

Challenges of Software Product Companies: Results of a National Survey in Finland

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Abstract

This paper reports findings from a survey that has been conducted in Finland to study how the software product companies have matured and evolved over the years. In addition to introducing some key terms for characterizing the software product business, we will provide some overall data on the sector, and discuss some specific issues related to the software R&D process and subcontracting. The survey is one of the largest such surveys covering the software product companies and has revealed several interesting findings on software product companies. Most notably, the software companies have shown to be dynamic and resilient in challenging business environment; and their biggest challenges in growth are not technical but management and marketing related. Furthermore, we also discovered that the most important improvement areas are improving the degree of productization and level of competence of personnel and that the ability to network with other companies is critical for younger companies. This survey also revealed that programming and planning are the two most common types of subcontracting, and difficulties in modularity and specifications are the biggest hurdles that prevent wider use of subcontracting.

1 Introduction

One of the unique characteristics of software along with other information products is that once it is developed, it can be replicated at close to zero marginal costs [Messerschmitt *et al.*, 2003; Shapiro *et al.*, 1998]. Companies that can leverage this opportunity can grow profitably and prosper. While the reality of software business often involves customer specific adaptation and the delivery costs of software are rarely zero, the low

cost of replicating software is an important and fundamental industry characteristic.

Companies that can package and replicate their software offering in this fashion are called software product companies, as we will discuss later in this paper.

Software products have become an increasingly important part of the economy: the worldwide packaged software market is expected to reach 250 billion Euros in 2003. It is the fastest growing market of the IT sector, and it is estimated to account for nearly a quarter of all IT spending by 2006 [IDC, 2003]. The U.S. software market is the largest market for the software, responsible for almost 60 % of the world markets. The U.S. is also the largest country to produce packaged software and generated total revenue of over 105 billion Euros in 2002 [BSA, 2003].

The success of these products and software product companies determines how well and widely software based solutions are used in the industry. In order to understand the characteristics of this industry sector, it is important to collect and analyze the data from it so that trends and issues related to the software companies can be identified and used to improve the sector.

Most countries collect various kinds of data on companies in general, but the data collection procedures and coding used do not allow accurate enough identification and capture of relevant functions of software product companies. Thus, we have conducted a focused survey annually since 1997 to collect relevant data from software product companies in Finland [Hietala *et al.*, 2004]. The survey has covered several topics, such as general business performance, degree of internationalization, degree of productization, characteristics of the R&D process, and financing. The survey is annually sent to ca. 2,000 software product based companies in Finland.

This data has allowed us to obtain a better understanding of this industry sector, its structure, its growth trends, and the critical issues in the R&D processes of the sector. Based on this information, concrete guidelines and recommendations have been proposed and implemented to improve the prospects of the sector as a whole.

In this paper, we will first introduce the key concepts related to the software product business (chapter 2). In chapter 3 we will explain the research methods used in the study. In chapter 4 we will provide the basic characteristics of the software industry, both globally and in Finland. In chapter 5 we will discuss the findings related to the R&D processes of software product companies and in chapter 6 we will discuss the subcontractor and distributed development related issues. In chapter 7 we present some suggestions for future research in this area and chapter 8 presents our conclusions.

2 Defining the Software Product Field

The offerings of the software industry can be roughly divided into three categories: software products, customer tailored software (or customized software), and embedded software, as shown in Figure 1 [Nukari *et al.*, 1999]. In this study, we are interested in software products as a product category that is distinct from embedded software, on the one hand, and customer tailored software, on the other. We do this by examining the object of trade and the degree of customization.

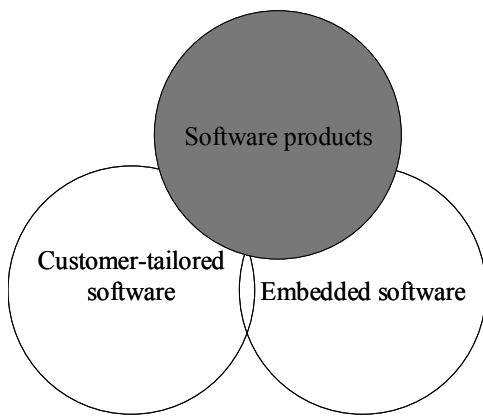


Figure 1: Types of Software Products [Nukari *et al.*, 1999]

Software products are traded on their own, not as part of other products. Although software product business often includes other things, such as installation, training, and even customization, the main object being traded is software. However, depending on the business model and product offering, even the “purest” software

product companies may receive majority of their revenue streams from services, as the recent study of Cusumano [Cusumano, 2004] indicates.

Embedded software, on the other hand, consists of software that is built into other products, such as cellular phones, refrigerators, paper machines, or television sets, and is not sold separately. As embedded software has not traditionally been sold as a separate product, our previous surveys have covered it only marginally. However, as it is increasingly being sold as a software product, our future surveys will include embedded software as well.

Software can be prefabricated, developed specifically to the needs of each customer, or both. This dimension, the degree of productization, is crucial for differentiating between software product and project business. The spectrum of productization ranges from standard “packaged” software products that are delivered “as is”, i.e., without any changes to a large number of customers, to customer tailored software, i.e., software that is developed according to the needs and specifications of individual customers. Figure 2 illustrates this spectrum and shows the positioning of software products within it.

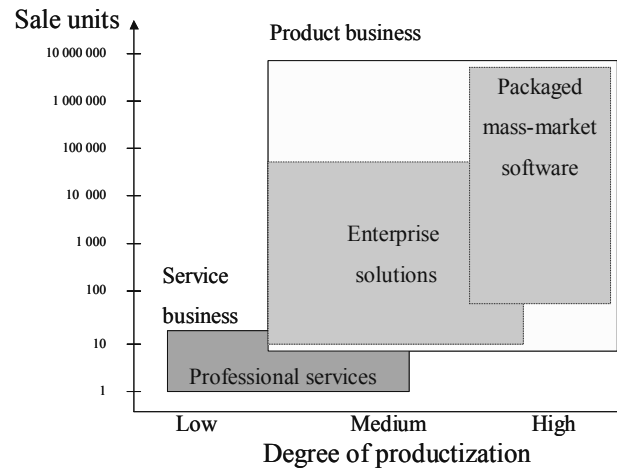


Figure 2: Software Product and Service Business [Hoch *et al.*, 1999]

Productization means standardization of the elements in the offering. The term productization includes several technological elements from the very early stages of designing a product (i.e., managing requirements, selection of technological platforms, design of product architecture etc.) to the commercial elements of selling and distributing the product (i.e., delivery channels, positioning of the product and the company, and after sales activities). Some of the key elements influencing the degree of productization are product market, concepts, benefits, positioning,

requirements, features, specifications, delivery channel, marketing, selling, and packaging (adapted from [Cooper, 2000]).

Pure software products are highly productized and often referred to as packed, mass-market, or shrink-wrap software. These kinds of products are delivered to a large number of customers in exactly the same format – without any customer tailoring. In this case, the product development and order-delivery processes are completely separated. Software products of this kind can be sold to millions of customers because of close to zero marginal costs – there are hardly any traditional production costs [Hoch *et al.*, 1999]. Typical examples of packaged software products include word processing packages, spreadsheets, some business software, and operating systems.

In the enterprise solutions business, there is practically always at least some customization needed in order to integrate the software to the customers’ other information systems, and infrastructure. This also puts certain limits to the number of customers; the number of customers is counted in hundreds or thousands rather than in millions. Installation projects take typically months or even years, instead of minutes or hours required by mass-market products. Still, the business is based on pre-developed software products, making it a highly productized business

Table 1: Comparing Product and Service Business Companies on Five Key Issues [Nambisan, 2003]

Key issue	Software product companies	Software service companies
<i>Intellectual property rights</i>	Very important	Less Important
<i>Product complementarity</i>	Very important	Less Important
<i>Returns from scale</i>	A fixed-cost structure allows for higher returns from scale	A variable-cost structure makes increased returns from scale rare
<i>Abstracting knowledge and integrating technology</i>	The company must be able to gather generic product knowledge so that the product can be used in a variety of contexts. Architecture level technology integration is important for the smooth running of the end product	Knowing clients’ idiosyncrasies is more important than the knowledge abstraction. Companies rely upon data-interface-based technology integration: the primary emphasis is on development efficiency
<i>Connections with users</i>	Companies have long-term relationships: typically the users are technologically sophisticated	Companies have project-driven relationships: typically, the users are technologically unsophisticated

At the low end of the productization spectrum, still belonging to software product business, we have situations in which the customization is done by changing the code of the software product on a customer

specific basis. Here, the distinguishing feature is that the amount of work going into customer-specific tailoring is small compared to the whole effort of developing the product.

Customized software consists of software developed to the specifications and needs of single customers. This business is often based on selling projects, not software, and has many characteristics of a service industry. Although synergies exist between product and service businesses, extending the business beyond company’s dominant position is very challenging as these sectors differ significantly. There is strong evidence that majority of the service companies have failed their product business initiatives. Main differences between the product and service businesses are listed in Table 1 [Nambisan, 2003].

3 Research Methods

The most recent survey was conducted in 2003. The data was gathered by a questionnaire, which was sent to 1971 companies in March – May 2003. We received a total of 261 responses, of which 166 were in software product business. This gives a response rate of 13.2%, a substantially lower response rate than in previous years, due to more complex questionnaire used in the previous year, when the response rate was 25%. According to professional estimates, there were approximately 1,000 software product companies in Finland at the end of 2002. Thus, we reached 17 % of the industry with the survey. However, we did not reach young companies as well as expected. In addition, we systematically approached larger companies in order to estimate volumes at the industry level.

We used a commercial address service for selecting appropriate, targeted companies. In essence, we over-sampled the companies as the survey was sent to more companies than there are software product companies in the country. This was done to ensure that as many as possible of the companies were reached, despite potential problems with industry classification codes in databases. The companies that replied to our survey but did not have software product based business were excluded from the data set.

The questionnaire sent included a cover letter and a pre-paid return envelope. Each questionnaire also had a unique identification number, making the identification of respondents possible even if the contact information was left blank. In order to improve the response rate we promised to send all the respondents a summary from the results.

The questionnaire totaled 8 pages and had six main sections: 1) the main software product and business related to it, 2) international business, 3) corporate

financing and ownership, 4) general company information (revenue, personnel and development of business), 5) corporate strategy, product development and networking and 6) respondent demographics.

We tested the questionnaire with four software product representatives before mailing it and gathered also comments from several industry experts. We learned that it took some 30-50 minutes to fill in the questionnaire. We changed the wordings of several questions, as well as shortened the questionnaire based upon the feedback from the testing.

After the second mailing 142 companies had returned the questionnaire. Most of the large enterprises had not answered the survey because of the legislation of public limited companies. In order to gather at least the numerical data the major companies were phoned and/or their annual reports were studied. Information of 25 companies was gathered in other ways, mostly by phone but also using the Internet and companies' annual reports.

We used SPSS version 11.0 for Windows for analysis of data. We used simple statistics like frequency counts, averages as well as regression and factoring among other statistical analysis tools. We used correlations to describe linear dependencies of the variables. We used Pearson correlation if variables were measured at least on interval-scale and Spearman correlation if variables or only one of them was measured on ordinal-scale.

The reliability of the constructs used was measured with the Cronbach alpha coefficients, and the values were in every section of the questionnaire close to 0.700, which is normally considered as a good level for the reliability. Because of the relatively large amount of companies, it is quite hard to verify the answers companies have given. Often companies want to give more positive views of their situation than the actual condition is. Also, companies often tend to have very optimistic views on future that may not always be quite realistic. To assist in the interpretation of the data, we presented the data and findings to industry experts in order to understand the phenomena better and validate the conclusions.

Construct validity relates to how well questions asked measure the actual phenomenon –not something else. Questions that were not understood homogeneously in the testing phase of the questionnaire were changed or removed. Even so, there were some questions in the final questionnaire that did not exactly measure the desired topic and, therefore, the answers from these questions were not used in the analysis. Also, we obtained secondary assessments of knowledge intensity from industry experts (venture capitalists, government

officials, and entrepreneurs) in order to reduce the chance of a systematic error.

While we believe that the validity of the study is relatively good, it seems that in the survey we did not reach very well companies of very small size, “micro-companies”, for some reason. This can bias the results, since these micro-companies are not well represented in the data. These micro-companies often face different challenges than more established companies, can operate very dynamically due to their small size, and can also gain growth at a very fast pace. Hence, we have to acknowledge the “lack” of these companies in our sample. In addition, it is worth mentioning that in this paper we tried to give a good general overview of the Finnish software industry despite the fact that the industry is very diversified (by the size and age of the company, product offering, processes etc.) Therefore, some of the statistically significant correlation coefficients are relatively low. Thus, probably we would have found more evident linear dependencies between variables, had we divided the data into separate, more homogeneous subsets.

4 Characteristics of the Industry

According to BSA [BSA, 2002], the Western European packaged software market will grow substantially faster than the general economy despite the general economic outlook and the global impact of the events of September 11, 2001. Western Europe's software industry is forecasted to grow significantly, from a 2000 level of 56.7 billion Euros to 109.3 billion in 2005. This represents an aggregate yearly growth of nearly 14 %. The Western European packaged software market also employed approximately 1.1 million people through direct employment, upstream operations (manufacturing and logistics), and downstream operations (reselling, training, and consulting).

According to EITO's report in October 2003 [Anon., 2003], the Western European IT markets are suffering from the general economic recession. The software product markets gained no growth (0.0 %) in 2002. According to EITO's most current report from February 2004, the market is expected to grow by 2.1 % and 4.6 % annually in 2003 and 2004 [Anon., 1998]. Software products have a 10.9 % share of the whole ICT market, with a market value of 592 billion Euros in 2003. The overall growth for the ICT market has been just 4.1 % in 2001 and growth has nearly stopped in 2002 (growth 1.1 %). In an earlier forecast from February 2002, EITO predicted that the growth rate of the software products would outperform other ICT segments. However, as can be seen in Figure 3, software product markets are outperformed by IT and carrier services in 2001-2003.

In Finland, the software industry is still relatively small, although it has grown rapidly during the 1990's. The total revenue for the whole industry (including project based business and consulting services) 2003 has been estimated at 4 billion Euros [Nukari *et al.*, 1999]. European companies have lagged behind the U.S. firms in the packaged software segment, due, e.g., to small and diverse home markets, low degree of productization and internationalization, and weak links to universities [Malerba *et al.*, 1996]. This seems to be true also for Finnish companies. The trend, however, seems to be towards greater degrees of both productization and internationalization, i.e., from custom software developed for local markets towards mass-market software intended for international distribution.

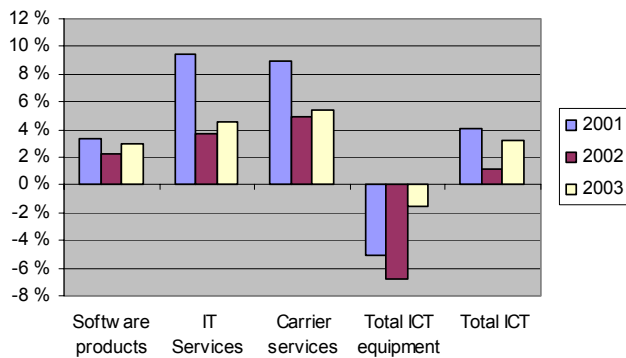


Figure 3: Western European ICT Market Growth by Segment in 2001-2003 [Anon., 1998]

Companies were asked about their revenue in the year 2002, their budgeted revenue for the year 2003, and a revenue estimate for the year 2005. In addition, we asked how the software product business revenue is divided between domestic and international markets.

The software product companies had an average total revenue of 16.9 million Euros (16.1 million Euros in 2001) and a median revenue of 0.7 million Euros in 2002 (0.6 million Euros in 2001). The average software product business revenue was 4.6 million Euros (4.1 million Euros in 2001) and median revenue 0.4 million (0.5 million Euros in 2001). The large difference between averages and medians is explained with large companies that bring the average up. As can be seen by studying the medians, most companies are comparatively small. Distribution of the responding companies' software product business revenue in 2002 is presented in Figure 4.

The total revenue tends to grow when companies mature, evidenced by a positive correlation between the total revenue and the age of the company (Pearson correlation 0.276). The total revenue's (Million Euros) regression against the age of the company reveals that the coefficient of the age of the company is 3.45. Pearson correlation between the software product business revenue and the age of software product business is 0.382 and the respective regression coefficient of the age of the software product business is 0.607. Both correlations are significant at the 0.01 level.

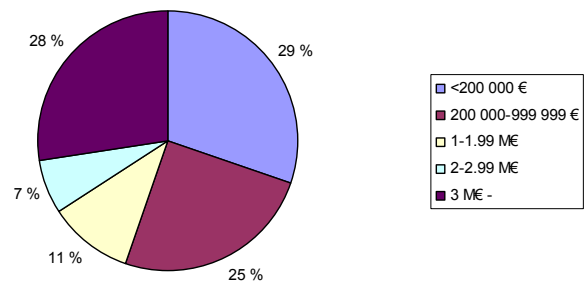


Figure 4: Responding Companies' Distribution of Total Revenue in 2002 (n=152)

In order to gain knowledge regarding the business focus of the respondent companies, Figure 5 shows the percentage of company's own software product business revenue from the overall company revenue. On average, the respondents had 60% (64% in 2001) of their total revenue acquired from their own software product business and the median was 70% (80% in 2001). Small decrease in the share of software product business revenue can indicate that some companies have

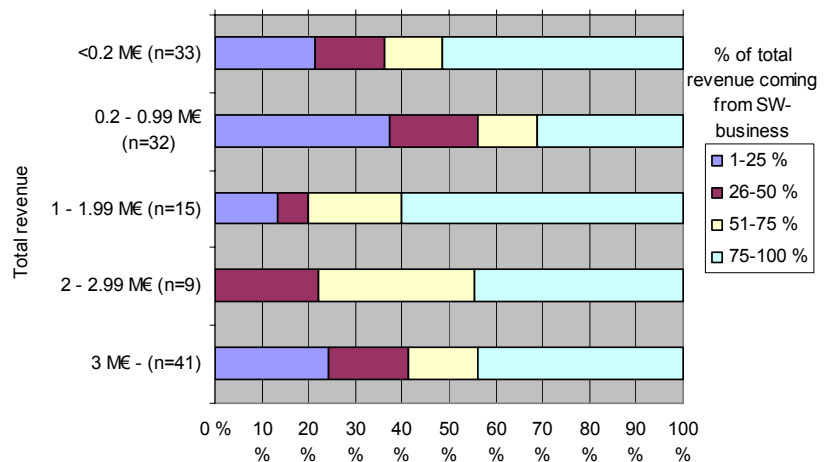


Figure 5: Percentage of Companies' Total Revenue Acquired from Company's Own Software Product Business in 2002 (n=130)

increased their project business in order to generate revenue as product business has suffered from the economic situation. As Figure 5 shows, companies reached in the survey had quite often software product business as their core business. This is quite logical, since these companies are probably most eager to improve the conditions in the Finnish business environment and participate in the survey. However, a relatively large amount (38 %) of companies with the total revenue ranging from 0.2 to 0.99 Million Euros acquired less than 26 % of their total revenue from software product business. This can indicate that since Finnish software market is rather small, accounting for less than 1 % of the world markets, companies do not specialize their offering for the domestic market and, instead, tend to operate in any way necessary in order to generate revenue.

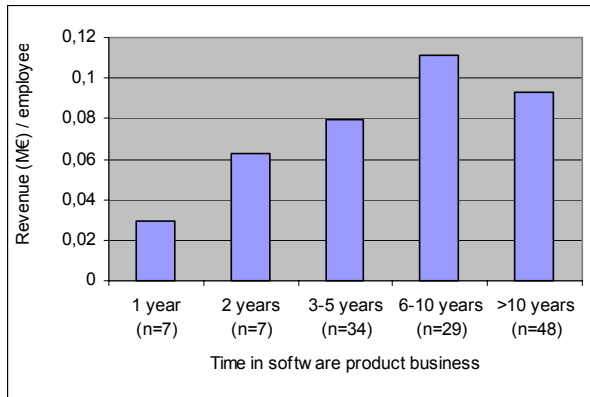


Figure 6. Development of Revenue per Employee in 2002 According to the Maturity of the Software Product Business

The total revenue and the amount of employees working for the companies responding in the survey was summed up, which made the revenue per employee 107,000 Euros (105,000 Euros in 2001). However, the number of large companies strongly influences this ratio. When calculating the revenue per employee ratio as an average of single companies mean ratios, the ratio is 87,000 Euros per employee (84,000 Euros in 2001). When we studied the development of the ratio based on the time the companies had been in the business we found out that the ratio was essentially higher for those companies who had been in the business for more than five years. This indicates that it can take up to five years before the first product is successfully launched into the markets. An interesting phenomenon can be seen in Figure 6: revenue per employee rate is larger for companies that have been in business for 6 to 10 years than for those that have been in business for more than 10 years. There can be many explanations for this. Some of the successful Finnish software product

companies are in the 6-10 years age rate, which can dramatically improve the average. In addition, since these companies were of smaller size (a total revenue in median 0.93 Million Euros versus 1.65 Million Euros; overall personnel in median 5 versus 6.5; R&D expenditure of the total revenue in median 20 % versus 25 %), short-term cost savings (employee layoffs, e.g., in R&D department) can have a significant effect on the revenue per employee ratio.

When studying how the software product business revenue affects the revenue per employee ratio, we can see that companies with software product business revenue exceeding 1 Million Euros reach the ratio of over 100,000 Euros per employee. Companies smaller than this are most likely still in a product development phase, which can be seen in moderate rates (under 80,000 Euros per employee) as can be seen in Figure 7.

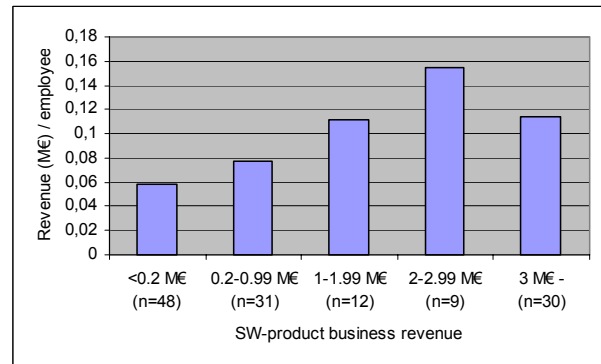


Figure 7. Development of Revenue per Employee by the Revenue of the Software Product Business

It is also worth pointing out that the revenue per employee ratio in the Finnish software product companies is rather low compared to other countries. For instance, in Israel the corresponding ratio may be as high as 215,000 [IASH, 2004]. However, it is not clear how reliable this reference figure is.

5 Company R & D

Figure 8 shows how personnel are allocated to various functions. Over one third (34 %) of the employees work in product development (35 % in 2001). The share of personnel providing product services and delivery slightly increased from the previous year — 23 % of the personnel were allocated to this area (20 % in 2001). The share of personnel in customer service increased to 15 % from 13 % in 2001. 17 % of the employees work in sales and marketing (20 % in 2001). The share of management and administration also decreased to 9 % from 12 % in 2001.

We asked the companies how the skills of the workforce recruited meet the practical needs of the company. Only 20 % of the companies felt that the skills of the workforce did not meet the demands of the company (23 % in 2002 survey). This is understandable as in the current economical downturn there are highly competent employees available at reasonable expenses.

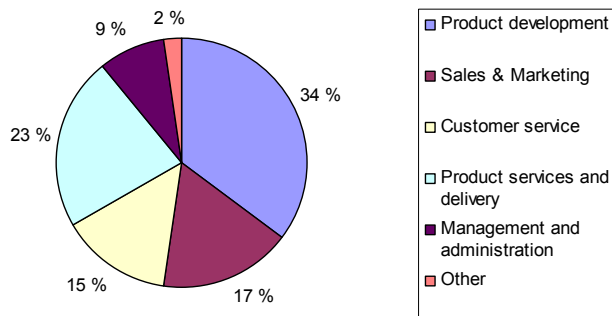


Figure 8: The Allocation of Personnel to Functions (n=133)

The most common problem areas in finding competent personnel were in sales and marketing, especially for international markets. In addition, quite often sales and marketing personnel had inadequate knowledge of the problem domain from a technological perspective. In general, it can be concluded that problems in finding competent personnel were most often in business and administrative tasks, not in technological. Compared to results from 2002 survey, the study indicated that acquiring competent technical people has become easier. This might be caused by layoffs of some large IT-companies and increased competence of the current workforce. Summaries of the listed competence problems in different categories are listed in Table 2.

We defined eight possible improvement areas in the

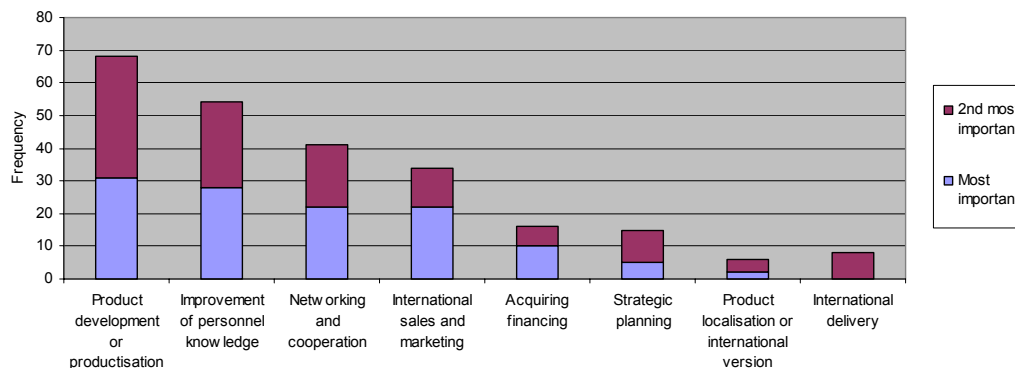


Figure 9: The Most Important Improvement Areas within 2003-2005 (n=122)

survey, as presented in Figure 9, in which companies are focusing in 2003-2005. The companies were asked to value their two most important improvement areas with numbers 1 and 2, where one was the most important and two the second most important improvement area in the next three years. The companies were also asked to value their two least important improvement areas with numbers 7 and 8, where 8 was the least important improvement area and 7 was the second least important improvement area.

Table 2: Managerial Competence Problem Areas in Recruiting

Leadership and management	Frequency
International sales and marketing	12
Problem domain knowledge of business personnel	5
General management skills	3
Project management	2
Business process consultants	1
Managing a start-up company	1
Productization	1
Starting international operations	1

56 % of the companies rated product development or productization as the most important or the second most important improvement area. It is worth to mention that only 2.4 % of the companies rated product development or productization as the least important or the second least important improvement area. Improvement of personnel knowledge and networking and cooperation were also quite often ranked as important improvement areas as can be seen in Figure 9.

We studied how a company's age affects to the improvement areas. It is worth to mention that older companies (age > 10 years) selected most often improvement of personnel knowledge as the most important improvement area as can be seen in Figure 10.

This, together with the finding that older companies' revenue per employee ratio is lower than companies with age between 6 to 10 years (see Figure 6), could indicate that older companies have strong commitment to the personnel, because they see improvement of personnel knowledge such an important improvement area. Therefore, we believe,

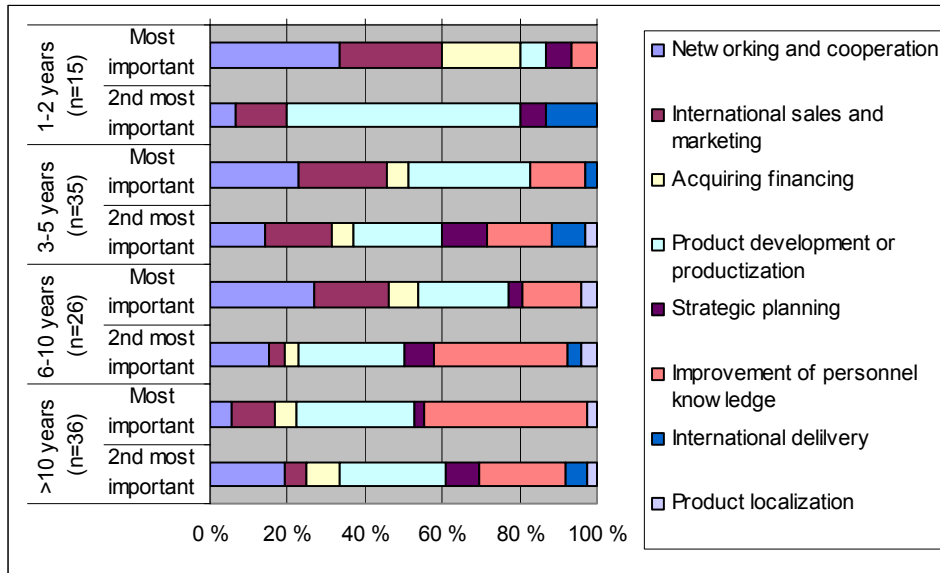


Figure 10: : Distribution of the Most Important Improvement Areas within 2003-2005 Based on the Age of the Software Product Business (n=112)

they are not necessarily so willing to lay off personnel in economically bad times and this can cause temporarily lower revenue per employee rate. An interesting finding is that youngest companies saw networking and co-operation as the most important improvement area, followed by product development. This could indicate that companies are still unsettled in their ways of operating business and try to position themselves in the business environment and the value chain.

We also studied how the size of the company, defined by revenue, affects the improvement areas. Small companies (revenue 0-2 Million Euros) selected most often product development or productization as the most important improvement area. Interestingly, larger companies ranked most often improvement of personnel knowledge as the most important improvement. Smallest companies seemed to find networking and co-operation as very important improvement areas whereas largest companies seemed to manage this area rather

well. Despite the size of the company in general, most important improvement areas seemed to relate to very fundamentals of business, i.e., product development, networking and improving personnel knowledge. We can also see that due to the small size of the domestic market, even the smallest companies regard international sales and marketing as a central issue. Most and second most important improvement areas by the size of the company are presented in Figure 11.

We also asked companies about their product development processes. 61 % of the responding companies indicated that they have at least a relatively specific description of the features and requirements of their products (given at least value of 5 on a 7-scale Likert). We also asked if a company always has a pilot customer before making a decision of new product development. 40 % of the companies indicated, that there almost always is a pilot customer (given at least a value of 6 on a 7-scale Likert). However, 29 % of the

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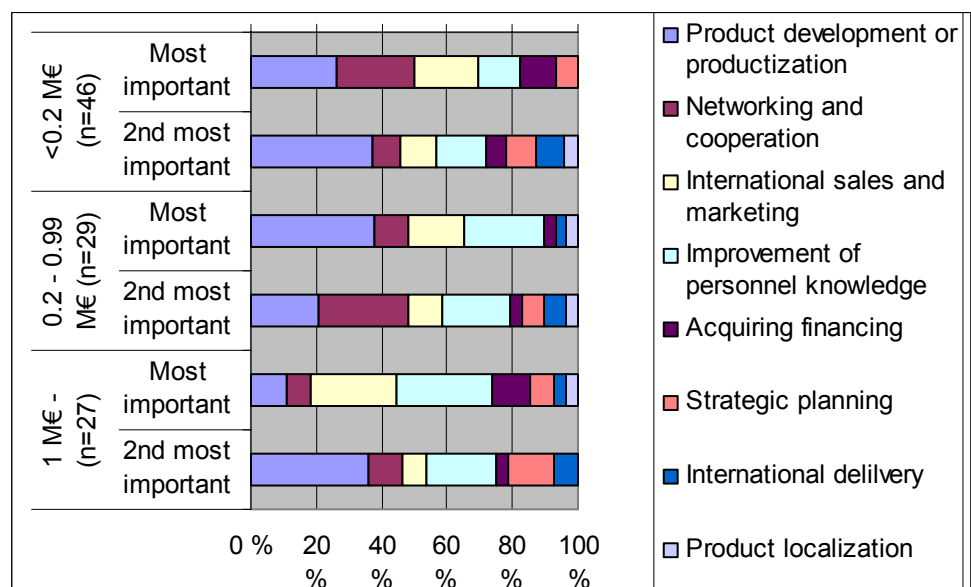


Figure 11: Distribution of the Most Important Improvement Areas within 2003-2005 by the Software Business Revenue (n=102)

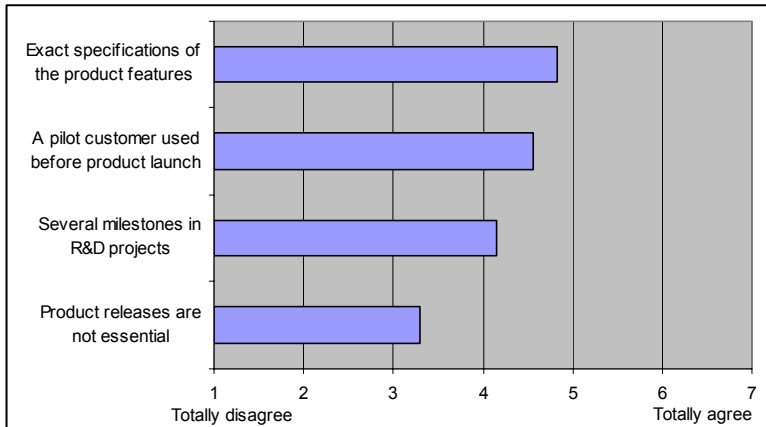


Figure 12: Describing Factors of the Product Development Process

companies indicated that they only rarely have a pilot customer (given no more than a value of 3 on a 7-scale Likert). Over half (55 %) of the companies did not systematically set several milestones for their product development projects (given no more than a value of 4 on a 7-scale Likert). 59 % of the companies disagreed at least quite strongly (given no more than a value of 3 on a 7-scale Likert) with the statement that talking about product releases is not essential to them. The averages of the used approaches in product development are depicted in Figure 12.

Interestingly, the previous methods used in product development process did not dramatically seem to correlate with the degree of productization. However, small correlation was found between the using milestones in product development and occurrence of a customer-specific version of the product (Spearman correlation -0.168, significant at the 0.05-level). This indicates that companies using milestones operate more systematically in their product releasing and, therefore, do not release customer-tailored versions. In addition, companies indicating that they knew their markets thoroughly also had more detailed specifications of their products (Spearman correlation 0.236, significant at the 0.05-level).

We also asked companies to estimate their product development process by some statements, where the far-

ends were not necessarily opposites, but describe, e.g., how information for products is primarily gathered (see Figure 13). Majority of the companies indicated that new product development projects are at least partly based on understanding the market needs, instead of basing decisions merely on their own technological competences (given at least a value of 5 on a 7-scale Likert). Releasing a new product was by 34 % of the companies quite clearly based on a fixed time schedule (given no more than a value of 3 on a 7-scale Likert) where as 43 % of the companies were including almost all the wished features despite delays in releasing (given at least a value of 5 on a 7-scale Likert). Majority of the companies gathered requirement

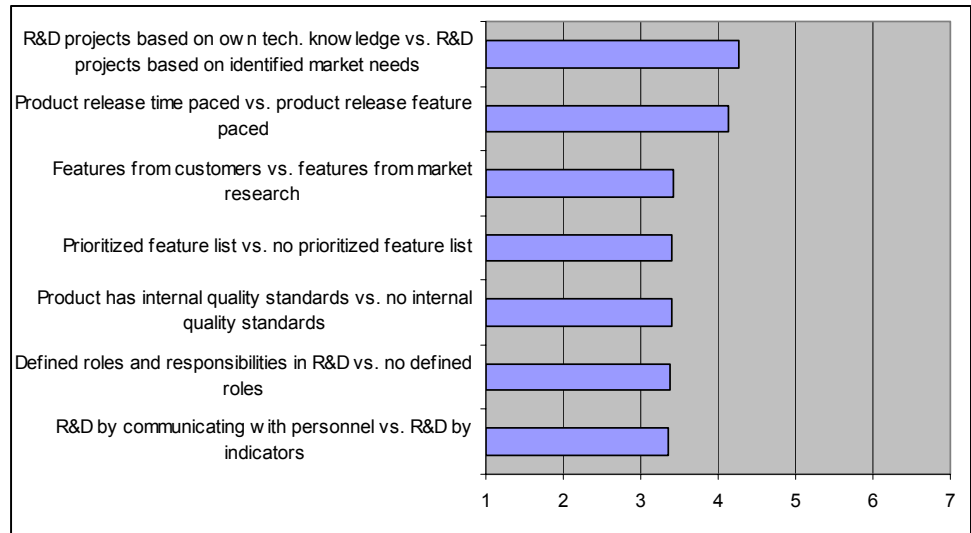


Figure 13. Characterizing Factors of the Product Development Process

and feature needs from their customers where as using market research was quite seldom used, as only 22 % of the companies indicated so (given at least a value of 5 on a 7-scale Likert). Majority of the companies have prioritized their list of features to be made as only 15 % indicated that features are not prioritized (given at least a value of 6 on a 7-scale Likert).

Interestingly, no significant correlations were found between the process describing variables and the degree of productization. However, it seems that companies producing enterprise systems are quite advanced in their processes. Companies announcing that they produce enterprise systems (i.e., CRM, ERP or SCM) had significant correlation with having R&D followed by indicators (Spearman correlation 0.202, significant at the 0.05-level). In addition, these companies seemed to create new products based on the market need

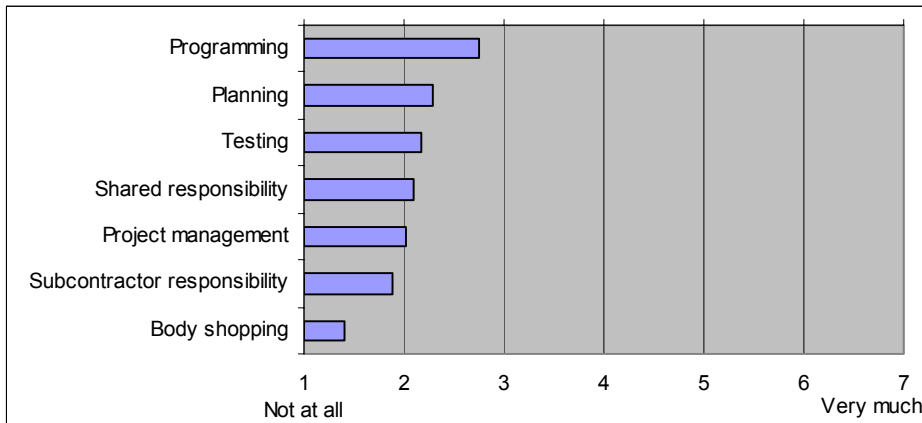


Figure 14. Importance of the Central Types of Subcontracting (n=133)

(Spearman correlation 0.304, significant at the 0.01-level) instead of their own technological competence. This is quite logical as enterprise systems are often designed to fill a specific need of a market. In addition, many small companies provide add-ons to large enterprise systems (e.g., SAP).

6 Subcontracting and Distributed Software Development

We asked companies to indicate to what degree they use different forms of subcontracting in their software development. Figure 14 shows the importance of seven central types of subcontracting for the studied companies. The importance of subcontracting in the company's product development was measured on a seven-point Likert scale. The most important form of subcontracting was programming, followed by program and architecture planning and testing. Subcontracting of programming was of moderate to extreme importance to 30 % of the respondents, and 51 % did at least some subcontracting of programming. Subcontracting of program and architecture planning was of moderate to extreme importance to 26 %, and subcontracting of testing was of moderate to extreme importance to 20 %. However, when looking at the other forms of subcontracting, at least 80 % of the respondents reported that they do not use other forms of subcontracting at all or only in

small volume.

We also asked the companies, what kinds of factors restrict their use of subcontracting. The opinions on six restrictive factors were measured on a seven-point Likert scale, where value 1 means absence of restricting impact and value 7 extreme restricting impact. As shown in Figure 15, the most restricting factor is the difficulty to identify suitable modules from the product to be subcontracted. Nearly 55 % of the respondents reported that this difficulty restricts their decisions to

subcontract quite much, much or extremely. The second biggest obstacle is the difficulty to give sufficiently detailed specifications to the subcontractor. Nearly 45 % reported that this difficulty with specifications restricts their subcontracting quite much, much or extremely. The rest four factors – unsuitability of the available services, lack of in-house project management resources, lack of practices in distributed subcontracting and low quality of the subcontracted work – were all reported to have a small restricting impact on the decisions to subcontract software.

When taking a closer look at the correlations between the restricting factors and some variables describing the software process of the companies, there seemed to be a connection between the variable "several clearly defined milestones in the process" and "lack of practices in distributed subcontracting". Since these variables are measured on an ordinal scale (or on the Likert scale), Spearman ordinal correlation coefficient

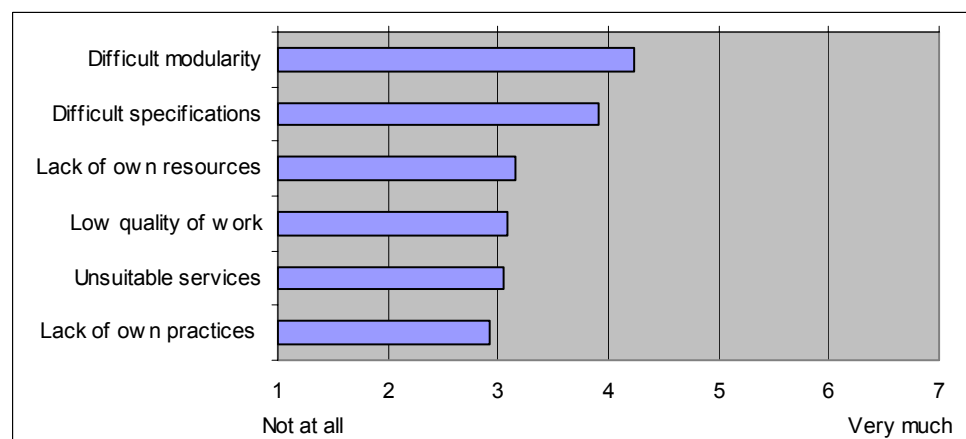


Figure 15. Restricting Factors in Subcontracting (n=125)

was selected as the method of analysis. There is a significant negative 0.27 correlation between these variables (significant at the 0.01-level), which means that the more clearly the process is structured and defined, the more confident the companies are about their own capacities to manage subcontracting successfully. The correlation is not very strong though; nevertheless, it is significant and indicates that a clearly structured process might prove to be helpful in the planning and execution of subcontracting.

Another interesting finding is that there is a very significant correlation between the restrictions posed to subcontracting by insufficient specifications and the reported capacity of the companies to handle subcontracting (Spearman correlation 0.49, significant at the 0.01-level). This indicates that the more the subcontracting is threatened by the companies' inability to provide subcontractor with sufficient specifications, the more the companies feel that they do not have the capacities to manage the subcontracting relationship. In other words, ability to provide subcontractor with good specifications seems to be related with confident expectations about the management of subcontracting.

7 Suggestions for Future Research

The findings and limitations of this research suggest several areas where further research would be interesting and beneficial. First, this study is based on quantitative survey, where a typical respondent is at high executive position. This naturally narrows the areas covered in the survey, e.g., software engineering and product development processes were not thoroughly covered in this study. Also, the method of using quantitative survey does not enable to gain deeper understanding of actual processes and drivers in the companies, with case studies this knowledge could be dramatically improved.

This kind of data could be compared to other software product industry surveys conducted abroad, where further conclusions of the current state of the Finnish industry could be formed.

The original idea for the need of the software product industry research came in the mid- 1990's and one main reason behind this reasoning was to prove that the software product industry is an industry with national significance or at least has the potential to become one. A question could be stated, whether the goals of this kind of survey should be refocused in the near future. The current "heavy" questionnaire is quite demanding for the busy CEOs and response rates have been dropping. By gathering the basic statistical information such as revenue and personnel amount from other resources (this would basically require an industry code of its own), this survey could focus more on a few

chosen topics and hopefully gather deeper knowledge of these areas. In addition, the questions on the survey are merely focused on established companies that are already beyond the entrepreneurial phase. Since the micro-companies business environment, challenges and the scope of operations can be quite different of more established companies, an additional survey focusing on start-up and micro-sized companies could be carried out.

This paper is merely a descriptive introduction to the data gathered by the Helsinki University of Technology. We are currently making further analyses of selected groups from the data. The attempt to give a general overview of the entire industry shows in low correlation coefficients. By selecting more homogenous subsets of companies in analyses and by selecting the most relevant variables for each subset, more evident dependencies could be achieved. In addition, by focusing on more homogenous groups of companies, better understanding of their ways of running the business could be gained.

8 Conclusions

Despite the current economic situation, the Finnish software product industry grew 13% in 2002. This is a significant result in the light of the current economic situation: in correspondence the Western European software products remained at the 2001 level in 2002 [Anon., 2003]. 2003-2005, companies are still expecting to continue their growth even though expectations for the future are not regarded as positive as some years ago. Despite the fact that there are already some fully internationalized and mature companies, majority of the companies are still rather immature with respect to degree of productization and level of internationalization. This can be seen in moderate revenue, in low revenue per employee ratio, in lack of established business models, and in low degree of productization. In addition, despite the fact that especially young companies' product development costs were cut back in 2002, many companies are still in a relatively early product development phase.

Raising the degree of productization is one of the most important issues for software product companies. At the difficult economic times, this is especially challenging, as companies have to find a balance between long-term productization aims and short-term need for cash (often done by customizing and customer projects). In order to find a balance, good and clear vision and strategy for the products and business is needed in addition to suitable and flexible software production processes. While the technologists often see the biggest challenges in software industry to be technological, our survey indicated that software companies are more concerned with managerial and

marketing challenges, i.e., how to manage the growing enterprise. It seems that the technological challenges are less critical than these business challenges.

Subcontracting seems to be gradually increasing within software product companies. However, it seems that the process maturity in these companies will need to improve until subcontracting can be fully leveraged: insufficient specifications and poor architecting seem to limit wider use of subcontracting in many companies.

As software product business is knowledge based, the availability of highly skilled professionals is crucial. This, as well as the need for partnerships and networking – deemed important by most respondents – might explain the concentration of the industry to university cities and technology centers. The availability of skilled work force and support activities was good. Areas where more professional work force is needed were some special application programming skills and software business sales, as well as marketing skills.

The importance of networking with other companies was highlighted in our study in several ways. Especially young and small companies emphasized the criticality of networking to obtain leads, to find alliances, and to keep up with technological developments. In addition, due to the small size of the domestic market, Finnish software companies often face the challenges of the internationalization at a very young age and often partnerships are needed in order to cope with this challenge.

Finally, this series of surveys has shown that several important insights can be obtained by studying the field by such surveys. However, it is clear that many of the issues highlighted by the survey will require more in-depth studies, e.g., through interviews or case studies, so that more thorough understanding of the issues can be obtained. Also, we would like to encourage international cooperation in such studies so that data between companies can be shared and compared and welcome all potential research partners to contact us for such cooperation.

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