

# MOBILE SYSTEMS DEVELOPMENT

## *Challenges, Implications and Issues*

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**Abstract:** This paper takes a systems development perspective on mobility, building on preliminary findings of an on-going multiple case study covering 7 companies. The questions driving this paper are: What are the challenges facing development practice in the mobile industry, how do they affect practice and how are they dealt with? Analysis of the empirical data is done following a structured and inductive approach. A framework showing the segmentation of the mobile industry into five layers is proposed and challenges are presented according to two dimensions, namely a business dimension and a development dimension. Finally, implications stemming from these challenges are discussed and issues inviting for future research are proposed.

**Keywords:** Mobile systems development, multiple case study, software development

## 1. INTRODUCTION

Development of mobile systems is a challenging task surrounded by a high level of uncertainty: Rapid technology development and lacking standardisation, short time-to-market, lacking end-user adoption, missing killer applications are just some of the conditions creating an uncertain environment. Despite, the much uncertainty surrounding mobile systems development (MSD), contributions on the subject have been sparse - see e.g. (Lyytinen, Rose et al. 1998; Krogstie 2001; Krogstie, Lyytinen et al. 2004; Hosbond and Nielsen 2005). Obviously, traditional systems development (TSD) (Wieringa 1998; Sommerville 2000; Pressman 2004) should have a role to play in trying to understand MSD, but the limitations to its applicability are unclear. This study seeks to uncover the challenges that surround MSD practice and the actions taken in practice to handle these.

Respectively, it must be mentioned that Krogstie et al. (2004) have added to a greater understanding of the challenges in MSD on a conceptual level even though it remains unclear to what extent their propositions are based on empirical data. Not before understanding the challenges of MSD practice are we able to reason about the limitations of TSD and suggest improvements. Thus, the questions driving this paper are: What are the challenges facing development practice in the mobile industry, how do they affect practice and how are they dealt with?

The next section outlines the research approach. Section 3 is a presentation and analysis of the cases. Section 4 is a discussion of the analysis and its implications and Section 5 concludes the paper.

## **2. RESEARCH APPROACH**

MSD is indeed still uncharted land. To reach a holistic level of understanding we set out to (1) explore MSD challenges on different segments of the mobile industry and (2) to understand the dynamic interrelations between businesses and its effects on development practice. Hence, an exploratory multiple case study approach is applied (Yin 1994). Unit of analysis is development practice in seven companies within the Danish mobile industry. Collection of qualitative data is conducted using semi-structured and open-ended interviews (Patton 1990; Yin 1994). Questions address company background, development activities, and external collaborative efforts. Interviews are audio recorded and transcribed for later analysis.

Analysis of the empirical data is done following a structured and inductive approach taking place in between interviews, allowing for an “overlapping data analysis [and having] the freedom to make adjustments during the data collection process“ (Eisenhardt 1989, pp. 539). To generate explanatory theory from case studies a disciplined and structured approach to data analysis must be followed (Eisenhardt 1989; Dyer and Wilkins 1991). Effectively, a structured coding practice is initiated, applying the software coding tool Hyperresearch supporting the practice of inductive analysis. Through coding of the transcripts concepts are added as a level of abstraction to represent challenges. The added concepts emerging from the inductive analysis are used as constituting elements of the explanatory theory that this paper seeks to build (Eisenhardt 1989).

### 3. CASES AND ANALYSIS

Early on in the data collection and data analysis process it becomes clear that the mobile industry is divided into a set of layers forming a supply-chain. These constituting layers (see Figure 1) and their interrelations are important to understand as they may affect and indirectly shape development practice in other layers.

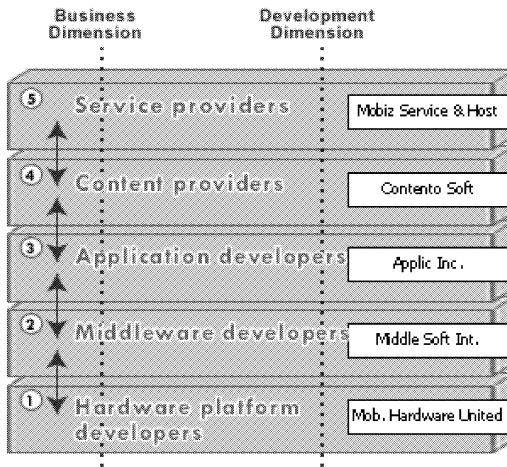


Figure 1. The five layers constituting the mobile industry.

Through analysis of the data, two dimensions emerge; the business dimension (business related challenges) and the development dimension (development specific challenges), see Figure 1. Together they represent the analytical lens applied for presenting and discussing the challenges, see Table 1. Cases are given fictive names for reasons of confidentiality.

Table 1. Overview of cases, business- and development related challenges.

Description	Business dimension	Development dimension
<ul style="list-style-type: none"> <li>▪ <b>Layer / Case:</b> 1 / Mobile Hardware United</li> <li>▪ <b>Profile:</b> One out of six R&amp;D sites within the company. Employing 150 hardware- and software engineers. A dominant global player within this segment of the mobile industry.</li> <li>▪ <b>Products:</b> High quality hardware platforms and software for testing reliability and correctness of hardware platforms.</li> <li>▪ <b>Supply-chain:</b> Dependent on other R&amp;D sites within the company as development takes</li> </ul>	<ul style="list-style-type: none"> <li>▪ Tough competition on price</li> </ul>	<ul style="list-style-type: none"> <li>▪ Communication and alignment of requirements across development projects</li> <li>▪ Cultural differences in interorg. development.</li> <li>▪ Quality management</li> </ul>

Description	Business dimension	Development dimension
<p>place through umbrella projects.</p> <ul style="list-style-type: none"> <li>▪ <b>Interviewee:</b> Software director responsible for initiation and completion of development projects part of interorg. development projects.</li> </ul>		
<ul style="list-style-type: none"> <li>▪ <b>Layer / Case:</b> 2 / Middle Soft International</li> <li>▪ <b>Profile:</b> One out of 9 R&amp;D sites around the world. Employing 400 software engineers. Global player involved in all layers except for layer 5.</li> <li>▪ <b>Products:</b> Software platform and client application development.</li> <li>▪ <b>Supply-chain:</b> Dependent on software development projects at other R&amp;D sites within the company.</li> <li>▪ <b>Interviewee:</b> Line manager, responsible for improving software development processes and alignment and coordination of development initiatives across R&amp;D sites.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Conflicting customer interests (mobile operators vs. end-users): revenue creating vs. free communication enabling technologies</li> <li>▪ Competition: Time-to-market and price</li> </ul>	<ul style="list-style-type: none"> <li>▪ Dispersed development: Alignment of requirements and development process</li> <li>▪ Quality management and security</li> <li>▪ Rapidly changing technology</li> </ul>
<ul style="list-style-type: none"> <li>▪ <b>Layer / Case:</b> 3 / Applic Inc.</li> <li>▪ <b>Profile:</b> Small company originating from Nokia Denmark R&amp;D. Customers are from layer one, two, and three.</li> <li>▪ <b>Products:</b> Consultancy business, in-sourcing of project managers and systems developers, out-sourcing of entire development projects, embedded software development.</li> <li>▪ <b>Supply-chain:</b> Dependent on establishing and maintaining good business relations with customers and strategic partners.</li> <li>▪ <b>Interviewee:</b> Technical director responsible for initiation and completion of development projects.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Competition: Time-to-market and price</li> </ul>	<ul style="list-style-type: none"> <li>▪ Lacking standardisation and documentation of middleware.</li> <li>▪ Integration and development on top of proprietary software platforms (middleware).</li> </ul>
<ul style="list-style-type: none"> <li>▪ <b>Layer / Case:</b> 4 / Contento Soft</li> <li>▪ <b>Profile:</b> Telecommunications branch within a large Danish Software development company employing around 2500 people.</li> <li>▪ <b>Products:</b> Managing and delivering sensitive content to mobile services targeted at jobs in public institutions, e.g. for home care workers.</li> <li>▪ <b>Supply-chain:</b> Dependent on formulation of revenue share and development cost share</li> </ul>	<ul style="list-style-type: none"> <li>▪ Revenue- and especially development cost-share models with mobile operators to lower business risks.</li> <li>▪ Lacking adoption of</li> </ul>	<ul style="list-style-type: none"> <li>▪ Lacking standardisation of proprietary middleware and mobile applications.</li> <li>▪ Integration with existing “static” IT systems.</li> <li>▪ Data security</li> </ul>

Description	Business dimension	Development dimension
business models. ▪ <u>Interviewee</u> : CIO in the telecommunications branch of the company.	mobile services.	▪ Defensive development strategy due to rapid technology replacement.
▪ <u>Layer / Case</u> : 5 / Mobiz Service & Host ▪ <u>Profile</u> : Employs 60 people in Denmark, Germany, and the UK. “Buys” applications (layer 3) and content (layer 4) and “sells” to mobile network operators (layer 5). Customers are mobile operators. ▪ <u>Products</u> : Offers mobile applications and hosting and service management of these. ▪ <u>Supply-chain</u> : Highly dependent on good business relations with application developers and content providers (layer 3 and 4) and mobile network operators on layer 5. ▪ <u>Interviewee</u> : Technical project manager responsible for integration and adaptation of mobile services onto software platforms and infrastructure components.	▪ Establishment of good revenue-share models is critical. ▪ Lacking adoption of mobile services making service and hosting of mobile services less sellable.	▪ Lacking standardisation of proprietary software platforms. Tailored solutions are necessary. ▪ Adaptation and integration of software components instead of bottom-up development.

#### 4. DISCUSSION

The challenges from the analysis together with derived implications and issues are summarised in Table 2. Business related challenges are included in Table 2 as these affect the conditions under which development projects take place. Discussion of these challenges and their implications infer issues needed to be addressed in order to create further understanding of these challenges and implications. Implications and issues stemming from interorganisational development and lacking standardization are now further elaborated on.

Table 2. Challenges, implications and issues.

Challenges	Implications	Issues
▪ Software quality ▪ Competing on price ▪ Software innovation ▪ Time-to-market ▪ Changing technology	▪ Highly complex development practice: Efficient, structured, agile, and enabling innovation.	▪ Mixing structured and process-oriented with agile and product-oriented development methods.

Challenges	Implications	Issues
<ul style="list-style-type: none"> <li>▪ Interorganisational development</li> </ul>	<ul style="list-style-type: none"> <li>▪ Development projects exceed organizational boundaries.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Extension of project scope in systems development.</li> <li>▪ Defining, coordinating and aligning requirements.</li> <li>▪ Cultural differences.</li> </ul>
<ul style="list-style-type: none"> <li>▪ Lacking standardisation</li> </ul>	<ul style="list-style-type: none"> <li>▪ Enormous resources spent on adaptation and integration.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Contemporary development methods in TSD assume bottom-up approaches – not integration and adaptation.</li> </ul>

### **4.1 Interorganizational Development and Lacking Standardisation**

Development practice in the mobile industry is characterised by dispersed R&D sites in multi-national corporations such as Mobile Hardware (layer 1) and Middle Soft Int. (layer 2). Development projects do not merely take place within the physical boundaries of a site. Instead development projects are defined as umbrella projects each comprising an arbitrary number of sub-projects with different responsibilities and tasks. This phenomenon is mostly related to businesses residing in the “mature” segments of the mobile industry. In the upper layers of the mobile industry (layer 3 to 4), collaborative partnerships and strategic alliances around development activities tends to dominate. The most obvious reason for this tendency is the missing critical mass of users that has not yet come to adopt and accept paying mobile services (Ling 2000; Aarnio, Enkenberg et al. 2002; Naruse 2003). Financial resources are therefore sparse and with a vast number of wireless technologies, businesses tend to specialise on a few core services and product areas. To strengthen the ability to invent smarter and better-looking services and content, businesses are to a greater extent establishing collaborative partnerships and strategic alliances around product development to stay competitive. Effectively, this means that development projects no longer can be perceived as physically fixed and taking place within a predefined team structure. Development activities exceed organisational boundaries as tasks are divided between the involved development teams. From interorganisational development, issues such as aligning requirements and solving cultural differences emerge. However, taking a look at the contemporary literature on traditional systems development, e.g. (Wieringa 1998; Sommerville 2000; Presssman 2004), it may be argued that the described development methods implicitly assume development teams to be geographically fixed and a development practice limited to the boundaries of single organisation. Consequently, a critical

stance as to the cultural issues is not provided. To enhance the understanding of interorganisational development we suggest an extension of the development project scope in mobile systems development taking an interorganisational perspective on MSD (Hosbond and Nielsen 2005). Furthermore, research within organisation of open source projects may prove beneficial to understand the phenomenon of interorganisational development. What are the mechanisms and structures applied in coordinating and aligning open source projects and can these mechanisms be applied in the attempt to understand the issue of interorganisational development in greater detail?

The mobile industry is still largely technology-driven. Focus is on innovation instead of standardisation. This is manifested in the vast amount of competing wireless technologies enabling mobile work, communication, collaboration etc. Technologies are innovated at the lower layers in the industry (layer 1 and 2) but it is the upper layers that are struggling with the consequences hereof. According to a report by Forrester Research application developers and content providers are forced to target their development against several SW platforms such as Java, Symbian, Windows Mobile, and Brew (Lussanet, Østergaard et al. 2004) in order to reach as many end-users as possible. In addition, middleware developers such as Middle Soft International extend the raw Symbian platform with proprietary features – despite that one of the core ideas of Symbian is to establish a standardised platform. The strong focus on innovation instead of standardisation at the lower layers of the industry implies that enormous resources are spent on integration and adaptation of applications and content on top of the SW platform. From a systems development point of view we may pose the question of how to actually approach integration and adaptation in systems development. It seems that traditional systems development literature does not lend it self to discussing these matters. Instead a bottom-up perspective on systems analysis, design, and implementation is often assumed.

## **5. CONCLUSION**

This paper presents preliminary findings of an on-going multiple case study. Based on an inductive analysis applying a structured coding scheme using the analysis tool Hyperresearch, a five layered framework of the mobile industry is proposed and challenges in development practice are elaborated on. The challenges are discussed with respect to the implications for development practice and several issues, see Table 2, inviting for future research for mobile systems development are suggested.

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