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MOBILE SYSTEMS DEVELOPMENT: AN EMPIRICAL STUDY

RESEARCH-IN-PROGRESS

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Abstract

As part of an ongoing study on mobile systems development (MSD), this paper presents preliminary findings of research-in-progress. The debate on mobility in research has so far been dominated by mobile HCI, technological innovations, and socio-technical issues related to new and emerging mobile work patterns. This paper is about the development of mobile systems.

Based on an on-going empirical study I present four case studies of companies each with different products or services to offer and diverging ways of establishing and sustaining a successful business in the mobile industry. From the case studies I propose a five-layered framework for understanding the structure and segmentation of the industry. This leads to an analysis of the different modes of operation within the mobile industry, exemplified by the four case studies.

The contribution of this paper is therefore two-fold: (1) I present preliminary findings from an on-going multiple case study that indicates and support a five-layered segmentation of the mobile industry, and (2) I propose four modes of operation reflecting the diversified nature of MSD.

Keywords: Mobile systems development, case study, strategic alliance, software development

1 INTRODUCTION

Traditionally, the theory on systems development practice is associated with software engineering (SE). SE has for decades been discussed extensively both in research and in practice. The result is manifested in the vast amount of literature on the subject, see e.g. (Pfleger 2001; Pressman 2004). Commonly though, the literature on SE has been dominated by proposals on tools to manage development practices; choice of process model, estimation practice, risk management etc. Even though, these contributions relate to systems development in a broad sense, a lot of the existing and well-established theories can of course also be applied in MSD practice. However, preliminary empirical findings have indicated interesting phenomena in the context of systems development, with strategic alliances being one of them. Prior research indicates that strategic alliances may prove valuable and beneficial for all actors when the market is dominated by much uncertainty, e.g. (Chan, Kensinger et al. 1997; More and McGrath 1999) and with continual technological innovations and lacking end-user adoption of mobile services, the mobile industry is still perceived as highly uncertain. The literature on systems development – primarily SE – does not say much about the issues and implications that follow from strategic alliances and consequently what challenges this create for systems development practice. Within the context of MSD, this represents the subject of this paper. Based on the findings of an on-going empirical multiple case study I therefore explore the question: What characterise MSD in the mobile industry?

2 RESEARCH APPROACH

To be able to reason about the characteristics of MSD I have followed a research design inspired and taking outset in an exploratory multiple case study strategy, see (Yin 1994). The purpose of the empirical study is to explore the structure of the Danish mobile industry and the conditions and challenges facing MSD. Hence, the unit of analysis is the Danish mobile industry. Collection of qualitative data is conducted using semi-structured and open-ended interviews, see (Patton 1990), due to the explorative nature of the study. The selection of interviewees has not been trivial as both knowledge of the development practice and business related areas of the company needs coverage in order to add empirical value. The interviewees have therefore been carefully selected in each case and range from project managers to CIOs to head of sales in order to ensure a valuable dialog.

The empirical data has first been linked to the research question by analysing the varying product and service offerings that together form the Danish mobile industry. In this process, I have applied a customer-supplier relationship to interpret and characterise the structure of the industry. To emphasize the relevance of the interpretation I have exemplified the structure through the presented cases. Finally, I consider the presented cases and the proposed structure of the Danish mobile industry and derive four different approaches for companies to sustain a successful business.

3 CASE STUDIES

To explore the research question I have so far conducted semi-structured interviews with 7 companies in Denmark. In this paper, however, I will only present four of the cases due to the limited format of this paper. The four cases will serve as descriptors and exemplifications for the varying characteristics of companies in the mobile industry.

Texas Instruments (TI)

The first case study concerns a development site within TI. The development site is located in Aalborg, Denmark. The development site may be considered a R&D site as it specialises in developing and innovating reference designs for mobile phones and GSM and UMTS protocol stacks.

Developing reference design is primarily a hardware task and is the backbone of a mobile device. For the sake of simplicity, reference designs will henceforth be referred to as the hardware platform. Protocol and stack development is a software development task and is only partly being developed in Aalborg as the main production is located in San Diego, USA. The dispersion of this development activity also represents one of the primary challenges to the development team in Denmark. That is, the process of aligning and integrating the development process with the on-going development activity in San Diego. Collaboration among geographically dispersed units is therefore of outmost importance.

As the development deals with both hardware and software products, two different corporate process models are applied. Hardware projects are managed through a well-defined and formal ISO manufacturing standard. This approach is applied in order to fulfil quality standards and customer requirements. Software projects on the other hand follow an adaptation of the V-model; see e.g. (Pfleger 2001, pp. 53; Pressman 2004) that has become the corporate standard software process model within TI. Common for both development approaches is that they have been continually improved over the years to fit the high quality standards at TI and its customers. Both process models are therefore regarded as mature.

3.1   Siemens Mobile Phones Development

This case represents one of 9 R&D sites within the Siemens Mobile Phones Development branch. The site is located in Aalborg, Denmark. Focus is on developing software platforms and client applications that ensure competitive and innovative mobile products. In general, Siemens is involved in nearly every aspect of the mobile industry; from development of the initial hardware platform to the final end-user product. The concrete case, however, deals with R&D in mobile software platforms and client applications. With software platforms I refer to embedded graphical user interfaces (GUI) and embedded operating systems (OS).

As Siemens is largely involved in every aspect of mobile technology development and therefore to a large extent is self-sufficient also means that other development sites, either within hardware or software, are suppliers for the R&D site referred to here. This means that the case is dependent on internal corporate suppliers and not on external partners. Issues such as continual negotiation of business contracts and protection of proprietary products, state-of-the-art knowledge and key staff are therefore not of much relevance. Instead, the practice of aligning and integrating products are central elements. Aligning product development is especially important as R&D is dispersed among 9 global sites. In this sense, aligning refers to coordinating R&D between the 9 sites.

To ensure innovative and at the same time robust products requires a somewhat mature process model for development. The applied process model reflects these demands by adopting best-practices from both the agile development tradition, see e.g. (Abrahamsson, Salo et al. 2002; Cockburn 2002), and the more traditional software engineering tradition, see e.g. (Pfleger 2001; Pressman 2004). To ensure innovativeness, small teams and pair programming are anchored in development practice, but to ensure product quality and reliability formal procedures such as planning, reviews, testing etc. are to a great extent also incorporated into daily practice. The latter part also eases the process of aligning the development with development projects located at other R&D sites. As reliability, quality, and innovation are fundamental parts in the development process, the process model is continually evaluated and improved. Development practice is therefore regarded as mature.

3.2   Wirtek

Wirtek is a small Danish company, which originates from Nokia Denmark. That is, just before the IT-crisis around year 2000 Nokia closed down a large number of their smaller R&D sites around the world. One of these sites, however, was re-established by former employees of Nokia as a new company, namely Wirtek. Wirtek is a company offering a wide palette of services within the mobile

industry; consultancy business, in-sourcing of project managers and systems developers, out-sourcing of entire development projects, and development of embedded software solutions.

Wirtek follows an adaptation of the rational unified process (RUP), see e.g. (Kruchten 1996), which has been the primary process model for development practice since the days with Nokia. The process model is continually improved and changed to reflect the needs of their customers and the changing market conditions. Wirtek is characterised by personnel all highly educated and experienced within the mobile industry. Furthermore, development practice has always been dominated by a strong passion for structuring, formalising and improving current practice which also has become a key offering as part of the consultancy business.

Due to its limited size and its type of delivered services, Wirtek is dependent on external collaboration and partnerships. Wirtek is therefore highly dependent on establishing and maintaining good business relations to companies within the mobile industry, e.g. with businesses from the embedded software development industry or the industry of application developers. Currently, Wirtek is about to initiate a partnership with a competitor because of a mutual interest in the competences, knowledge, and products that reside in each company. By combining their strengths they can deliver a unique product not offered by anyone else in the market, creating value for both companies. Partnerships and collaboration like this yields issues such as contract management, integration, and coordination.

3.3 End2End

End2End is a Danish hosting and service management company. End2End was founded in 2000 and employs today approximately 60 people in three countries – Denmark, Germany and the United Kingdom. End2End offers a highly complex IT infrastructure for hosting and managing mobile data services with everything from delivering content to managing billing of end-users. Traditionally, one would associate this business with mobile operators, however End2nd has established and invested €40 millions in a highly advanced infrastructure enabling mobile operators a more cost-effective hosting and management of these services. End2End is therefore attracting a still increasing number of mobile operators wanting to outsource this part of their business. The current customer base includes mobile operators such as Vodafone, Sonofon, Telia, Orange, Proximus, and Swisscom.

It should, however, be noted that End2End solely offer mobile applications developed by third parties. In turn, this makes End2End highly dependent on collaboration with external partners. Furthermore, as the market for hosting and service management is still maturing End2End are forced to be flexible when negotiating business contracts with mobile operators in order to attract new customers and to sustain and improve the business with existing ones. This creates customer contracts based on varying business models, i.e. agreements on the costs of the service that End2End delivers. These issues represent areas tension, i.e. continual negotiation of business contracts, and leave End2End in a vulnerable position and represent the most critical and greatest challenge in End2End's strive for success.

4 ANALYSIS

To understand the mobile industry, we need to grasp the different layers or segments that constitute this industry. That is, the different sub-industries that together form the mobile industry. Based on the initial findings resulting from the up-till-now 7 case studies and their different product and service offerings, I here propose five layers or segments that together constitute the mobile industry. The framework is depicted in Figure 1.
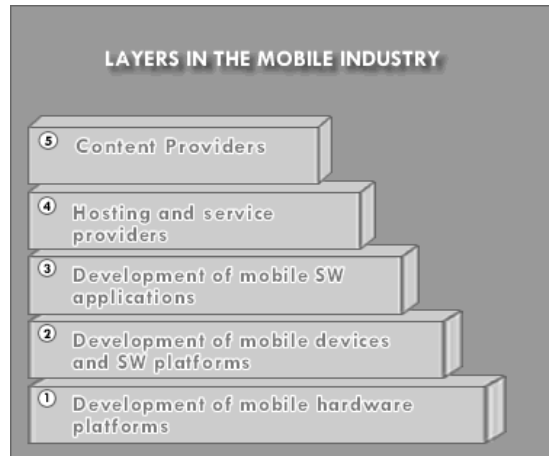
Figure 1.   The mobile industry divided into five layers.

The different layers are structured according to a supplier-customer relationship, meaning that a lower layer supplies an upper layer with the necessary hardware or software in order for the businesses in the upper layer to develop and offer products. In this respect, businesses in an upper layer are therefore customers of the suppliers at lower levels, but are at the same time suppliers for businesses located at a higher level than them.

4.1   Layers

To understand the meaning of the different layers and relate these to the presented cases, Table 1 is structured according to the primary products offered, primary characteristics, and case example. What becomes clear in the case descriptions is that the cases often offers several products in which case they in reality span several layers of the mobile industry. However, the case exemplifications in Table 1 are categorised according to their primary product areas and focus even though they may offer secondary services belonging to a different layer.

	PRIMARY PRODUCTS	PRIMARY CHARACTERISTICS	CASE EXAMPLE
LAYER 5	▪ Content	▪ Corporate data and downloadable content may be offered by almost anyone. Initial costs are therefore low and hence competition is significant.	
LAYER 4	▪ Hosting and service management	▪ Expensive IT infrastructure is required. ▪ Integration is a key element as customers' (mobile operators) networks must be integrated into the infrastructure and so must mobile applications. ▪ Competition is low as the high establishment costs becomes a barrier for new businesses.	▪ End2End
LAYER 3	▪ Mobile applications	▪ Development costs are low as development may be initiated at day one. ▪ The number of businesses entering this segment is accelerating as organisational and consumer demand is rising. ▪ Currently, this part of the mobile industry is shaped by small and medium-sized companies. ▪ Low development costs, rising demands, and the small players yield a segment with business potential.	▪ Wirtek

LAYER 2	▪ Manufacturing of mobile devices. ▪ SW platforms (embedded UI and OS)	▪ Making the most of the functionality on the HW platform. ▪ Innovative and yet a formalised practice is required to develop unique but error-free SW platforms. ▪ Correcting dysfunctional SW platforms is a costly process, formal testing procedures and quality assessment is therefore of outmost importance. ▪ Dominant players such as Nokia, Siemens, Sony-Ericsson, Motorola etc. control this segment of the mobile industry making new business start-ups very difficult.	▪ Siemens Mobile Phones Development
LAYER 1	▪ HW platforms (reference designs)	▪ Practice is R&D driven. ▪ Primary driver for tomorrow's technology. ▪ Stability and creativity are required in order to ensure innovative and reliable products. ▪ Testing is a central activity as the costs of error-prone platforms are immense. ▪ Large multi-national corporations dominate this highly competitive industry.	▪Texas Instruments

Table 1.   The characteristics underpinning each of the five layers.

Considering the layers in Table 1 and the case studies reveals four different modes of operation, i.e. four different ways of sustaining a successful business within the mobile industry. These are now presented and elaborated on next.

4.2   Four Modes of Operation

Based on the case descriptions in Section 3 and the five-layer framework, four different modes of operation may be derived stemming from the two dimensions: (1) the position of the business in the five-layer framework, i.e. what products are being offered and (2) whether the success of the company is dependent on interorganisational collaboration – strategic alliances.

	DEPENDENT ON STRATEGIC ALLIANCES	**NOT DEPENDENT ON STRATEGIC ALLIANCES**
OPERATING ON A SINGLE LAYER	First mode *(End2End)*	Second mode *(Texas Instrument)*
OPERATING ON SEVERAL LAYERS	Third mode *(Wirtek)*	Fourth mode *(Siemens Mob. Phones Dev.)*

Table 2.   The four modes of operation.

First mode: In the first mode of operation, companies focus development activities on a single layer. These businesses are dependent on strategic alliances either with companies within the same layer – representing a horizontal alliance – or with companies from higher layers (customers) or lower layers (suppliers). The latter form represents vertical alliances. End2End is an example of a company that seeks to establish vertical strategic alliances. Their business is highly dependent on good strategic relations with both mobile operators and application developers - see subsection 3.3. The reason is that End2End is still a rather immature business and that they are seeking to establish themselves in an area of the mobile industry by tradition belonging to mobile operators. The incentive for establishing strategic alliances from End2End's point of view is to establish relationships that can benefit all involved parties and at the same time create a sufficient and stable customer base. If this succeeds, End2End is ensured increased turnover and mobile operators a cost-effective service.

A fundamental element in strategic alliances is trust (Sabherwal 1999). Each company in the alliance must trust each other as corporate knowledge needs to be shared. Hence, there must be a mutual bond of trust among parties. Trust fosters commitment and aids in activities such as negotiation, contract management, and sharing of proprietary knowledge. The likelihood of success in a strategic alliance is therefore highly dependent of the presence of trust and commitment between parties (Kwon and Suh 2004).

Second mode: The second mode of operation characterises businesses operating on only one layer, but not being dependent on strategic alliances. Texas Instruments is such as business. The primary reason for not collaborating with external partners is that the company already is more or less self-sufficient. That is, the company is of such a size that the company can maintain and create the knowledge and competences required in order to sustain a successful business. Challenges relate to processes of aligning and coordinating R&D activities as these corporations often consist of several geographically dispersed units. The size of the company also indicates a mature segment of the mobile industry – in this case layer one. That is, this part of the mobile industry has existed long enough for companies to expand for example by buying into smaller existing businesses or making joint ventures. Consequently, this has fostered the creation of a sub-industry dominated by few but large enterprises, such as Texas Instruments.

Third mode: This mode of operation reflects businesses operating on several layers and dependent on strategic alliances. Common for such businesses is that they offer a varied set of services or products spanning several layers. The motivation for adopting this strategy may be rooted in several factors, but for the business to survive close collaboration and strategic alliances are of paramount importance. Strategic alliances may therefore be created on different layers depending on the need for anchoring within a specific sub-industry. Due to the strong dependency on strategic alliances companies adopting this business approach are vulnerable, but at the same time have the ability to seek strategic alliances reflecting changing market demands, thereby adapting to the current market condition. Of the four case studies, Wirtek is an example of such a strategy. Wirtek seeks strategic allies both horizontally and vertically. In particular, Wirtek is currently engaging into a horizontal strategic alliance with a former competitor, see subsection 3.2. Mutual interest and common goal congruence are incentives for the alliance, which are common denominators for the establishment of partnerships, see e.g. (Bjerknes and Mathiassen 2000). Especially in the sub-industry of software development – layer two and three – strategic alliances seem to be particularly valuable. From a survey of 345 strategic alliances Chan and Kensinger (1997) concludes that strategic alliances within software development can prove particularly valuable for the involved parties. As in the first mode of operation, trust is of course a vital element when maintaining and seeking to create strategic alliances, but here I refer to the argumentation previously provided.

Fourth mode: The last mode of operation characterises companies present at several layers of the mobile industry, but not dependent on collaboration with external businesses. Following this mode of operation we find large international companies such as Siemens, Nokia, Sony-Ericsson etc. Common for these companies is that they cover almost all the layers in the mobile industry, see subsection 3.1. Their size and extensive involvement in many of the layers in the mobile industry, makes these companies self-sufficient and are therefore not required to engage into strategic alliances. On the contrary, these enterprises are often doing their most to avoid leaking proprietary knowledge that may be of benefit to competitors. In such companies, however, there will be a strong need to align business strategy with development strategy. Resources need therefore to be spent not only on aligning the different development activities, but also on aligning the business strategy with the development strategy. Using Miles and Snow's (1978) concepts of defender, analyzer, and prospector, Sabherwal and Chan (2001) concludes from a survey covering over 160 companies that prospectors aligning the business strategy with the IS strategy results in increased business performance. Prospectors are refereed to as businesses seeking new product and market opportunities and highly dependent on the ability to innovate. With technological innovations still driving the mobile industry companies characterised by the fourth mode of operation, may therefore be refereed to as prospectors and may

benefit from increased alignment of business strategy with IS strategy, which the development strategy is part of.

5   CONCLUSION

This study presents preliminary findings of an on-going multiple case study and seeks to characterise and enhance the understanding of the conditions underpinning mobile systems development. By analysing empirical data I have proposed a five-layer framework for describing the mobile industry and correspondingly introduced four modes of business operation in the mobile industry.

Even though this paper reports of the preliminary findings of research-in-progress, this paper provides insights into the structure of the mobile industry and the different modes of operation that businesses apply in order to create and sustain a successful business. Both contributions may turn out beneficial when companies analyse and discuss strategic moves for ensuring a prosperous business.

As this is research-in-progress the proposals in this study needs further validation, both theoretically and practically. A theoretical discussion of the empirical findings compared to existing research within the discourses of systems development and strategic alliances will indeed increase both its practical and theoretical contribution. This will therefore be one of the primary future tasks.

References

Abrahamsson, P., O. Salo, et al. (2002). Agile Software Development methods: Review and analysis, VTT Publications.

Bjerknes, G. and L. Mathiassen (2000). Improving the Customer-Supplier Relation in IT Development. 33rd Hawaii International Conference on Systems Sciences, Hawaii, IEEE.

Chan, S. H., J. W. Kensinger, et al. (1997). "Do strategic alliances create value?" Journal of Financial Economics **46**: pp. 199-221.

Cockburn, A. (2002). Agile Software Development, Addison -Wesley.

Kruchten, P. (1996). "A Rational Development Process." Crosstalk **9**(7): pp. 11-16.

Kwon, I. G. and T. Suh (2004). "Factors affecting the level of trust and commitment in supply chain relationships." Journal of supply chain management **40**(2): 4.

Miles, R. E. and C. C. Snow (1978). Organizational Strategy, Structure, and Process. New York, McGraw-Hill.

More, E. and M. McGrath (1999). "Working cooperatively in an age of deregulation - strategic alliances in Australia's telecommunications sector." The journal of management development **18**(3): pp. 227-254.

Patton, M. Q. (1990). Qualitative Evaluation and Research Methods. Newbury Park, California, SAGE Publications.

Pfleger, S. L. (2001). Software Engineering - Theory and Practice. Upper Saddle River, New Jersey, Prentice Hall.

Pressman, R. S. (2004). Software engineering - a practitioners approach. New York, McGraw Hill.

Sabherwal, R. (1999). "The role of trust in outsourced IS development projects." Communications of the ACM **42**(2): pp. 8.

Sabherwal, R. and Y. E. Chan (2001). "Alignment between business and IS strategies: A study of prospectors, analyzers, and defenders." Information Systems Research **12**(1): pp. 11-33.

Yin, R. K. (1994). Case study research - design and methods. Thousands Oaks, California, SAGE Publications.