

# How small software companies innovate: a regional look from Finland

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***Abstract.** A sample of regional small software firms ( $N = 25$ ) are explored by semistructured interviews. Most of them are new entrants in the market benefiting from the rapid growth of this industry sector. The results of the study showed that about a half considered product superiority as their main competitiveness source ahead of more customer related factors. Internally these firms demonstrated a strong team and 'adhocracy culture,' although they realised that more formal procedures will come along with their growth. Externally there was very little network-extensive business behaviour. Furthermore, demand-oriented innovation efforts seemed to compete with traditional technology-driven activities in these firms and software business was often considered more product than service. The issue of 'informal innovation' is presented and further discussed in this context.*

## 1. Introduction

Programming and software have a key role to play in the development of information technology. Increasingly, the operation of society is controlled by means of computer software. Society, therefore, is increasingly dependent on software that works.

The size and complexity of software have grown hand in hand, and the same trend will continue in the future. There are question marks about the reliability even of existing applications, and it is very difficult and expensive to try to improve them. Unless methods can be improved, the problems with software may become a bottleneck in IT development.

Software is worldwide being outsourced to lower cost countries such as India and China. This may lead also Finnish software industry to lose one of its most significant competitive asset: its hold over software development. If this trend continues, research and the workforce in this sector will begin to dwindle.

The role of open source code, on the other hand, may well increase in the future. It enjoys very strong support among researchers and programmers in the field. It is possible that we will see a divergence in software between publicly funded program development based on open source code and closed software development in business companies.

The software industry is a relatively new industrial sector which has become one of the major growth industries over the past 40 years in advanced economies. This sector is characterized by a few big multinationals and a large number of small firms typically providing high-performance inputs into complex systems in production, of information processing and of product development. The software industry has also rapidly moved towards internationalisation of the sector, coupled with niche and

small-scale market opportunities due to the technological change and vertical disintegration (Harrison et al., 2004).

A great many firms in the sector appear to be relatively young, which is an indication that the expansion of the sector has provided opportunities for new entrants. Many of them are also ‘born global’, having much growth potential (Martin, 1998; Davenport et al. 2002; Autere, 2005).

The global volume of software industry is estimated to be about 350 billion EUR (2006) and its average growth in 2006-2008 6.5 per cent in the European Union (EITO 2007). The market for small and mid-market businesses in this industry is expected to be tens of billions a year in the future. Small enterprises can actually have the same expertise as big companies in the software business, which explains their potential competitive position in this sector (Hine & Miettinen, 2004).

The software industry is recognised as highly innovative. The research and development pipelines are generally short compared to other high technology industries such as elaborately transformed manufactures and biotechnology. Product life cycles are correspondingly short.

The software industry has become one of the major growth industries over the past few decades. As many studies have indicated (i.e. Harrison et al., 2004; Autere, 2005), software seems to be the primary element in most aspects of innovation from basic research through product innovation. Software provides the critical mechanism through which managers try to lower costs, compress the time cycles, and increase the value of innovation. It is also in the heart of the learning and knowledge processes that give innovations their highest payoffs.

There were about 1,200 software firms in Finland in 2006 employing 12,400 professionals (Lamberg, 2006). Their turnover in 2006 was 1.4 billion EUR including exports worth 0.5 billion (Rönkkö et al., 2007). The growth of this industry sector has also been rapid: 13.1 per cent in 2007 and has continued in 2008. This is above the average growth in industry. This growth has also been faster in Finland than in most other countries over the past few years.

Firms operating in this industrial sector are typically small, but a good number of them are growth oriented. In 2007, 40 per cent of software firms in Finland employed maximally six people. The average age of the enterprises was 11 years. Regionally a majority of software firms are located in Greater Helsinki area. Greater Tampere area is the second one in this sector having some 200 operating software companies (Lamberg, 2006; Rönkkö, 2007). Software industry in Finland is also considered an upcoming cluster playing potentially an important role in country’s economy.

Software is also one the core elements in process innovations or in creating the functionalities that make products valuable to customers. In others, software is actually the “product” or “service” the customer receives. Furthermore, software can provide the essential vehicle enabling the inventor-user interactions, fast distribution of products and market feedback that add most value to majority of innovations. Thus, software dominates today all innovation steps: it provides the enabling tools and infrastructure to other IT professionals in virtually all other industries. Given the changes within the information sector of the economy, typified by the shift in value added from hardware to software, there has been a significant rise in research interest in this area, too.

## **2. Research question**

In most advanced economies, the software industry has consciously moved towards an internationalisation of the sector occupying a key role in the development of the knowledge-based information economy. Still it is characterised by a great number of small enterprises and a few multinational companies. Another attribute of the sector is a large number of niche and small-scale market opportunity driven small firms due to rapid technological change and vertical integration. Great many firms appear to be relatively young giving the evidence that the growth of the sector has continuously provided opportunities for new entrants.

This study aims to explore how young and small software companies go about their internal management and external management in order to maintain their adaptive capacity, innovativeness and competitive advantage. The basis of their competitiveness and innovation efforts and experienced work loading are also studied.

## **3. Sample and Methodology**

A structured interview with managing directors of 25 small software firms were conducted in 2006-2007 in Pirkanmaa county (greater Tampere area) in Finland. A majority of the interviewees were founders of their young enterprises employing 11.3 people on average with the range from 4 to 42 employees. The interview lasting about one hour included items about their products and services, assessments about the creativity of their personnel, their communication techniques to the internal management as well as to the management of their external relationships, the basis of the competitiveness, collaboration with other firms, and innovation efforts. To analyse the responses, descriptive statistics such as means and standard deviations were used (several items were presented in the form of 5-point Likert scale).

Eight enterprises from this sample were studied more in detail. In these cases, Robert E. Quinn's Competing Values Framework (CVF; Quinn, 1991; Quinn & Spreizer, 1991; Rogers & Hildebrand, 1993) indicating potential tensions between internal and external management. The CVF questionnaire was completed in the case firms in small teams of 3-4 people consisting of managers and employees ("a barometer group"). The CVF profile includes rating the current situation and the ideal one.

## **4. Results**

### *4.1. Internal indicators*

To analyse the responses, both raw data presented in tabular form, and descriptive statistics are used, particularly means. It is important in assessing the internal processes of the firms to gain information on the extent of involvement of staff in the development activities. For example, innovation is a special tool through which firms try to strengthen their competitive position in the market.

Most development activities are dependent on a creative process. It is then useful to gather data on perceptions on the creativity of staff in the company. These evaluation are made by the managing di-

rectors and are biased to certain extent suffering from factors such as subjectivity, social leniency and halo effect. Anyway, Table 1 demonstrated that about a half of staff is considered very creative and another third reasonable creative.

The staff in the interviewed companies is mostly very young (less than 30 years of age) and well educated, most having a university degree. This might explain why this simple creativity assessment indicates high percentage of creative people working in the firms.

**Table 1. Percentage of creative staff (N = 25)**

Not creative	16.8 %
Reasonable creative	35.1 %
Very creative	48.1 %
Total	100.0 %

The software industry as most high-technology industries relies heavily on the intellectual abilities of its people. The following issue extends this probing into which skills are most critical in conducting their business operations. In this question was asked: How important is it for your staff to possess the following characteristics? The answers were given in 5-point Likert scale. (Table 2)

**Table 2. Importance of staff characteristics (N = 25)**

Characteristic	Mean	SD
Problem solving ability	4.70	0.66
Creativity	4.53	0.50
Self motivation	4.40	0.60
Independent action	4.25	0.64
Planning skills	4.20	0.62
Teamwork skills	4.13	0.89
Entrepreneurial behaviour	4.10	0.72
Technical skills	4.10	0.91
Customer interaction	3.85	1.09

The means and standard deviations are provided in the table above to indicate the variability of the responses. The highest score is not surprising: problem solving ability is in the core of typical software projects and also in the centre of training and education of software professionals. The responses also indicate that creativity, self-motivation, independent action, planning skills and teamwork skills play an important role in internal management of the firms. Interestingly enough, customer interaction scores lowest out of these nine characteristics. It may well be that the managing director him/herself takes the responsibility for this side of the business, because small firms seldom have specialised and separate personnel for this particular purpose.

Communication techniques are very important in the internal management of a business when it comes to taking an idea through to fruition. The type of communication techniques used need to re-

flect the level of creativity, cooperation and fluidity necessary for high performing to emerge. This is particularly important for project-based companies such as these. It is not surprising then that on a five point Liker scale of importance (5 = very important), face-to-face was rated most highly (Table 3), electronic next, followed by meetings and telephone not as important, tailing to paper (memos etc.).

**Table 3 Importance of various communication techniques to the internal management of business (N = 25)**

Technique	Mean	SD
Face-to-face	4.40	0.74
Electronic	4.15	0.81
Meetings	3.75	0.85
Telephone	3.30	0.92
Paper	2.73	1.14

Face-to-face communication appeared to be the most important communication means to the internal management of the firms ahead of other means such as formal meetings, electronic or telephone communication. In managing external relationships, electronic communication was ranked highest followed by face-to-face communication. Problem solving ability was considered the most important staff characteristic before creativity, self motivation, independent action, planning skills, team work and entrepreneurial behavior. As to their innovation efforts, customer feedback was most crucial followed by customer involvement, interfirm collaboration and arms length negotiations.

The results further demonstrate that firm expansion into a new market is an indication about a major form of strategic variation. It shows that firm expansion can be viewed as a form of constrained adaptation to growth opportunities. Enterprises in the sample that have undertaken major, discreet expansion moves exercise strategic choice in the sense that their management has substantial influence in determining and selecting among emerging options in terms of occurrence, timing and direction of growth and development. The object of such expansion exercised only by a few firms in the sample has been typically to improve performance by increasing profitability, business growth and the chances to survive.

#### 4.2. External indicators

More information can be gained about the business operations of the firms in the sample when questioning respondents about where their competitiveness comes from. In viewing the responses to this question, there is a strong evidence of a market pull effect in the business operations of each of the companies. In addition to market pull related issues, technology push factor were also often mentioned.

Given both the market pull and technology push and the consequent importance of *external relationships* in the market including customers, suppliers and collaborators, the picture is incomplete without questions relating to these relationships. A direct impact question was used to gain an indica-

tion of the importance of various external relationships. This question enquired how important different relational forms are to the firm's development effort? (Table 4)

**Table 4. Importance of various factors in development efforts (N = 25)**

<b>Factor</b>	Mean	SD
Customer feedback	4.45	0.88
Customer involvement	3.93	1.17
Interfirm collaboration	3.55	0.83
Arms length negotiations	3.40	0.99
Ability to outsource	2.30	1.34
Relationship with Government	1.90	1.02

Customer feedback is the most important factor for firm's development efforts followed by customer involvement. Interfirm collaboration is less preferred representing the middle group issues in this list. Partial explanation of this may come from the age of the firms, with a number of them being less than five years old. New firms tend to concentrate more on their products and product development, as they are seeking to establish in their market. An external focus, including building networks is more likely when the firm becomes more established in its market. Network-intensive business behaviour has become an emerging theme in entrepreneurship-driven SMEs, especially in technology and knowledge-intensive industries such as software, but does not seem to among the first issues of new entrants in this sector.

When it comes to the communication techniques employed in managing external relationships (Table 5), the picture is rather close to that describing the internal management of the firm (Table 3). Electronic has the highest mean followed by face-to-face and also telephone and meetings have changed their rankings, which is understandable given the small size of the companies. Paperwork has the clearly lowest mean in both cases.

**Table 5. Importance of various communication techniques to management of external relationships (N = 25)**

<b>Technique</b>	Mean	SD
Electronic	4.50	0.61
Face-to-face	4.30	1.08
Telephone	3.85	0.67
Meetings	3.85	0.99
Paper	2.75	0.97

One general observation from the literature is that the customer perspective and degree of customer relationships in small software companies varies considerably (Rajala & Westlund, 2007). The interviewees were asked to define briefly what they would see as the basis of the competitiveness of their company. The answers varied, but can be categorised in three groups.

The first one consists of “*mainly product oriented*” answers (such as “strong technical expertise”, “superior product offering”, “unique technology” or “technical competence”). The second group is that of “*mainly customer oriented*” (such as “understanding customers’ business”, “customer satisfaction” or “simply customers”) and the third “*combined/mixed*” (such as “technical know-how combined with closeness to customers”, “management of products and an ability to listen to the customer”, “our ability to communicate our product/service portfolio’s benefits to the customers’ language”).

**Table 6. General orientation of small software firms (N = 25)**

<b>Orientation</b>	<b>N</b>	<b>%</b>
Mainly product oriented	12	48
Mainly customer oriented	7	28
Combined/mixed	6	24
Total	25	100

The results in Table 6 indicate that almost a half (48 per cent) evaluated that their competitiveness comes in the first place from their products while another half of the respondents said to focus primarily on customers or combining their products and customers. This is somewhat surprising, because a vast majority of the firms have operated in software industry already several years, but also reminds about the fact that in most cases the entry decision was made based on rather technology/product know-how than customer related issues. Another observation was, however, that there appeared a clear tendency toward a closer cooperation between a good number of small software firms in the sample and forest, bio, ICT and media industries. Another existing trend was that of specialisation such as ‘a specialist in software vendor of remote managements and telematics solutions,’ ‘total machine-to-machine solutions’ or ‘specialist in web-applications improving customer’s business processes and information management.’ Yet a majority had difficulties in considering their business service rather than production.

#### 4.3. Organisational culture

Organisational culture of the small software companies was diagnosed by using Quinn’s well-known Competing Values Framework. This diagnosis was not conducted in all 25 firms in the sample, but in eight companies attending a particular development programme in 2007-2008.

The Competing Values Framework (CVF) has appeared to be useful for identifying the major approaches to organisational design, stages of life cycle development, organisational quality, theories of effectiveness, leadership roles and roles of human resource managers. It has been found to have a high degree of congruence with well-known and well-accepted categorical schemes (Cameron & Quinn, 1999).

The CVF was developed initially from research conducted on the major indicators of effective organizations. Thirty-nine indicators of effectiveness were submitted to a statistical analysis, and two

major dimensions emerged that organised the indicators into four main clusters. One dimension differentiates effectiveness criteria that emphasise flexibility, discretion, and dynamism from criteria that emphasise stability, order, and control. The second dimension differentiates effectiveness criteria that emphasise an internal orientation, integration, and unity from criteria that emphasise an external orientation, differentiation, and rivalry.

Together these two dimensions form four quadrants, each representing a distinct set of organisational effectiveness indicators. What is notable about these four quadrants is that they represent opposite or competing assumptions and values. Each continuum highlights a core value that is opposite from the value on the other end of the continuum. For example, flexibility versus stability, internal versus external. Thus, the dimensions produce quadrants that are also contradictory or competing on the diagonal (Figure 1).

The upper left quadrant identifies values that emphasise an internal, organic focus, whereas the lower right quadrant identifies values that emphasise an external, control focus. Similarly, the upper right quadrant identifies values that emphasise an external, organic focus, whereas the lower left quadrant emphasises internal, control values.

Each quadrant in the model (Figure 1) has given a label to distinguish its most notable characteristic – *clan*, *adhocracy*, *market (firm)* and *hierarchy*. These quadrant names are not randomly selected, but are rather derived from the scholarly literature that explains how, over time, different organisational values have become associated with different forms of organisations. Thus, four major culture types, *the hierarchy culture*, *the market culture*, *the clan culture*, and *the adhocracy culture* highlighting innovation and adaptation can be identified (Quinn, 1991; Cameron & Quinn, 1999).

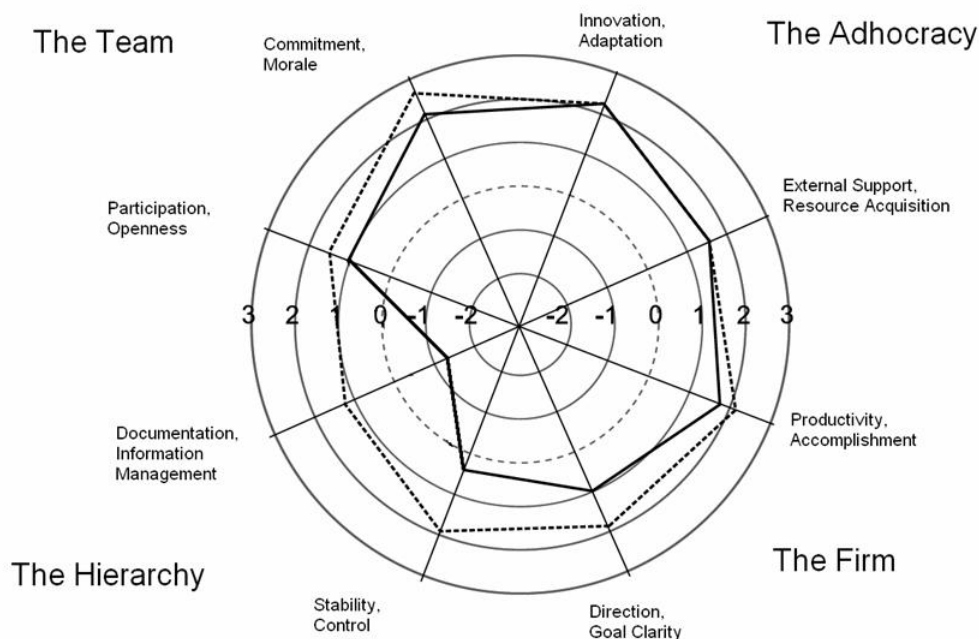
Not all eight CVF profiles are presented in this paper. There is only one example, but it is very typical and dominating among the eight cases. It is neither a mean profile, but rather ‘a dominant design’ profile fitting in about 80 per cent of the cases. In Figure 1, a full profile line represents the *actual* situation in the firm, and the dotted line an *ideal* one by the consensus evaluation by the ‘barometer group’ in each firm.

The result is very clear: the team and adhocracy culture are appreciated (current profile) and there is also willingness to maintain this situation (ideal profile). The hierarchy profile is least preferred, but interestingly enough there seems to be an awareness among the barometer group members that it will be the direction to which the firm is going in the future when growing bigger.

Shared values and goals, cohesion, participativeness, individuality, and sense of we-ness permeated clan-type, team oriented firms. They seem like extended families than economic entities. Instead of rules and procedures of hierarchies or the competitive profit centres of markets, typical characteristics of clan-type firms are employee involvement programmes, and commitment to employees. These characteristics are also evidenced by autonomous (or semiautonomous) work teams that receive rewards on the basis of team accomplishments (rather than individual ones) and that tend to hire and fire their own members.

Some basic assumptions in a clan culture are that environment can best be managed through teamwork and employee development, customers are best thought of as partners, the organisation is in the business of developing humane work environment, and the major task of management is to empower employees and facilitate their well-being at challenging work, enhance their participation, commitment and loyalty.





**Figure 1. An example of typical results from CVF-analysis: a ‘dominant design’ profile**

There might be several explanations to this result. All employees in the current study worked for small software companies unlike in the earlier national study. A good proportion of the respondents were also partners in the studied enterprises. A majority of companies were relatively new entrants in the sector maintaining still “the spirit of inquiry” and entrepreneurial enthusiasm. They also emphasized their advantage of a small size in organising their work in a flexible way influencing on how their employees felt about their working conditions and circumstances.

### **5. Informal innovation in small software firms**

Whilst it has gradually become accepted that there is likely to be no single firm size uniquely and unambiguously optimal for innovation, small firms maintain a distinct and critical role to play. Although fundamental or radical invention ordinary takes place within either large firms or large public laboratories, small firms are disproportionately responsible for near-to-market developments and initial market diffusion. In fulfilling this special role, small firms enjoy unique advantages associated with, lack of bureaucracy, flexibility, informal internal communication practices; and, adaptability through nearness to market (Freel, 2000).

In this era of flexibility, responsiveness and acceptance of diversity, the traditional measures of innovation appear standardised, inflexible and limiting (such as data on R&D inputs, patent data and bibliometric data). For small business, the innovation process often does not follow any formal path of research and development more recognisable in larger firms. Nor does small business figure in the

innovation statistics in many national databases. For example, none of the 25 small software enterprises in this study had a separate R&D budget. Thus, to achieve a more complete assessment there exists a need to recognize both input and ‘throughput’ as well as output measures and indicators.

The dissatisfaction with the inadequacy of existing formal measures has spawned a quest for alternative measures of innovation, both large and small firms. Early steps have been taken in seeking measures which are ideally suited to small firms and their circumstance. The concept of informal innovation and its measurement in the context of software industry was raised by Romijn and Albaladejo (2002) in defining some new determinants of innovation capability in small electronics and software firms in southeast England. They refer to both formal and informal innovation support activities, such as staff training, informal technological efforts such as problem solving, informal R&D such as learning on-the-job. They concede however that only estimates of such informal efforts can be made.

The internal environment of the firm interacts constantly and unwaveringly with the external environment to influence the competitive position of the firm. The innovation process contributes to and is impacted by this interaction. In analysing the informal innovation process, beyond the traditional measures of innovation, those factors which are attributable more to small innovative firms than larger ones, not only do input, output and impact factors need to be understood, but the influencing factors internal and external to the firm.

In terms of internal factors, Motwani et al. (1999) gave guidance on the need to create internal management systems and structure which themselves support the creation of a work environment that encourages initiative and entrepreneurial behaviour in a general work culture. So it is critical to incorporate measures of the level of creativity within the firm. This can be measured by the proportion of staff involvement in the product, process and non-technological innovations, as well as the time staff actually spend on the innovation process. Innovative firms such as software developers require extensive involvement of staff in idea generation and product development. These type of factors may provide much better assessment of staff involvement in the innovation process than nomination of R&D personnel or R&D expenditure for smaller firms.

Staff possession of skills useful in innovation relates largely to internal impact indicators for the firm. It reflects the intellectual assets as well as social and human capital available to the firm, incorporating diverse skills. The utilisation of skills is an important aspect of involvement in the stages of the innovation/commercialisation process, reflects the product development stages facing small companies. This will vary by industry sector, with biotechnology and life sciences firms facing much longer and more complex pipelines.

Innovation speed that is how long it takes to develop new products/services from inception to market, the product development or R&D cycle, is critical and indicative of the firm’s efficiency in bringing new ideas to fruition. It is a broadly accepted view that an innovation will be only recognised when it gets to market. It then needs to be novel when it arrives at market or else is not really innovation as it will be unlikely to have any economic impact. Innovation speed indicates also the effectiveness of the informal innovation approach over formal innovation.

## 6. Discussion and conclusions

The software industry is still a relatively new industrial sector which has become one of the major growth industries over the past 40 years in advanced economies. This sector is characterized by a few big multinationals and a large number of small firms typically providing knowledge-based and high-performance inputs into complex systems of production, of information processing and of product development. The software industry has also rapidly moved towards internationalization of the sector, coupled with niche and small-scale market opportunities due to technological change and vertical disintegration. Many firms in this sector appear to be young rather than established, which is an indication that the expansion of the sector has provided opportunities for new entrants. Many of them are also 'born global', having much growth potential.

Given the software sector's role as an 'enabling industry' and the changes within the information sector of the economy, characterised by the change in value added from hardware to software and services, there has been a significant rise in research interest in the software industry. Much of this research has focused on the 'internal' aspects of software production as an engineering discipline or has been extended to examine the interorganisational dynamics of software production and interorganisational variations of in performance and in learning and adaptability (Harrison et al., 2004).

In their study of 100 software companies around the world, Hoch et al. (1999) found that the critical success factors did not vary much across different regions, economic environments and cultures. However, the factors differed quite a lot across three industry segments: professional services, enterprise solutions and mass-market products. Contrary to these findings, there was notable variety in terms of external and internal adaptation mechanisms in this study among 25 software firms.

The organization boundaries of innovative small firms extend actually beyond their own employees. Customer, supplier and collaborator involvement in the innovation process, particularly of close to market developments as occur in the software development industry, are a source of innovation themselves. Where the traditional measures of innovation are internally focussed, it is important to accept that the innovative small firms does not in isolation.

Software provision is a very capital-efficient business. Therefore, venture capitalists and other financiers like to invest in software companies. For this reason economic resources tend not to limit growth and strategic choices to the extent that they do in many other industries. Even start-up enterprises with limited tangible assets find that it is possible to raise a sufficient amount of capital to succeed.

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