign task 1: The TPPI KPI at this stage of the method construction process asked separately for efficiency and effectiveness impacts of a task on the respective process. It became obvious that it is hard to differentiate between effectiveness and efficiency ratings in the TPPI scoring. (Source: field study 2 observations)

  ➔ *Resulting design change 1:* TPPI KPI “only” focuses and asks for total productivity impact of a task on the respective process.

  Redesign task 2: Move task characteristic “number of employees” to RPP KPI. (Source: field study 2 observations)

  ➔ *Resulting design change 2:* Change was respectively conducted.

  Note: Details, e.g., on wording updates and minor adjustments to task characteristics or FTPP items, have not been illustrated and discussed above.

- **Update productivity rating logic of assessment technique**

  Redesign task 1: Adjustment of effectiveness rating: It should be only asked for ratings of “process output quality” since it is possibly very hard for RRs to differentiate between process and outcome quality, e.g., for the sales process. At this stage of the method construction, it was asked for impacts on process quality and outcome quality. (Source: field study 2 observations)

  ➔ *Resulting design change 1:* Rating of effectiveness impacts is reduced to “process output quality”.

  Redesign task 2: More examples for productivity impacts extracted from literature could be added to the exemplary impacts in “Impacts_3” sheet. (Source: literature analysis)

  ➔ *Resulting design change 2:* Sheet “Impacts_3” was updated respectively.

- **Have questionnaires that can be filled in remotely by RRs**

  Redesign task: If the role representatives (RRs) are very "mobile", then the "collect information" (identification) and "rate productivity impact" (assessment) steps must be supported by questionnaires, that easily can be filled remotely by the RRs. These questionnaires should be discussed with the RRs and (ideally) BE for validation and clarification purposes. (Source: field study 2 observations)

  ➔ *Resulting design change:* Two questionnaires were set up and tested in the method application in field study 2. Additionally, a note referring to the use of these questionnaires was inserted into the IDA method description.

- **Adjust process step "propose device type(s)"**

  Redesign task: Adjust the step "propose device type(s)" of the definition process to focus on total mobile infrastructure. (Source: field study 2 observations)

  ➔ *Resulting design change:* The IDA method description, questionnaires, and IDA tool were adjusted respectively.

- **Adjust process step "outline obstacle(s)"**

  Redesign task: In the "outline obstacle(s)" step of the definition process, possible countermeasures should as well be addressed. (Source: field study 2 observations)

  ➔ *Resulting design change:* The IDA method description and IDA tool were adjusted respectively.

- **Adjust step "label quick wins"**

  Redesign task: For labelling a service idea as a quick win besides considering the costs, the existence of an app should also be a criterion. (Source: field study 2 observations)

  ➔ *Resulting design change:* The IDA method description and IDA tool were adjusted respectively.

Other refinements than those listed and discussed were done at this stage of the design process but for the sake of reduced complexity are not discussed here.

Evaluating the IDA Method in BIE cycle 4

The application of the IDA method in field study 2 had some deviations compared to the process steps defined in the method's procedure model. In the following the major deviations are discussed. As outlined in the description of field study 2, no BE role was involved in the process of applying the IDA method. Therefore, e.g., parameter setting in the preparation process and task selection in the identification processes were done by the author of this thesis who took over the MEE role. Moreover, there was no process and role selection done in the preparation phase. The process (sales) and role (client manager) to be analyzed were predetermined due to the scope of the prototype application (field study 1). Additionally, tasks were not listed again in the identification process. Rather, a selection of tasks named during the prototype application was taken as baseline. Finally, for the calculation of TCO, internal IT experts were only marginally involved. The calculated TCO figures could have been more company-specific if there had been a more intense, joint TCO calculation. Moreover, some incremental refinements were done to the method just during its application in field study 2, as described previously. A major refinement applied in the field study was the use of dedicated and optimized questionnaires in the identification and assessment processes, which could be easily and remotely filled. The questionnaires were discussed between the involved client managers (RRs) and the author of this thesis (MEE) via telephone calls or mail communication. In several iterative communication cycles the questionnaires were filled in. Thereby, most of the information gathered was provided by one of the client managers and verified or adjusted by the other one. Only rarely just one of the two client managers acted as single information source (e.g., for the questions in the assessment process on existing apps or other affected processes).

The main focus of the field study was to test how the designed techniques are supporting the *primary design goals*. The design goals focused on "collaboration between IT and business departments" and "fast service analysis" could only be tested limited.

The final field study emphasizes the *helpfulness* of the IDA method. By applying the method, tasks could be selected and service ideas could be defined for, that were rated to provide productivity benefits to the RR. Moreover, defined service ideas could be assessed and the multidimensional productivity-related value added illustrated. The field study also indicates that the IDA method can enable IT departments to proactively steer IT and business collaboration and that if company internal resources would be available for interviews and workshops, a two-week cycle time could be reached. Moreover, it demonstrates the *applicability* of the IDA method, as it could be applied at a sales department in a business company. Its successful application also provides evidence for its understandability.

After the field study, not only the results but also the design of the IDA method were discussed in *feedback interviews with three experts from the AR partner's IT department* who had already participated in the field study of BIE cycle 2 (in MEE or PM role). The three, separate feedback interviews started with a short presentation of the IDA method prototype, followed by a walk-through of the IDA method based on selected documentation and a presentation of the results of field study 2. Feedback of each expert was gathered in a questionnaire-based interview. Interviews were held via telephone calls, supported by a web conferencing session to present the selected documentation. The feedback was gathered in the same categories as done in the expert interviews of BIE cycle 3, discussed in section 6.3.2.3. Thereby, as done in these previous interviews the experts were asked to rate the method, its processes, and / or its predefined design goals on a five-point Likert scale ("1" = low, "5" = high). The experts were as well asked to provide any feedback on potential improvements to the IDA method. In addition, in all categories the experts were asked to compare the IDA method to its prototype. For method comparison again a five-point Likert scale was used ("1" = reworked method is worse, "3" = no difference, "5" = reworked method is better).

Helpfulness of reworked IDA method: The wording of the design goals guiding BIE cycle 4 and its evaluation steps did not vary in terms of overall scope, but in their wording to the final set of design goals. The following wording was used in the evaluation of BIE cycle 4:

- Primary design goal: Enable IT departments to introduce IT services for mobile consumer devices that provide a high value added (= productivity gains from efficiency and effectiveness gains - TCO).

- Primary design goal: Support IT departments to assess and illustrate the detailed, multidimensional value added of IT services for mobile consumer devices. Multidimensional value added assessments shall support later value added quantifications in pilot tests.

- Secondary design goal: Support a tight collaboration between IT and business departments (steered by the IT) during the service analysis phase of IT service introductions for mobile consumer devices.

- Secondary design goal: Support IT departments to quickly conduct service analysis to determine which IT service(s) for mobile consumer devices to introduce.

The evaluation of the IDA method through feedback interviews in BIE cycle 4 confirms the helpfulness of the IDA method (with no “1” or “2” ratings). The primary design goals, focused on assessment of value added, were seen by all interviewees to be met (with only “4” or “5” ratings). Moreover, for the two primary design goals, the final version of the method was judged by all interviewed IT experts to be more helpful than the method’s prototype. One expert for instance mentioned that the multidimensional value assessment and illustration was not part of the prototype. Another interviewee stated that the primary design goals are better met by the reworked method because it is described more understandable and has got a better handling, leading to a higher efficiency. The third interviewee, e.g., saw the predefined value added impacts and the reworked scorings to be an advantage over the previous method prototype regarding fulfillment of the primary design goals. This expert thereby also outlined the benchmark cost figures of the prototype to be a possible issue because they could have been invalid and were merely a rough estimation.

Regarding the secondary design goal to provide tight collaboration between IT and business departments, two experts stated that the reworked IDA method fulfills this goal and one was unsure about it (“3” rating). The two experts who reported this goal to be reached mentioned the structured approach to be a characteristic of the method supporting this goal. One of the interviewees thereby additionally mentioned the designed BE role involvement. Comparing the two versions of the method, two experts did not see any difference in reaching this design goal and one saw an improvement because of the enhanced understandability supporting the collaboration. Finally, the ability to support a quick service analysis was rated by two interviewees to be reached. One interviewee mentioned that missing TCO benchmarks and the use of MEE instead of a generic project manager depicts a bottleneck to possibly slow down the method application. This interviewee was unsure about the goal fulfillment (“3” rating) and also saw the prototype to possibly be more appropriate therefore. Nevertheless, this expert mentioned that with the manual TCO calculation of the reworked method the quality could be better. From the other two interviewees one could not outline any big differences between the two method versions (“3 / 4”), and only one clearly stated an improvement provided by the reworked method.

Consistency of reworked IDA method: The reworked IDA method was judged by all interviewees to be consistent with existent practical best practices. One of the experts thereby compared the method to the ITIL strategy module, where the business value resulting from a service is in focus. From the three experts interviewed two rated the reworked method to be more consistent than the prototype. One interviewee perceived no difference between the two method versions.

Interoperability of reworked IDA method: The ratings for interoperability were comparable to those for generalizability. All experts saw the reworked method to be interoperable but did not see any difference to the IDA method prototype. However, one interviewee outlined that the MEE role has to be available in-house or has to be sourced from external market. Getting external support was reported to possibly be difficult because mobile enterprise is not a typical consulting field. Additionally, it was questioned if external consultants would be familiar with the IDA method or if it is possible to get external support for the short time frame of method application. Only if the availability of the MEE role is taken for granted, this interviewee rated the method to be interoperable.

Completeness of reworked IDA method: All experts stated that the reworked IDA method is complete. Comparing the method to the prototype, all interviewees perceived it to be more complete. Reasons mentioned were, e.g., the predefined productivity impacts or the assessment process in general.

Applicability of reworked IDA method: All interviewed experts of the AR partner rated the reworked IDA method and its four processes to be applicable. One expert thereby mentioned that it is done well, based on Microsoft Excel. However, the availability of the MEE role, realized through an internal employee or an external consultant, was mentioned by one expert to be a requirement for applicability. From the three experts participating in the feedback interviews, one did not see an applicability difference between the two method versions and two saw an improvement, e.g., because of the higher understandability.

Generalizability of reworked IDA method: In the feedback interviews, all experts reported the reworked method to be generalizable. One interviewee for instance stated that it is generic and could be applied at different companies. Nevertheless, no expert could mention any differences regarding generalizability between the reworked method and its prototype.

Understandability of reworked IDA method: All three experts rated the design goals of the reworked IDA method to be understandable with no possible perceived improvements. As well the method processes and the presented results of field study 2 were seen by all experts to be understandable, with improvement potentials only named by one interviewee. Regarding the comparison of the reworked method with the prototype, one expert did not see any difference of understandability, but two judged the reworked version to be more understandable. Reasons mentioned were, e.g., the understandability of the assessment process and the building blocks used.

<table>
<tr><td colspan="3">Helpfulness</td></tr>
<tr><td colspan="3">DG I: 4,7 of 5   DG II: 4,3 of 5   DG III: 4,2 of 5   DG IV: 4,3 of 5</td></tr>
<tr><td>Applicability</td><td>Understandability</td><td>Consistency</td></tr>
<tr><td>4,6 of 5</td><td>4,7 of 5</td><td>4,96 of 5</td></tr>
<tr><td>Interoperability</td><td>Generalizability</td><td>Completeness</td></tr>
<tr><td>4,3 of 5</td><td>4,7 of 5</td><td>4,7 of 5</td></tr>
</table>

Table 14: Summary of average ratings across BIE cycles 3 and 4
Source: Own illustration

Note: One expert reported not being able to rate DG III-helpfulness and interoperability criteria.

In Table 14, the average of the ratings given (on Likert scale) by the experts in BIE cycles 3 and 4 are illustrated. Even if not statistically significant, this gives a qualitative indication to what extent the interviewed experts (AR partner internal and external) judged the criteria to be met by the IDA method.

Potential IDA method enhancements identified in BIE cycle 4

Finally, potential areas for improving the IDA method gathered in in BIE cycle 4 are listed below. Thereby, again only possible enhancements are presented that could be extracted repeatedly in one interview or across several interviews.

- *BIE-4-1 "Formulate MEE limitation":* A limitation of the method could be that there has to be (internally or externally) an MEE with mobile expertise available for the method application.

- *BIE-4-2 "Include business departments for process selection":* Include business departments for process selection (because IT departments can possibly not do this on their own, since the IT possibly does not know enough about the business processes).

How the above depicted areas for improvement (and others identified in BIE cycle 4 and before) were considered for the final IDA method design is presented in section 6.3.2.5.

6.3.2.5 BIE Cycle 5: Feature-Based Evaluation

The final design of the IDA method has been built in the fifth BIE cycle. Refinements have been mainly derived and extracted from final literature analysis as well as from the observations gathered in the second method application and enhancements derived from the evaluation steps of BIE cycles 3 and 4.

Building the IDA method in BIE cycle 5

To provide an overview of major refinements conducted in BIE cycle 5, a selection of build activities to construct the final IDA method and the sources they have been derived from are discussed below. For this list of construction activities not all redesign tasks which have finally been applied are included, but a selection of top-level adjustments:

- **Rephrase provision of value added design goal (no. 1)**

  Redesign task: Rephrase the design goal which focuses on "provision of value added" to be more precise. (no specific source)

  ➔ *Resulting design change:* The corresponding design goal was updated and rephrased to focus on defining value-adding service ideas for tasks identified to benefit most from mobilization.

- **Rephrase assessment of value added design goal (no. 2)**

  Redesign task: Rephrase the design goal which is focused on "assessment and illustration of value added" to reflect that the assessment of value added in this thesis is regarded to firstly result from determination & illustration of productivity-related value added and secondly from its quantification. Moreover, the wording of the design goal should consider that a first abstract quantification shall be provided by the scores calculated in the assessment process. (no specific source)

  ➔ *Resulting design change:* The corresponding design goal was updated and rephrased respectively.

- **Rephrase collaboration and customer interaction demand**

  Redesign task: Mobile IT eases collaboration for workers and corporate communication with customers and vendors (Strategic Growth Concepts 2012). The wording of the FTPP items “collaboration demand” and “customer interaction demand” should be rephrased to reflect these twofold internal and external collaboration and communication benefits. (Source: literature analysis)

  ➔ *Resulting design change:* The two FTPP items were rephrased to “internal collaboration demand” and “external communication demand”. The IDA method description, the IDA tool, and one predefined questionnaire were adjusted respectively to include wording updates of the corresponding FTPP items / building blocks and the resulting changes.

- **Have single on-site workshops**

  Redesign task: Use case screening is even more efficient if BD is in the same room as PM. All participants should be in the same room and the workshop should not be split up. (Source: field study 1 interviews / BIE-2-3)

  ➔ *Resulting design change:* The IDA method description was respectively adjusted to include a note asking for single on-site workshops for data collection in the identification process.

- **Include business departments for process selection**

  Redesign task: Include business departments for process selection (because IT departments can possibly not do this on their own, since the IT possibly does not know enough about the business processes). (Source: field study 2 interviews / BIE-4-2)

  ➔ *Resulting design change:* The IDA method description was adjusted to include a respective note.

- **Include RR and / or BE in definition process**

  Redesign task: Involve RR and / or BE into the definition step to benefit from their role and process- / task-specific know-how. (Source: expert interviews)

➔ *Resulting design change:* The method application in field study 2 showed that RR and BE involvement is not mandatory in the definition process if the identification steps are conducted thoroughly. Nevertheless, to enhance the method design, a note was included into the method description to ask for RR / BE involvement.

- **Formulate MEE limitation**

  Redesign task: A limitation of the method could be that there has to be (internally or externally) an MEE with mobile expertise available for the method application. (Source: field study 2 interviews / BIE-4-1)

  ➔ *Resulting design change:* The IDA method description was respectively adjusted to include the MEE limitation.

- **Check and explain roles**

  Redesign task: Check whether further roles are required in the preparation step (e.g., Finance), better explain the BE role, and give a detailed description of the duties of the BE role and its business impact. (Source: expert interviews / BIE-3-1)

  ➔ *Resulting design change:* It was verified during the method evaluation in BIE cycle 4 whether the method is regarded to be complete by the interviewed experts. Additionally, the BE involvement role is described in detail in the IDA method description.

Evaluating the IDA Method in BIE cycle 5

A feature-based evaluation has been carried out to summarize and verify whether, and how, the IDA method included the required features. The attributes and elements a method should possess, listed in Braun et al. (2005), constitute the baseline for evaluation. In Table 15 the required attributes are discussed, and in Table 16 the required elements are highlighted.

Goal Orientation
YES – Four design goals are defined, refined, and considered throughout the BIE cycles of phase I and II. The two primary design goals are focused on, enabling IT departments in the service analysis stage to introduce IT services for mobile consumer

devices, which are expected to provide a high value added. The two secondary goals put a focus on tight IT business collaboration and fast service analysis.
Systematic Approach
YES – A systematic and structured rule-based approach, outlining which activities in which way need to be conducted, is part of the procedure model and the techniques of the method.
Principles
YES – Detailed guidelines to conduct the crucial process steps of the procedure model are provided through the designed techniques, one for each major process of the method.
Repeatability
YES – The detailed documentation and instructions that come with the IDA method, as part of the procedure model, the techniques and the tool, do support its intersubjective repeatability.

Table 15: Feature-based evaluation of IDA method attributes
Source: Own illustration

Procedure Model
YES – Activities to be conducted are described in four processes of the procedure model: the preparation, identification, definition, and assessment process.
Roles
YES – Roles are defined to execute the activities of the procedure model: mobile enterprise expert (MEE), business department executive (BE), role representatives (RR), and internal IT experts (ITE).
Techniques
YES – Techniques for the three main processes of the procedure model describe how to execute the most important process steps to create results: identification technique (based on KPI scorings), definition technique (based on building blocks), and assessment technique (based on productivity and TCO expert ratings).
Tool
YES – The IDA tool offers Excel-based support to carry out, and partially automate, the techniques of the method.
Specification Document
YES – A PowerPoint-based specification document provides a template to document the results created in each process of the procedure model.

Meta Model
NO – As the scope of the IDA method is on service analysis and not on service design or implementation, a data model was not developed as an outcome of our research.

Table 16: **Feature-based evaluation of IDA method elements**
Source: Own illustration

6.4 Summary and Discussion of Results

The IDA method offers capabilities to enable the corporate introduction of value-adding IT services for mobile consumer devices in the service analysis stage. First of all, the *requirements* which guided the method design have been derived from the attributes and elements a method should possess, summarized by Braun et al. (2005). How these attributes and elements are considered for the IDA method design is described in detail in sections 6.3.2.1 and 6.3.2.5. One outstanding attribute a method is supposed to possess is goal orientation, which is manifested by two primary and two secondary design goals within the IDA method. The primary design goals are focused on enabling IT departments to introduce IT services for mobile consumer devices that provide a high value added. In specific, they ask for a method to enable IT departments 1) to define potentially value-adding service ideas for tasks identified to benefit from IT service support on mobile consumer devices (DG I), and 2) to determine, illustrate, and quantify the value added of these service ideas ex ante (DG II). The final set of design goals was compiled in iterative cycles based on several sources such as literature analysis, case study research, action research, and evaluation details.

The related body of literature was searched particularly for *frameworks* which provide capabilities for the assessment of the value added of mobile enterprise service use (see sections 5.2.5 and 6.1). These frameworks have been also evaluated for consideration of consumer IT specifics. A major finding of this comparison is that no approach found in the literature provides techniques to neither determine and illustrate nor to quantify productivity-related value added of mobile enterprise service use. Moreover, no framework considers mobile consumer IT specifics. Thus, there is a need to develop a specific method to address these research gaps.

The existing *literature* on mobile enterprise IT underlines the need for an IDA method, particularly for the assessment steps. This need is in detail illustrated in section 1.2, when discussing the problem statement, and summarized in section 6.3.2.1, when discussing the design goals. For instance, Deibert and Rothlauf (2006) elaborate on the significance of identifying processes suitable for mobilization and the quest of managers to determine, before its implementation, the benefits to expect from mobile IT. Similarly, Gröger et al. (2013) – based on literature analysis and industry interviews – state that it is crucial and challenging to identify processes and tasks to be supported by enterprise apps and to define fields of application and use cases for the app use. Pousttchi and Becker (2012), Balocco, Mogre, and Toletti (2009), and Leskinen (2008), for instance, elaborate on the importance and challenge to assess the value added of mobile IT use ex ante.

The IDA method has been designed in an ADR approach, in five *build-and-evaluate cycles* (spread over two BIE phases). First, a prototype was designed (section 6.3.1), which was transformed into a reworked, final version of the method (section 6.3.2). In phase I (BIE cycles 1 and 2), the prototype was built and tested. First, it was jointly constructed with the AR partner in a series of workshops (BIE cycle 1). At the AR partner, the prototype was then applied in a field study and evaluated based on interviews with involved experts (BIE cycle 2). In phase II, the method prototype was iteratively reworked to constitute the final IDA method (BIE cycles 3 to 5). The method was evaluated based on interviews with experts from the consulting industry and one expert from academia (BIE cycle 3), as well as by applying and evaluating it in a second field study at the AR partner (BIE cycle 4). Incremental refinements were made between these evaluation steps. Apart from the insights gathered through evaluating the IDA method, major input for refining the method came from insights gathered in BIE cycle 2 (of phase I) and literature analysis. Based on insights gathered in BIE cycles 3 and 4 and further literature analysis, the IDA method has been finalized in BIE cycle 5. A feature-based evaluation through the author of this thesis finally illustrates how the IDA method meets the general requirements (derived from Braun et al. 2005) initially set up for its design (BIE cycle 5).

The IDA method comprises elements, such as a *procedure model*, with defined *roles* and *tool-supported techniques* to create results, which can be captured in a dedicated *specification document* (see section 6.3.2.2 for details). At the core of the method are its techniques, which give detailed guidance on how to conduct the major process steps of the method's procedure model. The identification technique is enabled through KPI scores, which are calculated based on the information collected for a selected tasks of a selected process. The five scores provide an indication on how feasible it is to support these tasks with mobile enterprise services. In contrast to the initial prototype, ratings have not been merged into one productivity score in the final IDA method. As it can be expected that the impacts modeled by these five KPIs have varying effects and significance for the productivity gains, they have not been aggregated into one score. The definition technique leverages building blocks to build mobile enterprise service ideas for the identified tasks. These building blocks are extracted from one of the KPIs calculated with the identification technique. The KPI exploited in the definition technique is the FTPP, which focuses on functional mobile technology benefits. Through the assessment technique, value added of service ideas is finally rated in terms of productivity and TCO impacts through expert judgments. Through the technique, ratings are supported with predefined productivity impacts in efficiency, effectiveness, and employee satisfaction dimensions.

The *assessment of value added* (primary design goal, DG II) is not only supported through the capabilities provided through the assessment technique. Already, in the identification technique (focused on primary design goal, DG I) it is supported through the pre-assessment of task- and role-specific productivity increase potential modeled into the KPI scorings. A detailed and quantified assessment of value added is offered through the productivity and TCO ratings, conducted in the assessment process, for the defined service ideas. It is supported by detailed illustrations which have to be made by the RRs on where they expect the effect to result from and how exactly they think it will affect the process. The final results of applying the IDA method are concrete service ideas for the corporate use of IT services on mobile consumer devices, which are assessed ex ante for their productivity-related value added to a specific corporate process. Looking at the results of applying the IDA method in field studies 1 and 2, substantial enhancements the final IDA method provides compared to its prototype can be constituted. Major enhancements offered by the results of field study 2 (final IDA method) are not only the more detailed defined use cases / service ideas, but also the detailed illustrations and calculated scores of the efficiency, effectiveness, and employee satisfaction impacts based on a refined productivity concept and predefined performance impacts of mobile consumer IT use.

A tight *collaboration between IT and business departments* – steered by the IT – during the service analysis (secondary design goal, DG III) is fostered through incorporating the BE role into the IDA method. Throughout the method, the business department executive is supposed to be involved not only to maximize the business benefits of method application but also to maximize top management support right at the beginning of service introductions. Moreover, the IDA method not only fosters IT and business collaboration, it enables IT departments to proactively steer and facilitate the use of mobile IT innovations within the company.

To support IT departments *in quickly conducting service analysis* (secondary design goal, DG IV), the IDA method is designed to be fully applied in ideally just two weeks after the initial preparation steps. If company-internal resources are available, a first workshop with RRs and the BE is held at the beginning of week one to identify tasks for mobilization. At the end of this week, a second workshop is required to assess the value added of service ideas defined for these tasks. The time between those workshops should be sufficient to define service ideas based on the building blocks extracted from the KPIs calculated and the information gathered in the identification process. During week two, the TCO for the defined service ideas are calculated with the support of internal IT experts. TCO calculations and productivity ratings constitute the final value added assessments.

The IDA method addresses the *research gaps* identified in the literature on business value of mobile IT (described in section 5.3). The found research gaps depict drawbacks of existing frameworks for enabling companies to enable the introduction of IT services on mobile consumer devices, through value added assessment capabilities. In light of this, the IDA method offers the following capabilities not provided by other frameworks found in the body literature:

1. Detailed assessment technique supported by an Excel-based tool, supported by predefined questionnaires, to …
    - determine productivity-related value added over efficiency, effectiveness, and employee satisfaction dimensions,
    - illustrate the value added, supported by predefined performance impacts, related to service idea characteristics (building blocks),
    - and quantify the value added of concrete service ideas, through a KPI-based scoring logic,
    - with consideration of mobile consumer IT specifics, as part of the predefined performance impacts.

2. Detailed definition technique, supported by an Excel-based tool, to describe potentially value-adding service ideas for tasks expected to benefit from mobile IT support. Based on specific characteristics of the tasks selected to be supported (through the identification technique), the so-called building blocks, companies are enabled to compile detailed definitions for mobile enterprise service ideas. Defining concrete service ideas for identified tasks can be considered to be an important link between identification and assessment steps, not sufficiently considered by the frameworks analyzed.

The *quantification* of value added of mobile enterprise service ideas (ex ante, for the defined service ideas) is to a certain extent supported through the IDA method. A first quantification is provided by the productivity scorings and the calculated TCO (costs). Thereby, only the cost impact is quantified with financial figures, and not the productivity impact. As discussed by several authors, taking hard investment decisions based on pre-implementation data for the corporate mobile IT use is particularly challenging (see, e.g., Kadyte 2004). For the mobile IT use, this is particularly difficult since financial assessments of the value added are complicated, e.g., due to the many intangible benefits offered by its use (see, e.g., Leskinen 2008; Peltomäki/Hallikainen/Tuunainen 2009). For mobile consumer IT with its specific qualitative benefits, such as those related to employee satisfaction (see, e.g., Niehaves/Köffer/Ortbach 2012; Junglas/Harris 2013), this is even more relevant. Even if the interest was seen to be high, the spread of IT service use on mobile consumer devices in business companies can be expected to still be low, as shown by the case study analysis (see chapter 4). In this stage of mobile consumer IT use, the assessment technique of the IDA method enables IT departments and companies to quickly introduce value-adding mobile enterprise services. As a result of applying the IDA method, so-called quick wins can be identified. These quick wins come from service ideas for which apps exist and the calculated TCO are below a certain predefined margin. The productivity ratings for these quick wins, even if not supported by financial productivity calculations, enable to select those service ideas that are expected to provide a productivity increase. Due to the low TCO, the financial risk can be regarded to be marginal. Since there is an app, the company can quickly introduce the app as a mobile enterprise service. Thereby, the IDA method helps to quickly increase the mobilization degree with potentially value-adding services. Moreover, from a plethora of possible service ideas, even if they do not constitute quick wins, by the IDA method the ones promising most productivity benefits can be selected for pilot tests. This reduces the risk to pilot a mobile enterprise service idea that turns out to provide no substantial value added. Through these pilot tests, the value added can be validated and investment decisions may be taken. For these pilots, the insights and details gathered through the assessment steps of the IDA method application provide guidance on which benefits and costs can be expected and should thus be measured. Using pilot tests to get feedback from field use was already mentioned in the method evaluation of BIE cycle 2 by one of the interviewed experts. The importance of post-implementation value added measurements is further emphasized by Irani (2002). In this article, it is outlined that indirect costs of IS investments can hardly be fully identified and analyzed upfront and rather have to be measured retrospectively.

The method considers *consumer IT specifics* incorporated into the pre-modeled benefits and productivity impacts of the assessment technique. In the technique, as part of the IDA tool, eight corporate benefits potentially resulting from the mobile consumer device use are reflected. These benefits are, e.g., media break & paper use reduction, legacy device replacement, real-time support, or location-independence. They have been extracted from the body of literature on mobile enterprise IT, with specific consumer IT influence discussed for the benefits of context-sensitivity, user experience, innovation potential, and ease of learning technology (see section 5.2.2). However, it can be expected that all benefits considered in the assessment technique are at least intensified through effects resulting from consumer IT specifics. This can be stated as mobile consumer IT characteristics are supposed to specifically contribute to all eight benefits, as illustrated in "Impacts_2" sheet of the IDA tool (Table 19). For instance, the benefit of media break & paper use reduction[42] may be fostered through consumer IT specifics such as:

- the consumer technology's intuitive use (e.g., enabling easier data input mechanisms to be exploited for data capturing – so far done paper-based),
- the plethora of apps existing for mobile consumer platforms (e.g., offering support for a variety of specific use cases, enabling the device use for capturing and storing of data without media breaks – so far done paper-based, with media breaks),
- and the larger tablet screen size (e.g., providing better data input opportunities to use the device as a substitute for paper to capture data).

[42] The benefit of "media break & paper use reduction" is referred to as "less paper-based work & media breaks for data capturing, access, storage, exchange & editing" in "Impacts_2" sheet.

A comprehensive overview of the mobile consumer IT characteristics expected to influence and foster benefits of mobile IT use can be extracted from Table 19 in the Appendix (excerpt of "Impacts_2" sheet from IDA tool). As extracted from the literature, corporate mobile consumer IT use, particularly, can increase employee satisfaction (see section 5.2.2). Moreover, productivity impacts are expected from the benefits of mobile consumer IT use not only in the dimension of employee satisfaction but also in efficiency and effectiveness dimensions (see Table 19 and Table 20 of the Appendix). Mobile consumer IT specifics have also been followed for building the identification and definition techniques. This is illustrated through the three "Impacts" sheets and the way they are interlinked. The service idea building blocks (of the definition technique) have been derived from the FTPP KPI (used in the identification technique). This KPI and its sub-dimensions comprise specific mobile work functions which are expected to benefit from selected mobile consumer IT characteristics (see Table 18 and Table 19 of the Appendix). The benefits of mobile IT use in general and consumer IT use in specific constituted the starting point for all three techniques of the IDA method to be constructed.

The IDA method is not only built on the experience gathered from practice and experts throughout the BIE cycle, but it is also strongly *grounded in existing theory*. In the identification process, the idea of task-technology fit (see, e.g., Gebauer/Shaw/Gribbins 2004; Yuan et al. 2010; Zhang et al. 2011) is exploited for selecting tasks. Benefits provided mobile consumer technology and characteristics of tasks to be mobilized are evaluated and compared. Ulwick's (2002; 2005; 2009) outcome-driven innovation approach gives guidance on a technique for the definition of service ideas through an expert applying the method. As part of the technique, in the IDA method an expert defines mobile enterprise service ideas based on extracted details on existing mobile IT demands of a selected role. The concept of service productivity presented by Grönroos and Ojasalo (2004), in particular the productivity dimensions the authors described are to a certain extent used to structure the productivity assessments of the service ideas in the final assessment process of the IDA method. The assessments are carried out according to the subjective productivity measurement concept described in Vuolle et al. (2008). Apart from these key concepts exploited to design the IDA method – as discussed in section 6.3.2.2 – further insights extracted from the existing body of literature have been used to build the method or to support the validity of its elements (e.g., for the KPI logic of the identification process or predefined productivity impacts included in the IDA tool). Finally, taking the business processes (and subordinate tasks) as the unit of analysis of the steps to pre-/assess value added provided by mobile enterprise services can be derived from several publications. Gribbins, Subramiam, and Shaw (2006) assess enterprise information technologies through a process-technology fit model. More specific to mobile enterprise IT, several of the frameworks compared in section 5.2.5 focus on process analysis, such as Mobility-M (Gumpp/Pousttchi 2005; Pousttchi/Thurnher 2006; Pousttchi/Becker 2012), Mobile Process Landscaping (Köhler/Gruhn 2004a; Gruhn/Köhler/Klawes 2005; Gruhn/Köhler/Klawes 2007), and others.

The fulfillment of the initially set *criteria to evaluate the method* (see section 6.3.2.3) has been discussed across the several conducted evaluation cycles in this thesis. Summarizing the insights gathered, it can be stated that the consistency of the IDA method has been ensured not only by referring to existing theory (e.g., TTF concept, ODI approach, or service productivity concept) to frame and guide the method design, but also by deriving key elements of the method's techniques (e.g., selected KPIs or performance impacts) from literature. The compatibility of the IDA method to processes for service introduction in business companies is already grounded in the method's prototype. For this prototype, ITIL acted as a baseline to guide the development of the process model. ITIL is a widely used IT service management framework (Dubie 2008; Axelos 2014). The completeness of the IDA method can be evaluated by referring to Braun et al. (2005), who extracted different attributes and elements of a method from literature. In section 6.3.2.5, the IDA method's attributes and elements are discussed. The applicability of a method can be best tested by applying it in an organizational setting. During the BIE cycles, the prototype and the final IDA method were successfully applied in field studies at a business company. To support its generalizability, the final IDA method has been designed with the aim to be applied across industries and companies. Company-specific elements, (e.g., TCO benchmarks and rule set for architecture generation) of the method prototype have been removed in the further design process to maximize the fulfillment of this goal. Finally, the positive results of the expert and feedback interviews to evaluate the IDA method can be referred to for promoting the high understandability of the final IDA method[43].

6.5 Conclusion and Limitations

The action and design research presented and discussed in chapter 6 aims to answer the following research question (RQ 2):

[43] The helpfulness of the IDA method to fulfill the design goals was discussed at the beginning of this section.

"*How can the corporate introduction of value-adding IT services for mobile consumer devices be enabled by a method supporting IT departments to assess the value added of the service use ex ante?*"

Requirements for a method design have been gathered to address this research question (RQ 2a), existing approaches have been compared for fulfillment of selected requirements (RQ 2b), and the IDA method has been built and evaluated in several cycles (RQ 2c and RQ 2d). The requirements have been formulated on two levels: general requirements (attributes and elements a method should possess) and specific, functional requirements (design goals). The primary design goals have been derived from practice (case studies), but they address existing research gaps identified in the body of literature as well. Frameworks supporting the assessment of the corporate value added of mobile enterprise IT use (found in literature) have been compared for their fulfillment of the primary design goals. As none of these frameworks sufficiently supports the assessment of value added, the IDA method has been iteratively built and tested.

Evidence for the helpfulness of the final version of the IDA method to close the existing research gaps and to meet the design goals is provided through several evaluation steps. Expert interviews were held and a field study at a sales department of a large multinational company conducted. The field study shows that by using the IDA method, potentially value-adding service ideas can be defined for selected corporate tasks. Their value added can be determined, illustrated, and to a certain extent quantified ex ante. The quality of the results compiled in the field study was reviewed and overall acknowledged by IT management experts interviewed afterwards. Moreover, based on a method-walkthrough, experts interviewed in two cycles (incl. the field study) did not only consider the IDA method to be helpful overall, but they also rated the method to be consistent, interoperable, complete, applicable, generalizable, and understandable overall.

There are some *limitations* and assumptions which have to be considered when applying the final IDA method. The following *assumptions* have been gathered during the design process:

- Selection of tasks: Only roles where the tasks are comparably conducted across all involved employees should be considered and selected for IDA method application. If tasks vary across employee groups, then they can be divided into subtasks and then analyzed with the IDA method.

- Process-overarching benefits: Only benefits for mobile service support of a single process are considered, benefits resulting for other processes are not considered just named, if possible.

- Method implementation in business companies: ITIL-conform IT service management processes should be in place to implement the IDA method and connect its procedure model to.

- Process documentation: Companies should have documented processes and assigned process owners or business department executives responsible for selected processes.

- MEE role availability: An internal or external mobile enterprise expert familiar with the IDA method has to be available to take over the MEE role when the method shall be applied.

Additionally, it has to be noted that the IDA method puts a stronger *focus on positive impacts* of the mobile enterprise service use in the value added assessment. The mobile enterprise service use could as well have negative impacts, e.g., on efficiency, effectiveness, or employee satisfaction. Possible negative performance impacts are not considered in the IDA method.

On the benefits side of the value assessments, the IDA method puts a *focus on productivity* gains. Apart from this, there are other performance measures of IS business value as presented in Schryen (2013) which could be assessed and quantified. However, productivity is perhaps the measure most intensively discussed to rate the impact of IS investments on corporate processes (Schryen 2013).

Moreover, the IDA steps inherently have a certain *degree of subjectivity* by relying on feedback and ratings of experts. Through the use of the "Impacts" sheets with their predefined performance impacts (offered by the IDA method), the MEE is enabled to challenge expert feedbacks for completeness and feasibility. This can help to reduce the subjectivity of the productivity ratings. The subjectivity of the IDA method application can be further reduced by increasing the number of role representatives involved for each role.

Looking at the core of the IDA method, there should be *further validation* for its techniques. The techniques are to a strong degree derived from the body of literature, as well as action research, and have been evaluated in several ways (see section 6.3). Nevertheless, they inherit aspects that are not grounded in theory and rather stem from the author's in-depth experience from working in the mobile enterprise industry for several years. For instance, the questions and the criteria applied to decide on the single scores[44] of the KPIs in the identification technique should be verified. This also applies for the performance impacts resulting from benefits of the corporate mobile IT use, illustrated in the "Impacts" sheets of the IDA tool. The single productivity impacts have been gathered through literature analysis. However, how they relate to benefits of the corporate mobile (consumer) IT use and whether they (still) hold has to be empirically verified in order to increase the validity of the IDA method. Finally, how consumer IT characteristics influence and foster the benefits of corporate mobile IT use has to be validated and described in detail. In the "Impacts_2" sheet for each benefit the characteristics expected to have a specific influence on are listed. These elaborations have to be verified and researched in further detail to better understand whether certain benefits only hold for mobile consumer IT use or for mobile IT use in general. The "Impacts" sheets constitute a starting point, calling for further research and refinement to increase the instrument validity.

Finally, the *evaluation steps* conducted in method design process could have even been stretched to further scenarios. The evaluation of the iteratively constructed method could have been extended to incorporate, e.g., an application of the IDA method at different business departments and companies apart from the selected sales department of the AR partner. Moreover, the quality of the IDA method could have been further tested by having companies or departments assess the value added of mobile enterprise service use on consumer devices with and without the method. The utility of the IDA method would have been even more strongly supported if substantial enhancements through the IDA method use had been measured. It finally has to be noticed that some of the experts interviewed in the evaluation steps (across the BIE cycles) were also involved into the construction of the IDA method prototype and therefore might have a certain *bias* for evaluating the quality of the reworked IDA method. This bias was to a certain extent reduced by having remote interviews sessions via web and telephone conference (and not on-site, face-to-face), with each expert separately, guided by a structured and detailed questionnaire.

[44] (no = 0, yes = 1 or 2, yes - high = 2 or 4)

Despite those existing limitations and possible enhancements of the method design and its evaluation, the constructed IDA method constitutes a holistic and detailed framework which can be applied to assess the productivity-related value added, to enable the introduction of value-adding IT services for mobile consumer devices. It has been designed not only for a specific industry or business process, and has been thoroughly tested in several cycles. The triangulation of different evaluation steps, each providing positive feedback and findings on the helpfulness of the IDA method, gives profound evidence on the utility of the IDA method to address the problem statement and the research gaps identified in this thesis (see sections 1.2 and 5.3) and the fulfillment of the set up evaluation criteria for the method design (see section 6.3.2.3) .

7 Summary of Contributions and Areas of Future Research

To conclude this doctoral thesis, the theoretical and practical contributions are summarized and discussed (sections 7.1 and 7.2), and areas of future research are outlined (section 7.3). The contributions and future research areas are discussed twofold for the outcomes of research question 1, dealing with the challenges of mobile consumer device use and possible countermeasures, and of research question 2, focusing on the construction and evaluation of an IDA method, enabling the identification and assessment of value added provided by the corporate device use.

7.1 Theoretical Contribution of the Thesis

The consumerization topic has started to raise the attention of researchers throughout the last years. Nevertheless, it is a rather new and untouched playground. A first contribution of this doctoral thesis is the generation of knowledge on consumerization of IT and particularly on the use of mobile enterprise services on consumer devices. The case study analysis presented contributes to this field by exploring and explaining the implications the consumerization trend and the resulting corporate mobile consumer device use has for IT departments along the service lifecycle. It is one of the first studies that, based on detailed research, holistically explores information management challenges of mobile enterprise service use and possible countermeasures across several industries and which outlines consumer IT specifics. Thus the research activities carried out to address research question 1 contribute to the research fields of consumerization of IT and mobile enterprise by creating *theory of explanation* on a top-level (Gregor 2006). Moreover, as an outcome of the case study analysis conducted for RQ 1, a gap in practice and also a research gap for addressing the challenge of assessing value added of the device use has been found. For this challenge, no suitable countermeasures (frameworks) to tackle it could be extracted from the case studies nor from the body of literature.

Secondly, the major theoretical contribution of this thesis, provided in research question 2, can be classified as *theory of design and action* (Gregor 2006). By applying design and action research to build a method artifact, a contribution in the form of *nascent design theory* is constituted (Gregor/Hevner 2013). It generates *prescriptive knowledge* (Gregor/Hevner 2013) on how to do something (Gregor 2006). The built IDA method enables business companies to assess the value added of mobile enterprise service use on consumer devices. At the core of the method, a procedure model, as well as techniques, and a respective tool enable IT departments to introduce value-adding mobile enterprise services. The techniques and tools have been designed to operationalize the major process steps of the method's procedure model: identification, definition, and assessment steps. The constructed method to a certain extent reuses existing concepts, but constitutes a new and innovative way, in particular, to address the challenge of assessing value added of mobile enterprise service use on consumer devices. With this method a new problem solution is provided (Gregor/Hevner 2013). Major aspects of the problem statement, have been discussed in the IS and mobile enterprise literature for several years. Therefore, the artifact developed and evaluated in RQ 2 contributes as an "improvement" to research (Gregor/Hevner 2013). However, despite being discussed for years, the problem of assessing value added of mobile IT use for business companies can be expected to intensify through the upcoming of mobile consumer devices such as tablets like the iPad in business companies. Therefore, it could even be argued that the known problem will be new to many enterprises and practitioners in the field.

The prescriptive knowledge modeled into the IDA method can be further classified by discussing the scope of knowledge generated (Baskerville/Kaul/Storey 2015). As illustrated by Baskerville, Kaul, and Storey (2015) knowledge produced through design science research may be of nomothetic or idiographic scope. General theories or general solution artifacts are the outcome of nomothetic DSR, whereas idiographic DSR develops individual products or knowledge on individual artifacts in unique environments (Baskerville/Kaul/Storey 2015). However, the duality of design science often invokes both: an idiographic and a nomothetic knowledge scope (Baskerville/Kaul/Storey 2015). Across the build-and-evaluate cycles of the IDA method design process the artifact evolves from being *idiographic to nomothetic*. In particular, the IDA method prototype constitutes an individual solution statement for a specific organizational context of a selected business company (action research partner). Through the rework of the IDA method, an artifact is constructed which is designed to be generally applied across industries and companies. As part of the refinement process company specifics of the AR partner have been eliminated and through several cycles the IDA method has been evaluated, e.g., for its generalizability, applicability, and consistency.

A third contribution provided by this thesis and in particular by the designed IDA method is the ability to use the results of its application as the baseline to conduct holistic monetary value added quantifications through pilot tests. Existing approaches for calculating the monetary value added can be applied to measure the productivity and TCO impacts assessed through the IDA method. This constitutes a further enhancement of theory of design and action (Gregor 2006) by providing nascent design theory (Gregor/Hevner 2013) to extent and refine the use of existing artifacts. This contribution can be regarded to constitute *descriptive knowledge* (Gregor/Hevner 2013), as it gives insights on what productivity and TCO impacts are to be measured for a specific service idea in a pilot test.

Descriptive knowledge is not only offered through the assessment details resulting from method application, but also in general by the various possible benefits and productivity impacts (regarding efficiency, effectiveness, and employee satisfaction) included in the IDA tool and used in the assessment process. These predefined performance impacts, resulting from specific mobile (consumer) IT characteristics, have been derived from or are supported by the existing literature. They constitute descriptive knowledge on the benefits potentially provided by mobile enterprise services and a fourth contribution provided by the IDA method.

Finally, the results of applying the IDA method in two field studies at the AR partner constitute a fifth contribution of this thesis. In these field studies, the method was applied at a sales department of a large multinational company. The results of method application, such as the used IDA tool, the created questionnaires, and the defined and assessed service ideas for mobile enterprise service use, pose instantiations of the method artifact. Thus, by that *situated artifact implementation* (Gregor/Hevner 2013) further theory of design and action (Gregor 2006) is created.

7.2 Practical Contribution of the Thesis

The outcomes of research question 1 provide IT practitioners a detailed picture on what *challenges to expect from the corporate use of IT services on mobile consumer devices* in different service lifecycle phases. Thereby, different areas relevant for IT departments such as IT application management, IT architecture, IT security, IT support, IT knowledge, IT governance, or IT business value are touched. Moreover, *countermeasures which can be reused or adopted* to mitigate challenges are listed.

There is only one challenge for which no countermeasure could be extracted from the case study analysis. Neither in the body of literature any framework (measure) has been found providing detailed guidance (techniques) to enable the assessment of value added of the corporate mobile consumer device use. This finding should create *awareness* amongst practitioners to develop and apply best practices to support the task of assessing value added, if they want to leverage mobile consumer devices as a corporate platform for IT service use.

A structured approach which is designed to act as a best practice approach for IT departments to tackle this value added-related issue and to enable the introduction of value-adding IT services on mobile consumer devices is the *IDA method*, developed in this thesis. The IDA method offers a procedure model to guide its application, techniques and a tool to operationalize it, and templates to document the results of its application.

The IDA method enables IT departments not only to *assess the productivity-related value added* of service ideas but also to *identify quick wins*. In particular, quick wins depict opportunities to quickly increase the level of mobile IT support and to reap the benefits offered by mobile consumer IT, due to the low TCO and the existence of a mobile application. Moreover, the IDA method supports IT departments to *calculate a business case* for selected mobile enterprise service ideas. The productivity and TCO ratings of the assessment steps of the IDA method constitute the baseline and input to calculate a business case, e.g., based on measurements and insights taken from pilot tests for service ideas previously assessed with the method.

In particular for *sales departments*, the results of the conducted field studies at the AR partner constitute valuable findings. The information and feedback gathered as well as the service ideas compiled and assessed can be evaluated and reused to optimize the assessment of value added of the mobile consumer device use and respective introduction of service ideas.

7.3 Areas of Future Research

Regarding the analysis of the impacts of the corporate mobile consumer device use, future research will have to dig into the various potential research fields explored through the case study analysis. In this analysis challenges have been extracted in the fields of *IT application management, IT architecture, IT security, IT support, IT knowledge, IT governance*, *or IT business value*. This doctoral thesis focuses mainly on the IT business value challenge, addressed through action and design research. The other extracted topics and the underlying dynamics are subject to future research. Countermeasures identified in the case study analysis should be tested for their suitability to tackle these challenges, and if necessary, refined or extended. Moreover, the results of this case study analysis should be verified and explored in *globally in different markets*. The case study research conducted in this thesis has a focus on the German market.

In the focus of the IDA method and the underlying value added challenge, future research potential lies especially in *quantifying value assessments*. The quantification steps included in the IDA method provide a starting point. Future research will have to figure out ways to simplify or automate monetary value quantification, ex ante, in the service analysis stage.

Apart from improving the quantification abilities of the IDA method, a further enhancement would be provided through *reducing the subjectivity* the method inherits. The IDA method relies to a certain degree on expert feedbacks and ratings. In particular, ways to standardize the productivity and TCO ratings – without losing validity – would improve the efficiency and comparability of the method application and its results.

Moreover, the utility of the IDA method could be evaluated for different *business departments and processes*. The IDA method has so far only been evaluated for its utility in a sales department, respectively, on the sales process. If required, the IDA method and its components have to be adjusted and refined to reflect any specifics.

Furthermore, the *IDA tool*, currently implemented in Microsoft Excel, can be optimized. For instance, a feedback gathered during the evaluation of the IDA method is to provide web-based tool-support. Developing a web-based IDA tool would enhance the usability and efficiency of the method application.

Parts of the *KPI logic* of the identification technique and the *predefined performance impacts* and *consumer IT specifics* modeled into the assessment technique provide possibilities for further research and validation. Details on further validation steps are outlined in section 6.5.

As discussed and illustrated in the section 6.4, the IDA method incorporates mobile consumer IT specifics as part of its design. Nevertheless, it can be expected that it will be possible to apply the method to enable the introduction of value-adding IT services on mobile devices, no matter if the device platform historically comes from the consumer market (iOS, Android) or enterprise market (BlackBerry). Currently, it can be observed that both *worlds are melting* and that there will be less specific characteristics distinguishing the both. Sammer, Brechbühl, and Back (2013, 1) use the term "second-generation enterprise mobility" to refer to the corporate use of novel smartphones and tablets, e.g., based on iOS and Android. The IDA method can be expected to not only enable mobile consumer device use, but in general second-generation enterprise mobility. Future research will have to dig deeper into this trend and figure out if and what impact it has on the design and applicability of the IDA method.

Apart from the future research areas illustrated above, there are further research fields which can be derived from the assumptions and limitations outlined for the IDA method use in section 6.5.

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Appendix

Semi-structured questionnaire used in case study analysis

General: Mobile consumer device, BYOD, and app use
I: Are you providing mobile consumer devices such as the iPhone to your employees?
II: Are you supporting the use of personal mobile consumer devices in the company (BYOD)?
III: Are apps provided for mobile consumer devices in your company (self-developed or externally procured)?
M: Motivation to introduce mobile consumer devices
M1: Why are you providing mobile consumer devices respectively supporting the BYOD use in the company?
M2: Why are you providing apps for mobile consumer devices in the company?
M3: Why, do you think, mobile consumer devices are used by employees of the company?
I: Integration of mobile consumer devices
I1: Can you shortly describe a company-internal project (e.g., PIM-Integration or MDM) focused on integration of mobile consumer devices (motivation, focus (Germany / global), length, project phases, team, involved stakeholders etc.)?
I2: Which specific requirements and challenges did you encounter integrating mobile consumer devices?
A: Impacts of mobile consumer device use on enterprise IT
A1: Which impacts of the mobile consumer device use do you notice for supply, demand, and use of information in your company? Which impacts constitute challenges and how are you handling those?
A2: Which impacts of the mobile consumer device use do you notice for data, processes, application lifecycles, and IT system landscape in your company? Which impacts constitute challenges and how are you handling those?
A3: Which impacts of the mobile consumer device use do you notice for data storage, data processing, data communication, and technology bundles in your company? Which impacts constitute challenges and how are you handling those?
A4: Which impacts of the mobile consumer device use do you notice for IT governance, IT security, IT process, and IT costs in your company? Which impacts constitute challenges and how are you handling those?

Table 17: Semi-structured questionnaire (case study analysis)
Source: Own illustration

Note: The questionnaire illustrated above was derived from the one used in the pilot case study and applied (with minor changes) in the further interviews conducted. In selected interviews, excerpts or additional questions were used to consider the specific focus of the interviewee.

Table 17 shows the top-level questions of the semi-structured questionnaire used to guide the interviews of the case studies. For nearly all top-level questions, sub-questions were added to the questionnaire to have more open-ended questions and to gather more information on the topics of interest (not depicted in Table 17).

Sub-questions for selected top-level questions in section “General” asked, e.g., for mobile device types, further details of the supplied or supported devices, and employee groups eligible for the device use.

Sub-questions for selected top-level questions in section “M” asked, e.g., for reasons to provide or support mobile consumer devices, BYOD, and apps but also for reasons to object BYOD as well as for topics such as top management support and differences between “younger” and “elder” employee groups in their motivation to use mobile consumer devices.

Sub-questions for selected top-level questions in section “I” asked for specific challenges mobile consumer device integration projects possibly have to face such as data protection & legal alignment, IT security alignment, time pressure, business case calculation – to name just a few.

Sub-questions for selected top-level questions in section “A” asked for specific predefined problems that companies possibly are confronted with. These predefined problems were derived, e.g., from the results of the pilot case study.

Details of sheet "Impacts_1" of the IDA tool of the final IDA method

Task characteristics "FTPP items" / building blocks	Leading to benefits / productivity impacts (used as a reference in "Impacts_2")
1) internal collaboration demand	1
a) unpredictable	1
b) time-critical	2
c) context-sensitive	3
d) media breaks	5
e) use of legacy devices	4
2) external communication demand	1
a) unpredictable	1
b) time-critical	2
c) context-sensitive	3
d) media breaks	5
e) use of legacy devices	4
3) information access demand	1
a) unpredictable	1
b) time-critical	2
c) context-sensitive	3
d) media breaks	5
e) use of legacy devices	4
4) data capturing & storage demand	1,3
a) unpredictable	1
b) time-critical	2
c) context-sensitive	3
d) media breaks	5

Table 18: **Sheet „Impacts_1" from IDA tool (final version)**
Source: Own illustration

Details of sheet "Impacts_2" of the IDA tool of the final IDA method

No	Benefits to be expected	Major productivity impacts to be expected	Mobile technology characteristics creating benefits / impacts	Task or non-task-specific
1	+ **location-independent** data capturing, access, storage, exchange & editing (e.g., at home, when travelling, in hotels) ➔ data capturing is more location-independent as before!	➔ reduced execution time, reduced idle time, higher perceived process output quality	MAINLY: device portability (size), ubiquitous connectivity, personal employee use of enhanced devices AND: **higher tablet battery capacity, larger tablet screen size (compared to smartphone),** sensors & interfaces (e.g., camera, location, Bluetooth and others like RFID), multi-media use BUT: limited mobile network coverage, limited battery capacity, limited use of input devices (e.g., mouse), small screen size	functional / task-specific: to be applied only to corresponding service ideas
2	+ **real-time** data capturing, access, storage, exchange & editing (with minimum response delays)	➔ reduced execution time	MAINLY: device portability (size), ubiquitous connectivity, instant-on device use (no booting time) AND: **higher tablet battery capacity, larger tablet screen size (compared to smartphone),** sensors & interfaces (e.g., camera, location, Bluetooth and others like RFID), multi-media use BUT: limited mobile network coverage, limited battery capacity, limited use of input devices (e.g., mouse), small screen size	functional / task-specific: to be applied only to corresponding service ideas

3	+ **context-sensitive** data capturing, access, storage, exchange & editing (e.g., personalized, location based, RFID based)	➔ reduced execution time, higher perceived process output quality	MAINLY: user and device authentication, sensors & interfaces (e.g., camera, location, Bluetooth and others like RFID) AND: **higher tablet battery capacity, larger tablet screen size (compared to smartphone),** ubiquitous connectivity, multi-media use BUT: limited mobile network coverage, limited battery capacity, limited use of input devices (e.g., mouse), small screen size	functional / task-specific: to be applied only to corresponding service ideas
4	+ **replacement of legacy enterprise device use** for data capturing, access, storage, exchange & editing (e.g., hand scanners, command and control devices) ➔ laptops could be in scope!	➔ reduced input costs, higher perceived process output quality	MAINLY: intuitive use, less expensive devices (compared to proprietary devices), innovative technology, plethora of apps, personal employee use of enhanced devices, **higher tablet battery capacity (compared to laptops and smartphones), less disturbing tablet use (no noise compared to laptops, barrier-free use in meetings compared to laptops)** AND: device portability (size), ubiquitous connectivity, sensors & interfaces (e.g., camera) BUT: limited legacy enterprise app support (e.g., MS Windows), limited use of input devices (e.g., mouse), small screen size, limited battery capacity	functional / task-specific: to be applied only to corresponding service ideas
5	+ **less paper-based work & media breaks** for data capturing, access, storage, exchange & editing (e.g., for note taking)	➔ reduced input costs, reduced execution time, higher perceived process output quality	MAINLY: device portability (size), multi-media use, intuitive use, **larger tablet screen size (compared to smartphone),** plethora of apps AND: sensors & interfaces (e.g., camera), ubiquitous connectivity	functional / task-specific: to be applied only to corresponding service ideas

6	+ **use of innovative technologies** for data capturing, access, storage, exchange & editing	➔ higher perceived process output quality, higher employee satisfaction	MAINLY: <u>innovative technology</u>	non-functional / non-task-specific: to be applied to all service ideas
7	+ **positive user experience on mobile consumer devices & apps** for data capturing, access, storage, exchange & editing	➔ reduced execution time, higher employee satisfaction	MAINLY: multi-media use, <u>intuitive use,</u> instant-on device use (no booting time), **<u>larger tablet screen size (compared to smartphone),</u>** device portability (size), <u>personal employee use of enhanced devices,</u> <u>innovative technology</u> BUT: limited use of input devices (e.g., mouse), small screen size	non-functional / non-task-specific: to be applied to all service ideas
8	+ **less training for technology use required** for data capturing, access, storage, exchange & editing	➔ reduced execution time, higher employee satisfaction	MAINLY: <u>personal employee use of enhanced devices</u>	non-functional / non-task-specific: to be applied to all service ideas

Table 19: Sheet „Impacts_2" from IDA tool (final version)[45]
Source: Own illustration

45 <u>underlined:</u> characteristics of consumer devices
<u>bold:</u> characteristics of tablets

Details of sheet "Impacts_3" of the IDA tool of the final IDA method

Productivity impact assessment (concrete examples)	***Major effects***
higher employee satisfaction (qualitative)	➔ **faster execution time? / reduced idle time? / reduced input costs? / higher perceived process output quality?**
joy of (consumer) device use	➔ higher employee satisfaction?
personal experience with (consumer) device use	➔ higher employee satisfaction?
single (consumer) device use for business and personal life	➔ higher employee satisfaction?
higher perceived social status	➔ higher employee satisfaction?
increased work capability from home	➔ higher employee satisfaction?
higher perceived process output quality (qualitative)	➔ **effectiveness (output quality) ➔ higher process output? / reduced process input?**
higher perceived (individual or corporate) image	➔ higher perceived process output quality?
higher flexibility in work organization	➔ higher perceived process output quality?
higher transparency on (job or process) performance	➔ higher perceived process output quality?
higher data quality or lower error rate in information (transfer or collection)	➔ higher perceived process output quality?
better customer service	➔ higher perceived process output quality?
better decision-making	➔ higher perceived process output quality?
new (external or internal) products and services	➔ higher perceived process output quality?
higher process output (quantity or revenues)	➔ **efficiency (output/input)?**
reduced process input (time or costs)	➔ **efficiency (output/input)?**
1) reduced idle time	➔ *reduced process input? / higher process output? / reduced execution time?*
increased work capability while not at desk	➔ reduced idle time?
increased work capability from home	➔ reduced idle time?
increased work capability after office hours	➔ reduced idle time?
increased work capability while travelling	➔ reduced idle time?
2) reduced execution time	➔ *reduced process input? / higher process output? / reduced input costs?*
faster data & information capturing	➔ reduced execution time?
faster data & information storing	➔ reduced execution time?
faster data & information access	➔ reduced execution time?

faster data & information exchange	➔ reduced execution time?
faster data & information editing	➔ reduced execution time?
faster response time	➔ reduced execution time?
faster order processing	➔ reduced execution time?
faster invoicing and billing	➔ reduced execution time?
less transportation time	➔ reduced execution time?
less travelling time	➔ reduced execution time?
less waiting time	➔ reduced execution time?
higher data quality or lower error rate in information	➔ reduced execution time?
3) reduced input costs	➔ *reduced process input? / higher process output?*
less paper use costs	➔ reduced input costs?
less device costs	➔ reduced input costs?
less travelling costs	➔ reduced input costs?
less office space costs	➔ reduced input costs?
less inventory costs	➔ reduced input costs?
less transportation costs	➔ reduced input costs?
less staff costs	➔ reduced input costs?
less communication & collaboration costs	➔ reduced input costs?
less SLA obligation costs	➔ reduced input costs?
less capital costs	➔ reduced input costs?

Table 20: **Sheet „Impacts_3" from IDA tool (final version)**
Source: Own illustration

Im Rahmen der Dissertation werden die Auswirkungen der Nutzung sogenannter „Mobile Consumer Devices“ (z. B. iOS- oder Android-basierter Smartphones und Tablets) auf IT-Abteilungen erforscht. Es wird ein detaillierter Überblick zu Herausforderungen der betrieblichen Nutzung von IT-Services auf mobilen Endgeräten des Konsumentenmarktes und möglichen Gegenmaßnahmen gegeben. In Summe werden acht Herausforderungen und fünfzehn Gegenmaßnahmen extrahiert.

Es wird zudem eine Methode für die Bewertung des zu erwartenden Mehrwerts der Nutzung von IT-Services auf Mobile Consumer Devices präsentiert. Die IDA-Methode wurde entworfen, um IT-Abteilungen als Best Practice-Ansatz zur Bewertung des Mehrwerts zu dienen, um so die Einführung von mehrwertstiftenden IT-Services für Mobile Consumer Devices in Unternehmen zu ermöglichen. Die konstruierte IDA-Methode umfasst ein Vorgehensmodell, Rollenbeschreibungen, Techniken zur Operationalisierung der wesentlichen Prozessschritte, vordefinierte Vorlagen zur Dokumentation der Ergebnisse der Anwendung sowie Tool-Unterstützung.

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