

DANISH **R**ESearch **U**NIT FOR **I**NDUSTRIAL **D**YNAMICS

DRUID Working Paper No 01-10, 2nd version

Making Consumer Knowledge Available and Useful The Case of the Computer Games

By

Lars Bo Jeppesen

Making Consumer Knowledge Available and Useful The Case of the Computer Games

Lars Bo Jeppesen
lbj.ivs@cbs.dk

Department of Industrial Economics and Strategy,
Copenhagen Business School,
Howitzvej 60, DK-2000 Frederiksberg,
Denmark,

Center for Economic and Business Research,
The Danish Ministry of Trade and Industry,
Langelinie Allé 17, DK-2100 Copenhagen Ø,
Denmark

2nd version

Abstract

It has been demonstrated that users occasionally innovate. However, it can now be observed that even end-consumers act as a source novel product designs. A case study of a firm, and “its” consumers - from the computer games industry - illustrates how sourcing of consumer knowledge has enabled the firm to improve product design. Two conditions favor the results firms can obtain from consumer’s knowledge. First, is firm’s ability to exploit new opportunities of information and communication technology - on-line communities - to establish interfaces connecting them with consumers. Second, is firm’s ability to initiate a mode of organization by which the consumers are guided and motivated to reveal merely relevant knowledge.

Keywords: Innovation, Consumers, On-line communities, Computer games.

JEL: L22, O32

ISBN: (87-7873-109-7)

Introduction

In less than two years 79.873 persons have settled in the official online-community related to the computer game Counter-Strike. Throughout the next few hours thousands of Counter-Strike aficionados - dispersed over the globe - will interact with each other and with the producers of the game reporting their opinion of product features, knowledge of problems which they have spotted in product design and ideas for their solution.

The interesting thing about this observation is that it brings to the forefront some old problems of business. It has been recognized since the founder of modern economics - Alfred Marshall (1925) - the importance for firms of supplementing their own knowledge with an external organization. In order to develop new tangible or intangible products or processes firms need to complement the relevant parts of their own knowledge base with knowledge residing elsewhere. In the present paper it is argued that consumers might well form part of such an organization when they represent stocks of knowledge that is complementary to firm's purposes of product development.

Since Hayek (1945) it has been acknowledged that knowledge is dispersed and that making something useful out of it revolves around co-ordination. This also goes for consumer knowledge. Further, knowledge is not only dispersed, it is often also fallible and very seldom it comes in "ready to use" packages. This is most certainly the case with consumer knowledge. The question is then, why some firms (in the real world) manage to take advantage of consumer knowledge – despite its difficulties of dispersion and unreliable quality. This is the question that the present paper deals with.

From such a perspective the paper investigates a situation where valuable knowledge is dispersed – embedded in consumers, but where novel opportunities created by innovations in information and communication technologies establish ways in which it can be made available - at low cost. The answer to the question will be sought in an empirical example from the emergent industry of computer games. Along with the surfacing of the Internet and the on-line age certain firms within this industry are increasingly becoming aware of the potential advantages of collecting consumer knowledge. Some have managed to develop useful associations with consumers by exploiting opportunities represented by novel information and communication technologies. However, this technology does not stand-alone. In the final part of the case study it is argued that an organizational innovation - complementary to the technical innovation of the Internet - is in fact responsible for the efficient and meaningful use of this technology itself. The organizational innovation – named the "moderator reward function" – has allowed producers to exploit a rank based incentive and further to establish a weak authority relationship to consumers. One of the key arguments of this paper is that solely by the joint employment of the technical innovation and the organizational innovation it is possible to access and take advantage of consumer knowledge.

A specific study of a firm, its product, and "its" consumers show how consumer knowledge feedback in several cases has assisted the firm in improving its product design. The example is drawn from the US computer games industry. This industry is currently the fastest growing segment of the US entertainment industry. Despite fast growth the industry still resembles an immature business. Regardless of growing markets producers of games face massive obstacles and uncertainty. Changes in the industry have resulted in increasing development cost. The amount of sales required in order to break even has tripled within five years and only 7 percent of games presented on the market make a profit. Due to constant product introductions games are regarded as

old already after only six weeks. The typical consumer spends only seven to eight month with his game. These facts, leaves firms under pressure for constant improvements in product design and innovation in general.

A new source of innovation - the end-consumer

Much of the literature on innovation within economics, business- and technology studies has been preoccupied with the importance of supply-side driven innovation, while only a minor part of this research emphasize the importance of innovations originating from the demand domain - although the phenomena is observable in the real world. This said, one should promptly turn to acknowledge the small collection of exceptions to the rule, advocating that users play a prominent role in innovative activity – at least in some industries. These exceptions are to be found in earlier literature of technological innovation and might be grouped under the heading “user driven innovation”. This literature first appeared in economics in the mid 1970ties. Rosenberg’s study (1976) of the machine tool industry showed the role of “sophisticated users” in speeding up technological progress. Von Hippel demonstrated that users were responsible for progress within the field of scientific instrument (von Hippel, 1976) semiconductor process machinery (von Hippel, 1977) and he proposed a notion of a “lead user” as a source of novel product concepts (von Hippel, 1986). Finally, Lundvall (1988) has argued - and to some extent shown - that interaction among users and producers accounts in parts for the advancement of innovation in industry complexes.

At the outset, these contributors share in common a particular notion of a user who is skilled and specialized in a particular activity for the sake of earning a living¹.

However, it can now be observed that even “laid-back” end-consumers have begun actively to contribute to processes of product development and improvements carried out by firms. For a period of more than ten month I have studied the evolution of end-consumer – producer relationships in a so-called on-line community established by a firm from the computer games industry. The case study reveals that continuous knowledge feedback from an active segment of consumers has enabled the firm to improve product design faster and in a more targeted manner than would have been possible otherwise². The approach to innovation sketched out in the case study below result advantageous in this single example. However, I harbour suspicion that this approach - reliant on consumer knowledge for innovation - may well become a predominant way in which innovative activities is to be organized in the future.

The remainder of the paper is divided in two parts. The following section presents the case study taken from the computer games industry. It focuses on the relations between a firm and its consumers and the outcomes of innovation spurred in these relations. In the final section managerial implications are drawn out and conclusions are made.

¹ It should be noted that Lundvall - in byline at the final paragraph of his paper - mentions that also so-called “private users” may engage in innovative efforts. However, this argument remains undeveloped.

² The method underlying this study is described in Appendix 1.

The case

Towards the on-line age in computer games

The computer games industry was really shaped in the early 1980ties. Prior to that time unripe developments formed what by the 1996 was going to become the largest segment of the U.S. entertainment industry. It started in 1961 when MIT received the new model computer PDP-1 from the Digital Equipment Corporation. Its manufactures hoped that MIT's electrical engineering department would be able to do something interesting with it – win the space race, breed artificial intelligent robots, or at least revolutionize information processing for the greater glory of America. Within a year, the computing pioneers at MIT had done none of these things. But one of them had written the world's first computer game called "Spacewars" (Herz, 1997).

Since these initial "primitive blips" the computer games industry has gone through several stages. The most significant ones have been related to the development of different consoles³, games for PC, and the introduction of sophisticated graphics. The changes which marks new stages in the computer games industry have each time altered the competitive parameter for the firms of the industry and following left those who adapted fastest in a leading position for the next paradigm⁴.

In the most recent stage - characterized by the surfacing of the Internet - the industry has been revolutionized yet again. At the present moment most computer games are marketed in electronic form via the Internet, an increasing number of games are played on-line, and consumers communicate with each other and with producers at an increasing intensity via on-line facilities. The first step towards the on-line age was taken in late part of 1993 with the game Doom⁵. It marked the beginning of the present paradigm - the on-line age in computer games. Although investments in on-line gaming technologies and strategies are not perceived by CEOs to pay off immediately, on-line games are believed to be *the* prosperous area of computer games. Thus, although 55 per cent of CEOs members of ISDA - the most important trade organization within the industry - said that on-line games are either very or extremely important to their company's business strategy in the next 12 months, they also believe that revenues from on line games will not exceed 20 percent of their company's revenues until at least 2004 (ISDA Annual member CEO survey, 2000).

On-line communities

One of the most significant features of the on-line age in computer games is that it changes the way that consumers interact with each other and with producers of computer games. On-line communities are sites on the Internet where interaction among numerous individuals can occur. They can be regarded as virtual hubs for knowledge and information exchange, chat, and discussion. Albeit consumers might be separated by extensive physical distance, information and communication technology allow for high degrees of interaction. An on-line community serves as a club for its members. There exist innumerable types of on-line communities. In theory as many as

³ A well known example of a console is Sony Playstation.

⁴ Adapting fastest mean in this case being able fastest to take advantage of new technological opportunities. Or precisely, being able to reap the maximum benefits in software creation out of opportunities in the constantly evolving hardware solutions. That ability entails a great deal of foresight of predicting. Knowing - or guessing - when new hardware - of several categories - will be made available to consumers is crucial. Further, the ability to predict what this new hardware will be able to do is important.

⁵ December 10, 1993 at the University of Wisconsin crowds of students downloaded the first version cult-game Doom.

there exist topics of discussion. They are either open for everybody like a public place or of a more private nature, such as Rotary Societies or card clubs.

A survey (May 2001) of the 20 best selling computer games (ranked by units sold) in 2000 shows that 16 out the top 20 games' producers have established at least one on-line community. The quantitative dimensions of the phenomena reveal that each of these 16 on-line communities in the survey currently comprises member groups ranging from 2.578 up to 96.250 individuals. The total number of members in these on-line communities was approximately 173.000, growing with a total rate of approximately 1.550 members a week.

To consumers of computer games, on-line communities represent a "playground" where to exchange viewpoints, gossip, and in general enjoy interacting for its own sake. In this perspective the on-line community is an additional feature to the product that consumers already bought that allows them – if successfully employed - to search out more from the product and thereby to optimize joy. Seen isolated the playground is a fun service for consumers. I call the chitchat going on here for "playground gossip". Nevertheless, consumers also exchange need related information and what is more important they exchange problem solving knowledge of interest for firms.

To producers of computer games on-line communities are places where they can interact with their consumers, make announcements or simply watch what is going on among consumers. Computer games producers are to an increasing extent starting to use on-line communities as sources for feedback on various topics concerning their own products in a way, which was no possible before. Thus, a development manager explains that:

"Before [the on-line community] we only got response from those who found it worth picking up the phone or writing a letter. In that way you'll only get feedback from extremely happy or extremely angry customers" (Director of New Business Development at Bethesda Softworks, March 2000).

The categories of feedback

Different categories of feedback are not equally useful for innovation purposes in the firm. On the basis of the empirical study it became clear that the feedback from consumers must be divided into different categories. The first category I call "flimsy feedback". This kind of feedback reflects consumer needs e.g. satisfaction and which developments they would like to see in the future, complains and so on. Further, flimsy feedback reflects consumer's preferences, the ordering of the good confronting other products or the ordering of features contained in the product. However, flimsy feedback contains no direct suggestions or solutions. The second category is what might be called "focal feedback". It brings with it several useful answers to firm's prayers. Primarily it brings solutions to firm's problems in form of direct problem solving on technical issues such as detecting and - sometimes even - solving errors and mistakes in product design made by the producer⁶. Consumers act as a "quality control on the side" when they detect bugs and report them. Further, and equally as important consumers might reveal – "home brewed" – small innovations and

⁶ Within software environments errors in software-programs are called "bugs". Finding these errors is called "bug-detecting" and the following process of improving upon errors is called "de-bugging".

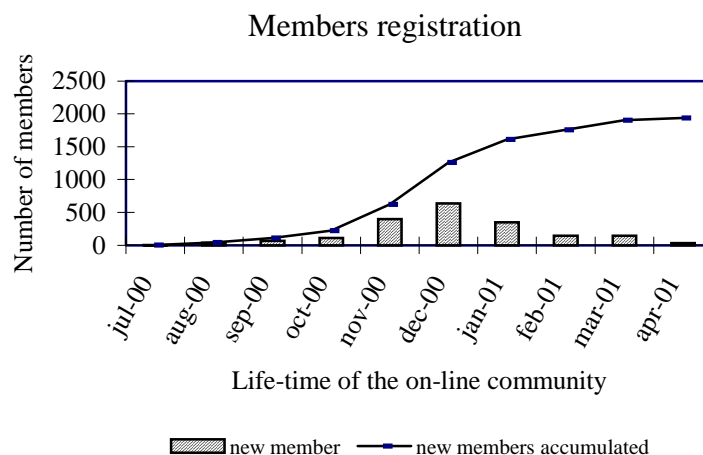
improvements that they have prepared for the game. For producers feedback of this kind is valuable for direct improvement in product design.

The computer game firm and its external organization of consumers

As an illustration of the consumer - producer interaction and its outcomes I introduce findings from a study of the firm Bethesda Softworks, its product, and its on-line community constituted by its consumers. Bethesda Softworks, is a game producer and publisher based in Maryland (U.S.). Its product the computer game “Seadogs” is one of several games invented and published by this firm. The game – a so-called “role-playing game” - and its story revolve around pirate life in the 16th century. The Russian software-development company Akella has undertaken most of the technical development of the game. The game was released in the middle of October 2000. Three month prior to product release Bethesda Softworks chose to launch the on-line community called “Seadogs Forum”. It was initially supposed to work as a discussion forum serving communication among the firm development department and its beta-testers during the test period, and further – as an additional spin-off - to fuel interest among potential consumers. The interest in the game prior to its release was substantial. As early as two weeks before product release, 225 members⁷ had entered the Seadogs Forum and their activity had at that time already resulted in 1.083 messages. In April 2001 - approximately six month after the product release - the forum comprises 1.935 members.⁸ As it is apparent from Figure 1, the largest proportion of members has arrived in the month following the product release, where consumers start to play the game.

Figure 1

Membership growth in Seadogs Forum from July 2000 to April 2001



⁷ I employ the term “member” as synonymous to consumers in cases when Bethesda Softwork’s consumers are enrolled in Seadogs Forum.

⁸ The proportion of consumers who have chosen to become members of the Seadogs Forum obviously represents only a minor segment of the total number of the consumer who bought the game.

Over time the Seadogs Forum has accumulated members originating from most parts of the world. The 1.935 individual members of Seadogs Forum represent 49 countries and can therefore be said to have a high degree of dispersion⁹. Despite the fact of their dispersion, this proportion of Bethesda Softwork's consumers interact with each other, with publishers in Maryland, and with software developers in Moscow on a continuous basis. Within the Seadogs Forum the response rate on the topics posted (questions asked or suggestions made) on the Seadog Forum is 86,3%. In average when a new topic is posted it gets four responses. This makes the probability of getting a reply to questions or suggestions high. The quality of feedback on Seadogs Forum is on average distributed with 36 per cent flimsy feedback, 41 per cent focal feedback and a rest of 23 per cent playground gossip.

Tracing the competent consumer

As an approximation for competence of Bethesda Softwork's consumers I use three criteria. The candidates must pass a threshold related to each of the three criteria to pass the competence test,

1) the total *number of messages* posted by the consumer in his membership time on the Seadogs Forum. This depicts the member's rate of activity, experience, and rate of interaction through which he is assumed to have gained knowledge. A minimum of 30 messages is required to enter as a candidate for the "consumer competence group".

2) consumer's *membership time* of the Seadogs Forum; reflects experience-time in the on-line community, and in most cases also experience time with the game. This is due to the fact that most of the consumers becomes members just after having purchased the game. A minimum of one-month membership is required.

3) a *valuation of outcomes* of the individual's interactions. That is if their interactions have resulted in potential solutions or other meaningful outcomes for firm use. To meet the criteria the individual's respective amount of emitted playground gossip and flimsy feedback is required to be below the average values of the Seadogs Forum in general. At the same time the amount of focal feedback must be above the average value of emitted focal feedback in Seadogs Forum in general. In this particular case it means that a maximum 23 per cent playground gossip and 36 per cent flimsy feedback is allowed, while a minimum of 41 per cent of focal feedback is required.

On this background we find on the Seadogs Forum that 202 members pass the first test. Most of them have posted far more than 30 messages, a few up to 700. In the second test 6 members are taken out leaving us with 196. In the third test 11 members fall, so the final group of competent consumers on Seadogs Forum consists of 185 individuals. Thus, the group of competent consumers on Seadog Forum makes up approximately 9,5 percent of the total number of members. Despite its relatively small size the competence group is responsible for 14.088 out of a total of 27.707 messages posted in the Seadogs Forum's lifetime. It means that a core member group of 9,5 percent accounts for no less than 51 percent of the total activity.

By analyzing the quality of feedback in an equal number of randomly selected messages taken respectively from the competence group and then for the rest group of "non-competent" a difference in the average values of quality of feedback between the two groups became apparent.

⁹ Member - top scorer is the U.S. where 70% of members are located, followed by Canada representing 8%, and third with 3,5% the U.K. But, members are also found in Zimbabwe and in the West Indies.

Table 1

The composition of feedback qualities in different groups of consumers (in per cent)

	Playground gossip	Flimsy feedback	Focal feedback
Competence Group	16	27	57
Non-competence Group	36	43	21
All	23	36	41

The disparity of the feedback qualities between the competence group and the non-competence group is remarkable. It shows that feedback originating from the competence group as a whole is much more focused than the feedback coming from the rest group.

Feedback effects

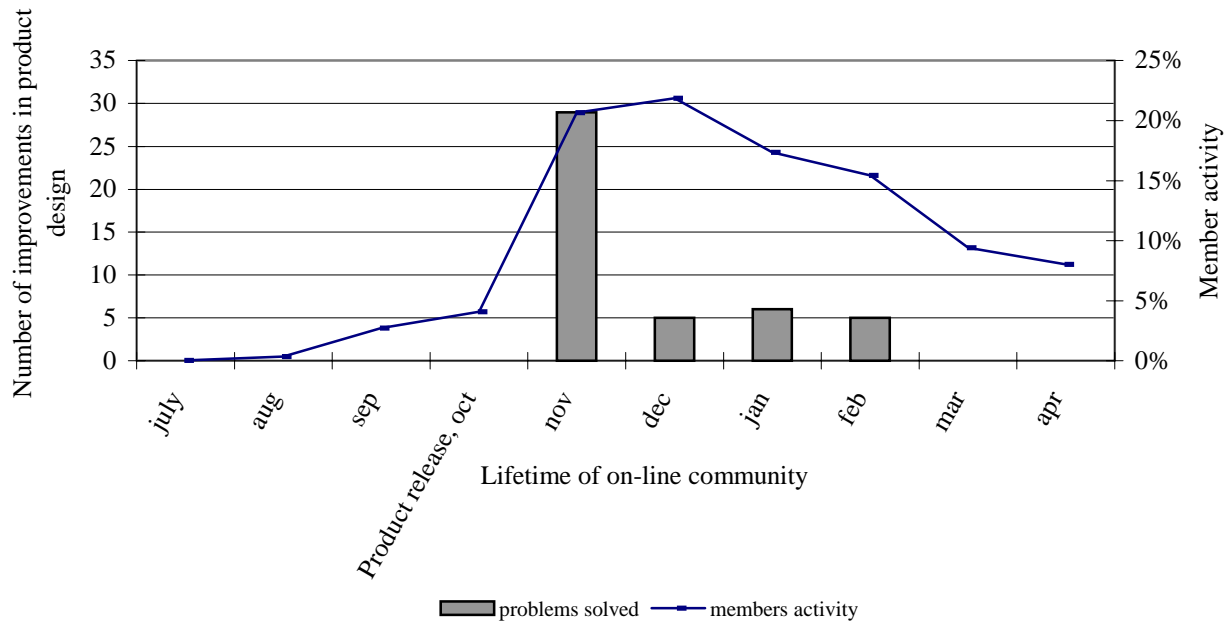
Using consumer feedback Bethesda Softworks and Akella have been able to resolve at least thirty-two more or less serious problems related to the product design and further of adding thirteen new features improving the experience of playing the game. This happened within the first fifth teen weeks following product release. So-called *patch-files* carrying the improvement have been created and made available - on-line and free of charge – to consumers. In this fashion, consumer's effort have been rewarded with an improved product and thus with more joy.

The first of a total of four patch-files was released six weeks after the product had been marketed. It contained twenty-two solutions and added seven improving features. The second patch-file came after eight weeks. It contained three solutions and two added features. The third was made available after twelve weeks and brought four solutions and two added features. Finally the fourth was launched in February 8, 2001 fifth teen weeks after the product release and enclosed three solutions and two added features. The trend is that most improvements were done on a short notice in the very beginning of product life-time. The last improvements served more for perfecting the product to a satisfying degree.

Bethesda Softworks' consumers are numerous. They count – of course - many more than those 1.935 individuals who chose to participate in Seadogs Forum. However, by means of the Seadogs Forum, Bethesda Softworks have been able to create a product test bed far larger than could be achieved otherwise. Despite the fact that Bethesda Softworks spent more than three month having beta-testers detecting the product prior to the product release, consumers immediately noticed remaining errors or inaccuracy in product design which *beta-testers* had overseen or have practically could do nothing to discover¹⁰.

Figure 2

Distribution of member activity and the number of improvements in product design made by the firm



As figure 2 illustrates, the activity (messages posted) in Seadogs Forum reaches its highest level in the two month immediately after product release. It is also in this period most of Bethesda Softworks makes the improvement on the basis of consumer feedback. Approximately forty per cent of the feedback that the firm has received is allocated during the first ten weeks. I find it reasonable to believe that timing of feedback also plays an essential role for explaining why consumer knowledge has been useful for product improvement. It is not likely that the feedback obtained by Bethesda Softworks would have been useful in the same way outside this time-window. With a product lifecycle of typically seven to eight month it is reasonable to assume that consumers feedback should fall within the first few months if improvement should take effects before the product starts to loose its appeal with consumers. I find reason to suspect that the instantaneousness of feedback has left Bethesda Softworks with an advantage in relation other firms which do not successfully employ on-line communities, because it allows product development to progress faster, thus meeting consumer's need more rapidly.

10 Many of the problems solved are related to the interface between the game software and specific computer configurations. Even through intensive testing it is almost impossible for the firms to take into account all the different combinations of hardware configurations on which the game will be installed and played. The scope for errors is extensive – and expanding, as up-to-the-minute hardware enters private homes.

Managing Consumer Efforts; a question of incentives and monitoring

To this point we have explored that consumer knowledge can be important for firm's product development and how knowledge can be pooled by the use of a technological devices. An important gap in this story remains to be closed. I have said nothing of about what motivates consumers to engage in efforts of problems solving activities and what makes them reveal their knowledge. There is a need for an account of this seemingly altruistic behavior of consumers. The underlying argument in this final part of the paper is that an organizational innovation - complementary to the technical innovation of the information and communication technology – is in fact responsible for the effective use of this technological innovation itself. The organizational innovation that we find in relation to on-line communities relies on a so-called moderator. The moderator is a person employed by the proprietary of the on-line community and his main function is to administrate a rank based incentive system similar as the one described by Lazear and Rosen (1981) and to monitor that that members stick to the rules comparable similar what has been illustrated by Alchian and Demsetz (1972). The moderator reward function, as I name, has become a general feature of the on-line communities.

In the commercial firm contemporary production methods often involve team characteristics in that the interaction among workers are so intense that individual contribution to the joint outcome are not necessarily measurable. As a result, a moral hazard problem may arise in which participating workers are induced to free ride on the other efforts (Aoki, 1994). Especially, private efforts to supply public goods seem very unlikely to result in any greater creations. Theories of free riding predict that privately provided public goods should have very few contributors and that contributors should be very small (Andreoni, 1995). Once produced a public goods can freely be exploited by anyone, also by those who have not contributed. At first glance, it might appear favorable for everyone to enjoy and make use of the contributions of others. This would allow everybody to profit although not sustaining any cost. Nonetheless, if every person did rationalized equally, the good in question would not be supplied. However, what we observe in the case-study is that privately consumer-supplied improvements is being produced and made available to the potential benefit of other consumers whether they have contributed to their development or not. In consequence, what is to be explained is why this happens.

In a classic paper by Alchian and Demsetz (1972), monitoring of team member's efforts is assumed to be a solution to free riding or shirking behavior. Bringing in a principal who monitors the agent inputs is suggested to solve the problem, because the principal monitor is furnished with the authority to revise contracts of employees, reward high output and penalize "shirking". However, according to the authors it is "*It is the system of rewards that stimulate a productivity response*". "Incentive are the prices in the game of life, the goals that people seeks, the carrots" Alchian and Meckling (1960) emphasized. People's goals differs and it is commonplace that that there is not enough wealth, power and prestige to go around and as every economist know this scarcity becomes evident as cost. In seeking prices people must make sacrifices (Alchian and Meckling, 1960).

Rank-based incentives have been explored by Lazear and Rosen (1981). Their model explains why vertical inequality may provide actors with incentives. A so-called tournament model describes within-firm wage distribution by arguing for the importance of job changes, defined as discrete wage jumps in a rank-order payment scheme. It suggests that efforts by employees are fostered by an opportunity to compete for a top job in the organization. Three aspects of the model are important. The first is that rewards to efforts are fixed in advance and based on contributor's

relative performance rather than absolute performance. Secondly, the spread between the steps in the rank system affect efforts. Third, there is an optimal spread; in fact the relevant first order requirement is that the spread should be chosen so that the marginal cost of effort just equals the value to the firm of the output produced with it (Lazear, 1991, 1995). The tournament model builds on analogies to sports competitions and the competitive nature of the human beings involved in such competitions, and thus highlights more general aspects of motivations leading to efforts. While most treatments of motivation in organizations acknowledge both monetary and non-monetary sources or determinants of motivated behavior (Lawler, 1973), the orientation of thinking about inducements and contributions, cost and benefits, money has come to play an overly important role in our thinking about causes of behavior (Pfeffer, 1988). However, although monetary rewards are known to be a motivational factor people's goals differs.

The Moderator Reward Function

Peer recognition plays an important role for the motivation of members in on-line communities. For some it is the ultimate goal, for other members recognition serves as means to obtain more valuable feedback. There are no monetary compensations. The most direct way to peer recognition goes via member rank. Rank is gained by those who make contributions to others in the community or to producers.

A moderator who is employed by the establisher of the on-line community serves as a gatekeeper who monitors members and seeks to encourage that the quality of contributions submitted to the forum remain high. He does so by rewarding the members of the on-line community that supply valid knowledge to the community with visible appreciation and an increase in rank. As appreciation from the formal authority and rank are objects of peer recognition they are to be considered the most important drivers of consumer efforts in the on-line community. The moderator basically selects among the messages posted by the members; useful from the useless ones. The reward function is almost automatic; for every perceived meaningful message posted the member receives a rank-point, that adds to his rank and thereby upgrade his member-rank. By responding to other's problems, by making problem solving for other consumers and the producer, the "problem solver" gets more rank-points. As the member accumulate number of messages that passes the moderators control - his rank increases from "new member" to "junior member" to "member" and in the case of Seadogs to a final step "captain". On the other hand when communication falls afar the forum purpose the moderator can choose to erase the message and therefore no points are given and subsequently no increase in rank will take place. Thus, members are measured on output, being the quantity and quality of knowledge that they allocate to the on-line community.

When the rank-incentive is not sufficient for interaction to bring about desired outcomes, the moderator steps in as a "helpful authority" and tries to guide consumer's interaction on track. The moderator is equipped with formal authority "the right to select actions affecting part or the whole of an organization" in the sense of Simon (1951) and possess the exclusive right to revise relationships of members of the community. However, if consumers are not performing according to the aspiration of producers, penalty or exclusion is not likely to be the first consequences. The producer needs consumers to volunteer (to provide his knowledge free of charge) and this makes their relationship distinct from the wage based employment relation. Only in cases where messages are deliberately useless or meant to insult a warning is given and in serious cases exclusions of the member is a probable consequence. Nevertheless, the moderator's authority to directly penalize is most often carried out in a soft way. The unique authority relationship between consumers and

producers in on-line communities is limited due to the fact that consumers can leave the relationship at costs close to zero. Thus, for producers it takes “more carrot than stick” to establish an effective authority relation to consumers. The optimal mode is when consumer efforts can be achieved by the incentive structure itself, or when acceptance of direction is welcomed by consumers.

The moderator reward function seems crucial to control that the discussion and exchange stay within a suitable frame of the purpose of the on-line community. This function is generally accepted by the members as means of keeping discussion – that is the quality of knowledge exchanged – effective. There exist, of course many examples of on-line communities lacking the moderator feature. Results are most frequently that discussions turn into anarchy, gets rude and subsequently it dies out.

Peer recognition as a driver of motivation is a particularly strong in the context of on-line communities because the technology allows for optimal transparency. Every member can observe all other members, their rank status, particular contributions, how much other members are being acknowledged and so on. Such strong signals on performance and talent provide stronger incentives to actors it is argued in the career concern literature (Holmström, 1999)¹¹. In the context of on-line communities the motivation to make an effort is obviously not associated with wishes of increased career status, but rather peer recognition, the clarity of signals still seems to be relevant to bring desired results.

Releasing resources

As organizational learning processes takes place on the consumer-side the moderator is able to decrease his effort. Over time, as the most active members gradually accumulate problem solving knowledge and build up rank they become able to take over the parts of the moderator reward function. In the more mature stage of the on-line community high rank members have begun to help out less experienced consumers with problems. Further, recognition effects can in this stage be obtained by being acknowledged by more experienced high-rankers in the community. In this manner the moderator get released from some of his duties. For most moderators this is a well-known phenomena and it explains why even a growing members crowd in an on-line community can be managed with decreasing moderating effort.

“we spend less time moderating members now than we did in the beginning...the point is to allocate all the essential knowledge to key-members...so, they’ll do the job”
”(Moderator “Sirhoser” at Seadogs Forum, March 2001).

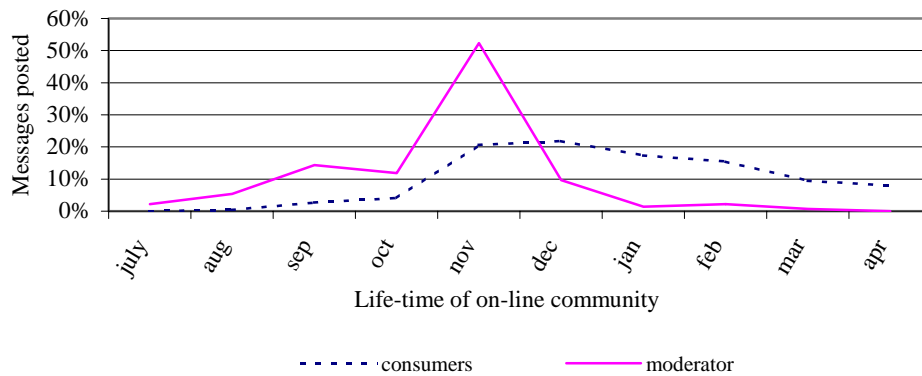
In this way moderators release time resources, which can be used more effectively to concentrate on picking up the outcomes. Figure 3 illustrates that the moderator is extremely active during, and just after, product release. Later as consumers accumulate knowledge and high-rankers establish their positions the moderator is able to decrease his activity. In the example he finally he falls to zero.

¹¹ Holmström, - interested in observability, monitoring and compensation issues and its role for creations of labor market incentives – emphasizes that clearer signals about performance and talent provides stronger incentive to employees. Holmström (1999) suggest that signaling incentives are stronger when performance is more visible to the relevant audience, the higher the impact of effort on performance, and the more informative the performance is about talent. Holmström’s contributions form part of the career concerns literature. Career concerns basically stems from the care of subordinates “about the impact of decisions on their future career”(Holmström and Ricart I Costa, 1986).

The on-line community floats by itself. Nevertheless, as the product turns towards the end of its life cycle the activity also drops in the consumer organization.

Figure 3

Distribution of relative activity; moderator vs. consumers



According to moderators, their effort-allocation should be intensified with the initial increase in consumer activity. In this fashion the firm is able to allocate crucial knowledge to consumers that guide consumers on track. As the moderator at Seadogs Forum explains:

“...it allows us to step back and spend more time wathching what’s going on”

The public relations management at Bethesda Softworks has lately begun considering “outsourcing” the moderator reward function to an individual consumer from Seadogs Forum. This possibility has become an option as management has become aware of potential individuals who in fact already act as “helpful authorities” in the on-line community. If “out-sourcing of functions to consumers” is a feasible strategy remains to be discovered – in another paper.

Discussion

As it becomes evident in the empirical example firms can take advantage of consumer knowledge despite its dispersion and unreliable quality. This can be done by exploiting opportunities of information and communication technology related to the Internet - in particular on-line communities, which serves as a tool for knowledge pooling. Further, by establishing an authority relation to consumers and aligning (the right) simple incentives it is possible to set up an organization of consumers that supply merely “high quality” knowledge. On the basis of this high quality knowledge the firm in the case study is enabled to improve the design of an existing product in a fast and targeted manner. The advantage gained from employing the method can be described as a “cost cut” on innovation. Taken together, the approach to innovation sketched out in the

example comprises at least three features, making it a compelling alternative – or supplement - to existing methods of product development.

Consumers are numerous

Numerous consumers represent a potential knowledge base regarding a particular products consumption- and use-features, which is far greater than producers could ever acquire from their own in-house activities such as testing, focus groups etc. In the way described numerous consumers constitute a giant test bed for products and a laboratory breeding knowledge valid for incremental innovations to existing products.

Consumer feedback can be made available instantly

As it was shown consumer's knowledge can be made available instantly – as soon as consumers engage the consumption and use of the product they report back. This permit firms immediately to spot problems related to their product. Thus, by allowing consumers to engage in product improvements the firm is able to improve product design much faster and in a fashion more targeted to consumer taste than would be possible otherwise.

The method can be implemented at low initial cost;

In the case presented the management chose to dedicate two minor investments to engage with consumers. The first was limited simply to acquiring the software needed to run the on-line community. The cost was approximately 200 \$US (primo 2000). The second investment made was allocated into managerial time. It was limited to the hours spent by the moderator carrying out his function. At peak periods four to five hours of daily moderating proved sufficient. As it was shown the effort required to manage the consumer organization decreases over time as consumers in the organization gets familiar with the way in which relationships work.

Although costs of initiating are minuscule it may be worthwhile reflecting on the range of application of this approach to innovation before undertaking the stages needed to build relationships - between consumers and producers - capable of transmitting complex knowledge.

The approach - reliant on consumer knowledge for innovation, is appropriate where interfaces can be easily established, and is relevant in situations where improvements represent a perceived value to consumers, but it is strongest where consumers have a high and persistent need for product improvements. However, the success of this method obviously requires that consumers are capable of acquiring knowledge of the product in question. This is possible in relation to most final products, although not to all. In the pharmaceutical industry, for example, the developments of new drugs have always relied on consumers – but never on their knowledge. Discovering new drugs and improving current versions is highly dependent on consumer response, but only the physiological aspects of this response is of interest to the developer. The use of drugs does not allow the consumer to acquire any knowledge concerning the product, which is valid for its improvement. Since consumers cannot properly identify relevant problems of product design there exist no knowledgeable or competent consumers of drugs. Thus, relying on consumer's knowledge for product improvement is not a relevant option – or at least inadvisable. In the same way, relying on consumer's knowledge for better aero engines cannot be recommended.

Concluding remarks

On the background of the case study presented I find reason to state that a new approach to innovation is emerging. It relies on consumer's knowledge and furnishes those firms that take advantage of new information and communication technology to establish an organization of consumers with advantages in form of "cost-cuts on innovation". As we have seen the method is valid for assisting incremental innovations to existing products. However, it may well in addition prove efficient for breeding innovations for future product versions or even serve to guide the direction of development for completely new products. Where consumer knowledge can be made available the method seems capable of overcoming some of the old problems of market response to genuinely new products and of reducing uncertainty in the process of product development.

Acknowledgments

The author wishes to thank Thomas Dahl Jensen who spent a considerable amount of time making the data material available and useful. The paper also benefited from comments made by Peter Maskell, Nicolai Foss, and Alfonso Gambardella. This is – naturally - gratefully acknowledged.

References

- Alchian, Armen A. and Demsetz, Harold "Production, Information, and Economic Organization", *American Economic Review*, 62 (1972): 777-795.
- Alchian, Armen A., and Meckling, William, Incentives in the United States. *The American Economic Review*, 50 (2): 55-61 (May 1960).
- Andreoni, James. Cooperation in Public-Goods Experiments: Kindness or Confusion? *The American Economic Review*, 85 (4): 891-904 (Sept. 1995).
- Aoki, Masahiko. The Contingent Governance of Teams: Analysis of Institutional Complementarity. *International Economic Review*, Vol. 35, No. 3. (Aug., 1994), pp. 657-676.
- Herz, J.C. *Joystick Nation*. New York: Little Brown 1997.
- Holmström, Bengt and Ricart I Costa, Joan. Managerial Incentives and Capital Management *Quarterly Journal of Economics* 101 (4): 835-860 (Nov., 1986).
- Holmström, Bengt. Managerial Incentive Problems: A dynamic perspective *Review of Economic Studies* 66:169-182 (1999).
- ISDA Annual member CEO survey, 2000).
- Lawler, Edward E. *Motivation in Work Organization*, Monterey: Brooks/Cole 1973.
- Lazear, Edward P. A Jobs-Based Analysis of Labor Markets. *The American Economic Review* 85 (2): 260-265 Papers and Proceedings of the Hundredth and Seventh Annual Meeting of the American Economic Association Washington, DC, January 6-8, 1995. (May, 1995).
- Lazear, Edward P. Labor Economics and the Psychology of Organizations (in Symposium: Organizations and Economics) *The Journal of Economic Perspectives*, 5, 2: 89-110 (Spring, 1991).
- Lundvall, Bengt Åke. Innovation as an Interactive Process: from User Producer Interaction to the National System of Innovation. In *Technical Change and Economic Theory*, Giovanni Dosi, Christopher Freeman, Gerald Silverberg, and Luc Soete (eds.). London: Francis Pinter, 1988.
- Marshall, Alfred. *Principles of Economics*. London: MacMillan, 1925.
- Pfeffer, Jeffery Incentives In Organizations. In: *Organization Theory*, Oliver Williamson (ed.). New York, Oxford University Press, 1990, pp. 72-98.
- Rosenberg, Nathan. *Perspectives on technology*. Cambridge: Cambridge University Press, 1976.
- Simon, Herbert "A Formal Theory of the Employment Relationship". *Econometrica* 19, 293-305 (1951).

von Hayek, Friedrich A. The use of knowledge in society, *American Economic Review*, 35: 519-530 (1945).

von Hippel, Eric. "Lead Users: A Source of Novel Product Concepts" *Management Science* 32 (1986): 791-805.

von Hippel, Eric. "The Dominant Role of the User in Semiconductor and Electronic Subassembly Process Innovation" *IEEE Transactions on Engineering Management EM-24* : 60-71. (1977):

von Hippel, Eric. The Dominant Role of Users in the Scientific Instrument Innovation Process *Research Policy*, 5:212-239 (1976).

Appendix 1

Methods and data used in the study:

This paper has investigated product improvements with a particular focus on the role of a consumer organization as a supplier of knowledge inputs. An in depth case study approach was used to produce the empirical part of this paper. A particular important source of the data for the study was the on-line community Seadogs Forum itself. During ten consecutive month downloads of information was carried out. The information communicated in the on-line community's lifetime has been captured in its entire form. This data provided information on individual member level and permitted us to observe every members membership date, location, number of messages posted, post dates, content of message, and who the member was communicating with (in its original form). Drawing on these data has been possible to reproduce illustrative graphs and obtain a general idea of the member dynamic of the community. The on-line community technology also allowed us to do observation in real time, which was very helpful way to study the ongoing member discussions. The initial working hypothesis and ideas generated from our data of the operations of the on-line community have been followed up and checked by in-depth interviews with the director of new product development at Bethesda Softworks and the employee who carry out the on-line community management (moderating of Seadogs Forum). In this manner we have checked internal validity with regard to causal statements about consumer activity leading to product improvements. Further, the interview provided both historic and actual insights. Data have also been collected from archival sources; information about the industry has been obtained from the computer game industry's member organization (ISDA) and firm information from various on-line documents.

Danish Research Unit for Industrial Dynamics

The Research Programme

The DRUID-research programme is organised in 3 different research themes:

- *The firm as a learning organisation*
- *Competence building and inter-firm dynamics*
- *The learning economy and the competitiveness of systems of innovation*

In each of the three areas there is one strategic theoretical and one central empirical and policy oriented orientation.

Theme A: The firm as a learning organisation

The theoretical perspective confronts and combines the resource-based view (Penrose, 1959) with recent approaches where the focus is on learning and the dynamic capabilities of the firm (Dosi, Teece and Winter, 1992). The aim of this theoretical work is to develop an analytical understanding of the firm as a learning organisation.

The empirical and policy issues relate to the nexus technology, productivity, organisational change and human resources. More insight in the dynamic interplay between these factors at the level of the firm is crucial to understand international differences in performance at the macro level in terms of economic growth and employment.

Theme B: Competence building and inter-firm dynamics

The theoretical perspective relates to the dynamics of the inter-firm division of labour and the formation of network relationships between firms. An attempt will be made to develop evolutionary models with Schumpeterian innovations as the motor driving a Marshallian evolution of the division of labour.

The empirical and policy issues relate the formation of knowledge-intensive regional and sectoral networks of firms to competitiveness and structural change. Data on the structure of production will be combined with indicators of knowledge and learning. IO-matrixes which include flows of knowledge and new technologies will be developed and supplemented by data from case-studies and questionnaires.

Theme C: The learning economy and the competitiveness of systems of innovation.

The third theme aims at a stronger conceptual and theoretical base for new concepts such as 'systems of innovation' and 'the learning economy' and to link these concepts to the ecological dimension. The focus is on the interaction between institutional and technical change in a specified geographical space. An attempt will be made to synthesise theories of economic development emphasising the role of science based-sectors with those emphasising learning-by-producing and the growing knowledge-intensity of all economic activities.

The main empirical and policy issues are related to changes in the local dimensions of innovation and learning. What remains of the relative autonomy of national systems of innovation? Is there a tendency towards convergence or divergence in the specialisation in trade, production, innovation and in the knowledge base itself when we compare regions and nations?

The Ph.D.-programme

There are at present more than 10 Ph.D.-students working in close connection to the DRUID research programme. DRUID organises regularly specific Ph.D-activities such as workshops, seminars and courses, often in a co-operation with other Danish or international institutes. Also important is the role of DRUID as an environment which stimulates the Ph.D.-students to become creative and effective. This involves several elements:

- access to the international network in the form of visiting fellows and visits at the sister institutions
- participation in research projects
- access to supervision of theses
- access to databases

Each year DRUID welcomes a limited number of foreign Ph.D.-students who want to work on subjects and projects close to the core of the DRUID-research programme.

External projects

DRUID-members are involved in projects with external support. One major project which covers several of the elements of the research programme is DISKO; a comparative analysis of the Danish Innovation System; and there are several projects involving international co-operation within EU's 4th Framework Programme. DRUID is open to host other projects as far as they fall within its research profile. Special attention is given to the communication of research results from such projects to a wide set of social actors and policy makers.

DRUID Working Papers

- 96-1 **Lundvall, Bengt-Åke:** The Social Dimension of the Learning Economy. (ISBN 87-7873-000-7)
- 96-2 **Foss, Nicolai J.:** Firms, Incomplete Contracts and Organizational Learning. (ISBN 87-7873-001-5)
- 96-3 **Dalum, Bent and Villumsen, Gert:** Are OECD Export Specialisation Patterns 'Sticky?' Relations to the Convergence-Divergence Debate. (ISBN 87-7873-002-3)
- 96-4 **Foss, Nicolai J.:** Austrian and Post-Marshallian Economics: The Bridging Work of George Richardson. (ISBN 87-7873-003-1)
- 96-5 **Andersen, Esben S., Jensen, Anne K., Madsen, Lars and Jørgensen, Martin:** The Nelson and Winter Models Revisited: Prototypes for Computer-Based Reconstruction of Schumpeterian Competition. (ISBN 87-7873-005-8)
- 96-6 **Maskell, Peter:** Learning in the village economy of Denmark. The role of institutions and policy in sustaining competitiveness. (ISBN 87-7873-006-6)
- 96-7 **Foss, Nicolai J. & Christensen, Jens Frøslev:** A Process Approach to Corporate Coherence. (ISBN 87-7873-007-4)
- 96-8 **Foss, Nicolai J.:** Capabilities and the Theory of the Firm. (ISBN 87-7873-008-2)
- 96-9 **Foss, Kirsten:** A transaction cost perspective on the influence of standards on product development: Examples from the fruit and vegetable market. (ISBN 87-7873-009-0)
- 96-10 **Richardson, George B.:** Competition, Innovation and Increasing Returns. (ISBN 87-7873-010-4)
- 96-11 **Maskell, Peter:** Localised low-tech learning in the furniture industry. (ISBN 87-7873-011-2)
- 96-12 **Laursen, Keld:** The Impact of Technological Opportunity on the Dynamics of Trade Performance. (ISBN 87-7873-012-0)

- 96-13 **Andersen, Esben S.:** The Evolution of an Industrial Sector with a Varying Degree of Roundaboutness of Production. (ISBN 87-7873-013-9)
- 96-14 **Dalum, Bent, Laursen, Keld & Villumsen, Gert:** The Long Term Development of OECD Export Specialisation Patterns: De-specialisation and “Stickiness”. (ISBN 87-7873-014-7)
- 96-15 **Foss, Nicolai J.:** Thorstein B. Veblen: Precursor of the Competence-Based Approach to the Firm. (ISBN 87-7873-015-5)
- 96-16 **Gjerding, Allan Næs:** Organisational innovation in the Danish private business sector. (ISBN 87-7873-016-3)
- 96-17 **Lund, Reinhard & Gjerding, Allan Næs:** The flexible company Innovation, work organisation and human resource management. (ISBN 87-7873-017-1)
- 97-1 **Foss, Nicolai J.:** The Resource-Based Perspective: An Assessment and Diagnosis of Problems. (ISBN 87-7873-019-8)
- 97-2 **Langlois, Richard N. & Foss, Nicolai J.:** Capabilities and Governance: the Rebirth of Production in the Theory of Economic Organization. (ISBN 87-7873-020-1)
- 97-3 **Ernst, Dieter:** Partners for the China Circle? The Asian Production Networks of Japanese Electronics Firms. (ISBN 87-7873-022-8)
- 97-4 **Richardson, George B.:** Economic Analysis, Public Policy and the Software Industry. (ISBN 87-7873-023-6)
- 97-5 **Borras, Michael & Zysman, John:** You Don't Have to Be A Giant: How The Changing Terms of Competition in Global Markets are Creating New Possibilities For Danish Companies. (ISBN 87-7873-024-4)
- 97-6 **Teubal, Morris.:** Restructuring and Embeddeness of Business Enterprises-Towards an Innovation System Perspective on Diffusion Policy. (ISBN 87-7873-025-2)
- 97-7 **Ernst, Dieter & Guerrieri, Paolo:** International Production Networks and Changing Trade Patterns in East Asia: The case of the Electronics Industry. (ISBN 87-7873-026-0)
- 97-8 **Lazaric, Nathalie & Marengo, Luigi:** Towards a Characterisation of Assets and Knowledge Created in Technological Agreements: Some evidence from the automobile-robotics sector. (ISBN 87-7873-027-9)

- 97-9 **Ernst, Dieter.:** High-Tech Competition Puzzles. How Globalization Affects Firm Behavior and Market Structure in the Electronics Industry. (ISBN 87-7873-028-7)
- 97-10 **Foss, Nicolai J.:** Equilibrium vs Evolution in the Resource-Based Perspective: The Conflicting Legacies of Demsetz and Penrose. (ISBN 87-7873-029-5)
- 97-11 **Foss, Nicolai J.:** Incomplete Contracts and Economic Organisation: Brian Loasby and the Theory of the firm. (ISBN 87-7873-030-9)
- 97-12 **Ernst, Dieter & Lundvall, Bengt-Åke:** Information Technology in The Learning Economy – Challenges for Developing Countries. (ISBN 87-7873-031-7)
- 97-13 **Kristensen, Frank Skov (p):** A study of four organisations in different competitive environments. (ISBN 87-7873-032-5)
- 97-14 **Drejer, Ina, (p) Kristensen, Frank Skov (p) & Laursen, Keld (p):** Studies of Clusters as a Basis for Industrial and Technology Policy in the Danish Economy. (ISBN 87-7873-033-3)
- 97-15 **Laursen, Keld (p) & Drejer, Ina (p):** Do Inter-sectoral Linkages Matter for International Export Specialisation? (ISBN 87-7873-034-1)
- 97-16 **Lundvall, Bengt-Åke & Kristensen, Frank Skov (p):** Organisational change, innovation and human resource Development as a response to increased competition. (ISBN 87-7873-036-8)
- 98-1 **Præst, Mette (p):** An Empirical Model of Firm Behaviour: A dynamic Approach to Competence Accumulation and Strategic Behaviour. (ISBN 87-7873-037-6)
- 98-2 **Ducatel, Ken:** Learning and skills in the Knowledge Economy. (ISBN 87-7873-038-4)
- 98-3 **Ernst, Dieter:** What Permits Small Firms to Compete in High-Tech Industries? Inter-Organizational Knowledge Creation in the Taiwanese Computer Industry. (ISBN 87-7873-039-2)
- 98-4 **Christensen, Jens Frøslev:** The Dynamics of the Diversified Corporation and the Role of Central Management of Technology. (ISBN 87-7873-040-6)
- 98-5 **Valente, Marco (p):** Laboratory for Simulation Development. (ISBN 87-7873-041-4)
- 98-6 **Valente, Marco (p):** Technological Competition: a Qualitative Product Life

Cycle. (ISBN 87-7873-042-2)

- 98-7 **Lam, Alice:** The Social Embeddedness of Knowledge: Problems of Knowledge Sharing and Organisational Learning in International High-Technology Ventures. (ISBN 87-7873-043-0)
- 98-8 **Jørgensen, Kenneth M. (p):** Information Technology and Change in Danish Organizations. (ISBN 87-7873-044-9)
- 98-9 **Andersen, Esben Sloth:** Escaping Satiation in an Evolutionary Model of Structural economic Dynamics. (ISBN 87-7873-045-7)
- 98-10 **Foss, Kirsten:** Technological Interdependencies, Specialization and Coordination: A Property Rights Perspective on The Nature of the Firm. (ISBN 87-7873-046-5)
- 98-11 **Andersen, Poul H:** Organizing International Technological Collaboration in Subcontractor Relationships. An Investigation of the Knowledge-Stickyness Problem. (ISBN 87-7873-047-3)
- 98-12 **Nymark, Søren (p):** Billeder af strategi i forandringsrige organisatoriske omgivelser: 3 cases fra DISKO studierne. (ISBN 87-7873-048-1)
- 98-13 **Andersen, Esben Sloth:** The Evolution of the Organisation of Industry. (ISBN 87-7873-050-3)
- 98-14 **Foss, Kirsten & Foss, Nicolai J.:** The Market Process and The Firm: Toward a Dynamic Property Rights Perspective. (ISBN 87-7873-051-1)
- 98-15 **Lorenz, Edward:** Societal Effects and the Transfer of Business Practices to Britain and France. (ISBN 87-7873-053-8)
- 98-16 **Ernst, Dieter:** Catching-Up, Crisis and Industrial Upgrading. Evolutionary Aspects of Technological Learning in Korea's Electronics Industry. (ISBN 87-7873-054-6)
- 98-17 **Kaisla, Jukka (p):** The Market Process and the Emergence of the Firm: Some Indications of Entrepreneurship Under Genuine Uncertainty. (ISBN 87-7873-055-4)
- 98-18 **Laursen, Keld (p):** Do Export and Technological Specialisation Patterns Co-evolve in Terms of Convergence or Divergence?: Evidence from 19 OECD Countries, 1971-1991. (ISBN 87-7873-056-2)
- 98-19 **Foss, Nicolai J.:** Firms and the Coordination of Knowledge: Some Austrian Insights. (ISBN 87-7873-057-0)
- 98-20 **Mahnke, Volker (p) & Aadne, John Harald:** Process of Strategic Renewal, Competencies, and the Management of Speed. (ISBN 87-7873-058-9)

- 98-21 **Lorenzen, Mark (p):** Information, cost learning, and trust. Lessons form co-operation and higher-order capabilities amongst geographically proximate firms. (ISBN 87-7873-059-7)
- 98-22 **Lam, Alice:** Tacit Knowledge, Organisational Learning and Innovation: A Societal Perspective. (ISBN 87-7873-060-0)
- 98-23 **Lund, Reinhard:** Organizational and innovative flexibility mechanisms and their impact upon organizational effectiveness. (ISBN 87-7873-061-9)
- 98-24 **Christensen, Jesper Lindgaard & Drejer, Ina (p):** Finance and Innovation System or Chaos. (ISBN 87-7873-062-7)
- 98-25 **Laursen, Keld (p):** How Structural Change Differs, and Why it Matters (for Economic Growth) (ISBN 87-7873-063-5)
- 98-26 **Holmén, Magnus & Jacobsson, Staffan:** A method for identifying actors in a knowledge based cluser. (ISBN 87-7873-064-3)
- 98-27 **Richardson, G. B.:** Production, Planning and Prices. (ISBN 87-7873-065-1)
- 98-28 **Foss, Nicolai J.:** Austrian Economics and Game Theory: a Preliminary Methodological Stocktaking. (ISBN 87-7873-067-8)
- 98-29 **Foss, Nicolai J. & Mahnke, Volker (p):** Strategy Research and the Market Process Perspective. (ISBN 87-7873-068-6)
- 98-30 **Laursen, Keld (p):** Revealed Comparative Advantage and the Alternatives as Measures of International Specialisation. (ISBN 87-7873-069-4)
- 99-1 **Lorenz, E.:** Organisationaal Innovation, Governance Structure and Innovative Capacity In British and French Industry. (ISBN 87-7873-070-8)
- 99-2 **Ernst, Dieter:** Responses to the Crisis: Constraints to a Rapid Trade Adjustment in East Asia's Electronics Industry. (ISBN 87-7873-071-6)
- 99-3 **Foss, N. J. :** Understanding Leadership: A Coordination Theory. (ISBN 87-7873-072-4)
- 99-4 **Foss, K & Foss, N. J:** Understanding Ownership: Residual Rights of Control and Appropriable Control Rights. (ISBN 87-7873-073-2)
- 99-5 **Foss, K & Foss, N. J:** Organizing Economic Experiments: The role of Firms. (ISBN 87-7873-075-9)
- 99-6 **Jørgensen Kenneth. M. (p) :** The Meaning og Local Knowledges. (ISBN 87-7873-076-7)
- 99-7 **Foss, N. J.:** Capabilities, Confusion, and the Costs of Coordination: On Some Problems in Recent Research On Inter-Firm Relations. (ISBN87-7873-

077-5)

- 99-8 **Lund, Reinhard:** Tillidsrepræsentantsystemet og de fleksible virksomhedsformer. Juli 1999. (ISBN887-7873-078-3)
- 99-9 **Nymark, Søren:** Organisatorisk læring gennem den værdibaserede organisations fortællinger. (ISBN 87-7873-079-1)
- 99-10 **Laursen, K. & Meliciani, V.:** The importance of technology based inter-sectoral linkages for market share dynamics. (ISBN 87-7873-080-5)
- 99-11 **Laursen, K., Mahnke, V., Vejrup-Hansen, P.:** Firm growth from a knowledge structure perspective. (ISBN 87-7873-081-3)
- 99-12 **Lundvall, Bengt-Åke, Christensen, Jesper. L.:** Extending and Deepening the Analysis of Innovation Systems - with Empirical Illustrations from the DISCO-project. (ISBN 87-7873-082-1)
- 00-1 **Llerena, Patrick & Oltra, Vanessa:** Diversity of innovative strategy as a source technological performance. (ISBN 87-7873-085-6)
- 00-2 **Llerena, Patrick & Mireille Matt:** Technology policy and cooperation: A paradigmatic approach. (ISBN 87-7873-086-4)
- 00-3 **Cusmano, Lucia:** Technology Policy and Co-operative R&D: the role of relational research capacity. (ISBN 87-7873-087-2)
- 00-4 **Mikkola, Juliana Hsuan:** Modularization assessment of product architecture. (ISBN87-7873-088-0)
- 00-5 **Yvrande, Anne:** The new British railways structure: A transaction cost economics analysis. (ISBN87-7873-089-9)
- 00-6 **Dijk, Machiel van & Nomaier Önder:** Technological diffusion patterns and their effects on industrial dynamics. (ISBN 87-7873-090-2)
- 00-7 **Storper, Michael & Chen, Yun-chung with De Paolis, Fernando:** The Effects of Globalization on Location of Industries in the OECD and European Union (ISBN87-7873-091-0)
- 00-8 **Sanders, Mark & Weel, Bas ter :** Skill-Biased Technical Change: Theoretical Concepts, Empirical Problems and a Survey of the Evidence (ISBN87-7873-092-9)
- 00-9 **Tomlinson, Mark:** Innovation surveys: A researcher's perspective (ISBN87-7873-093-7)
- 00-10 **Nymark, Søren:** Value-based management in learning organizations through 'hard' and 'soft' managerial approaches: The case of Hewlett-Packard

(ISBN87-7873-094-5)

- 00-11 **Yoguel, Gabriel; Novick , Marta & Marin, Anabel:** Production Networks: Linkages, Innovation Processes and Social Management Technologies (ISBN87-7873-095-3)
- 00-12 **Yoguel, Gabriel & Boscherini, Fabio:** The environment in the development of firms' innovative capacities: Argentine industrial SMEs from different local systems (ISBN87-7873-096-1)
- 00-13 **Arocena, Rodrigo & Sutz, Judith:** Interactive Learning Spaces and Development Policies in Latin America (ISBN87-7873-098-8)
- 01-01 **Mathews, John A.:** Competitive Interfirm Dynamics within an Industrial Market System (ISBN87-7873-099-6)
- 01-02 **Giarratana, Marco & Torrisi, Salvatore:** Competence accumulation and collaborative ventures: Evidence from the largest European electronics firms and implications for the EU technological policies (ISBN 87-7873-100-3)
- 01-03 **Nemirovsky, Adolfo & Yoguel, Gabriel:** Dynamics of high-technology firms in the Silicon Valley (ISBN 87-7873-101-1)
- 01-04 **Castellacci, Fulvio:** A 'technology-gap approach to cumulative growth': toward an integrated model. Empirical evidence for Spain, 1960-1997 (ISBN 87-7873-103-8)
- 01-05 **Nuvolari. Alessandro:** Collective invention during the British industrial revolution: The case of the Cornish pumping engine (ISBN 87-7873-104-6)
- 01-06 **Costa, Ionara:** Ownership and technological capabilities in Brazil (ISBN 87-7873-105-4)
- 01-07 **Foss, Nicolai J.:** Economic organization in the knowledge economy: some austrian insights (ISBN 87-7873-106-2)
- 01-08 **Cantwell, John & Kosmopoulou, Elena:** Determinants of internationalisation on corporate technology (ISBN 87-7873-107-0)
- 01-09 **Loasby, Brian:** Industrial dynamics. Why connection matter (ISBN 87-7873-108-9)
- 01-10 **Jeppesen, Lars Bo:** Making Consumer Knowledge Available and useful (87-7873-109-7)
- 01-11 **Laursen, Keld:** The Importance of Sectoral Differences in the Application of (Complementary) HRM Practices for Innovation Performance (87-7873-110-0)

- 01-12 **Johnson, Björn & Segura-Bonilla, Olman:** Innovation Systems and Developing Countries: Experience from the SUDESCA Project (87-7873-111-9)
- 01-13 **Foss, Nicolai J. :** Bounded Rationality in the Economics of Organization: Present Use and (Some) Future Possibilities (87-7873-112-7)
- 01-14 **Reichstein, Toke & Dahl, Michael S.:** Patterns and Dependencies of Firm Growth (87-7873-113-5)
- 01-15 **Foss, Nicolai J. :** The Problem With Bounded Rationality: On Behavioral Assumptions in the Theory of the Firm (87-7873-114-3)
- 01-16 **Foss, Nicolai J. :** Selective Intervention and Internal Hybrids: Interpreting and learning from the Rise and Decline of the Oticon Spaghetti Organization (87-7873-115-1)
- 02-01 **Foss, Kirsten, Nicolai Foss, Peter G. Klein & Sandra K. Klein:** Heterogeneous Capital, Entrepreneurship, and Economic Organization (87-7873-117-8)

All correspondence concerning the DRUID Working Papers should be send to:

Dorte Køster
Fibigerstræde 4
DK-9220 Aalborg OE
Tel. 45 96 35 82 35
Fax. 45 98 15 60 13

E-mail: druid-wp@business.auc.dk