

Technological Development in Estonian Networks: Some Case Study Evidence

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Abstract

The paper aims to examine how Estonian firms have used network relationships for technological development and how this has advanced their internationalization. It includes four cases (these firms managed to renew or develop their own technology and started producing and exporting it) and ends with research implications.

Keywords: networks, technological development, internationalization, Estonia, case study

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Introduction

In small transition countries like Estonia, the role of (international) networks in technological and international development is especially important. Estonia's population of less than 1.4 million and still not a very high GDP per capita mean that firms have to internationalize fast, if they want to grow. This is not easy especially for recently established local companies, as they tend to lack technology, knowledge and contacts with foreign buyers and suppliers. For some older firms, internationalization has been also very difficult: after the dissolution of the Soviet Union, many former trade arrangements broke down and some former member states (for instance, Russia) imposed high trade restrictions. So, most of Estonian companies were forced to find new foreign buyers and suppliers quickly.

In addition to losing markets, these firms had to face another problem: renewing technologies, as in some industries, the technological inferiority was very large compared to foreign competitors. So, due to the loss of markets and problems with technology, many enterprises had to decrease their activities considerably. The firms that still managed to stay on the market were mostly not able to buy new technologies from Estonia, as the companies producing them also had similar problems. So, they had to buy those from the West and/or East. In some cases, the enterprises could not obtain standard technology, but had to develop it together with their (foreign) network partners.

Despite the subject's importance, there are not many studies trying to examine the issues of technological development, networks and internationalization together. Several authors have stated that these issues should be studied further (see, for example, Hyder and Abraha 2004 and Saarenketo et al. 2004). Thus, this paper aims to examine how Estonian firms have used network relationships for technological development and how this has advanced their internationalization.

The paper starts with a literature review: there, the literature on internationalization, networks and technological development is examined. Then, after a methodology section on case studies, four cases from Estonia are introduced. It is shown how these companies managed to form network relationships, develop their technologies and internationalize. After discussing the results, the paper continues with some managerial and future research implications.

Literature Review

A large quantity of research has been based on the **Uppsala** (or the **U-** or the **internationalization process**) **model**. Its authors assume that experiential market knowledge is the driving force of the internationalization process. Its acquisition, integration and use are gradual and relatively slow. Thus, internationalization is usually long, slow and incremental. Firms first begin to export to neighboring countries or those that are comparatively well known and similar. They pass through a number of steps from no regular export activities to export via independent representatives or agents, overseas sales subsidiaries and production/manufacturing units (Johanson and Vahlne 1977, 1990; Johanson and Wiedersheim-Paul 1975). There are three exceptions to the model (Johanson and Vahlne 1990): large or resourceful enterprises can more easily internationalize; in stable market conditions, relevant market knowledge can be obtained in other ways than through experience; if a company has considerable experience in similar markets, it may use it in a specific country.

Innovation-related internationalization (or **I-**) **models** state that foreign market expansion is incremental and dependent on an enterprise's experiential learning and uncertainty regarding the decision to internationalize (Morgan and Katsikeas 1997). Unlike the U-model, the I-models demonstrate that knowledge is not the only factor that influences internationalization. For instance, it may be affected by top managers' attitudes, the existence of patented products and the level of the firm's technological development (for an overview, see Bilkey 1978). In addition, some forces may influence foreign-owned firms' internationalization more than that of their domestic counterparts: the initial decision to start exporting could be taken in the headquarters and sales might be organized through their global marketing network (Wiedersheim-Paul, Olson and Welch 1978). Consequently, network relationships can be quite important for internationalization.

The **Finnish model** agrees with the previous approaches that at first, firms tend to penetrate closest countries. As they gain confidence, they might start seeking more distant markets. The model also acknowledges that as enterprises internationalize, they may change the method of operating

(Luostarinen and Welch 1997; Welch and Luostarinen 1988). It emphasizes the importance of firm competencies, including technology (Welch and Luostarinen 1988). The model suggests that several firms can speed up their internationalization by leapfrogging some stages (Chetty 1999). It also claims that inward internationalization might precede and influence the development of outward activities and vice versa (Korhonen 1999). For instance, many companies have their first international contacts as potential customers of foreign enterprises. Through them, they may acquire technology and foreign market knowledge and reduce the time required to establish new international operations (Luostarinen and Welch 1997). Finally, the enterprises may start cooperating on technological know-how, production, marketing, purchasing and transporting. The Finnish model also shows that de-internationalization may occur at any of the stages. This process may be followed again by re-internationalization (Luostarinen 1994).

The interest in **born globals** arose in the early 1990s. Born globals are generally the firms where the top management has a desire and commitment to export. The companies, which compete on value (mainly quality, technology and product design) and those with a strong customer orientation, belong to this category as well (McKinsey & Co 1993). The authors belonging to this research stream have shown that although many firms are young and small, their markets are most volatile and they lack market experience (Oviatt and McDougall 1994), they internationalize fast instead of moving through the steps suggested by the U- and I-models. A new term, born-again global, has been created to refer to the firms that have been well established in their domestic markets, with apparently no great motivation to internationalize, but which have suddenly done it. Mostly, this change has been caused by a critical incident: for example, takeover by another enterprise, acquisition of a company with international connections or the internationalization of a domestic client (Bell, McNaughton and Young 2001). Thus, this approach also points to the importance of network relationships.

According to the **network approach**, relationships can be a crucial means to increase an enterprise's ability to innovate and to take part in technological development (Håkansson and Snehota 2000). The network approach has been often applied to **internationalization**. From this point of view, an enterprise's internationalization means establishing and developing business relationships in networks in other countries (Johanson and Mattson 1988). Through network relationships, a firm can gain access to other enterprises' knowledge without necessarily going through the same experiences (Eriksson et al. 1998). In addition to learning about the partners' capabilities, needs and strategies, it can obtain knowledge about their business conditions and market networks (Johanson and Johanson 1999). Thus, a typical internationalization sequence has changed from gradual expansion to expansion in leaps by joining the nets (Hertz 1996). On the other hand, network relationships cannot only drive and facilitate, but also inhibit a company's internationalization (Ford 1998).

Substantial **research** has been made **on the relationships between foreign direct investments (FDI) and host country exports**. Several authors have shown that foreign subsidiaries are usually more international (they export more) than locally owned firms. This is caused by the following two reasons (Blomström 1990; Dunning 1994; Lauter and Rehman 1999):

- subsidiaries have better business contacts abroad, higher management and marketing skills, superior technology, greater general know-how and the right to use their parents' brand names;
- the owners can help them to set up a distribution network, follow industrial norms, safety standards and consumer tastes; deal with product design, packaging, distribution, servicing and shaping a new product image.

There is also some **other literature on networks, technological development and internationalization**. Some authors have demonstrated how technologies have been developed through networks. For instance, Koch (2004) showed how for software development, players engaged in long-term network relationships as it was too uncertain a task to in-source all the needed competence areas. Hallikas et al. (2004) stated that through networking, companies aim at reducing financial and technological risks and improving their competitive advantage through deeper specialization; however, this may force them to make partner specific investments in technology, processes and skills, reducing the amount of potential partners. Hyder and Abraha (2004) showed that likely candidates for internationalization are firms with unique technology that can be exploited in other markets or developed further through international collaboration. Saarenketo et al. (2004) demonstrated that the more technological and marketing capabilities a company has the more international it can become (learning is possible through creating network relationships and also through other ways: for instance, observing other companies).

Based on the previous overview, the following conclusions about internationalization and the importance of technological development can be made.

- If a firm lacks (foreign market) knowledge and technology, it starts its internationalization from nearby countries and simpler market entry modes. Afterwards, it may progress to more distant markets and more demanding market operation modes.
- Technology can be developed and knowledge acquired through creating network relationships (with foreign owners and other network members with whom it does not have ownership ties).
- If a company has actively acquired (foreign market) knowledge and developed its technology, it may considerably quicken its internationalization. Still, sometimes, it may fail in their acquisition and this may, instead of quickening, inhibit the internationalization process.

Methodology

To examine the above-made conclusions, case study methodology was chosen. By combining previously developed theories with new empirically derived insights (Yin 1994), it is especially appropriate in new topic areas. This method allows transcending the local boundaries of the investigated cases and capturing new layers of reality. Its use can result in developing novel, testable and empirically valid theoretical and practical insights (Eisenhardt 1989; Voss, Tsikrikitis and Frolich 2002). The case study method also enables to conduct research in a country where the small sample base means that there might not be enough firms to justify using statistical generalization (Chetty 1996). Moreover, contrary to some other research methods, which aim at statistical correlations with less regard for the underlying explanations, case research is capable of discovering true causal relationships (Hillebrand, Kok and Biemans 2001). This method can be also used for studying processes like internationalization (Arenius 2002). The data collection can be carried out over a sustained period of time. Consequently, the researcher can go far beyond a cross-sectional snapshot of a process and understand how and why things happen as they do (Miles and Huberman 1994).

In this paper, multiple case study approach was used. This may reduce the depth of study but it can both augment external validity and help guard against observer bias (Voss, Tsikrikitis and Frolich 2002). There is no ideal number of cases in the multiple-case approach. Still, it is difficult to generate theory with less than four case companies, and with more than ten cases, the data volume is not easy to cope with (Eisenhardt 1989). In addition, once a pattern emerges, each new field site adds to the research data but at a diminishing rate (Stuart et al. 2002). This paper is based on four cases. The cases were selected by replication logic rather than by sampling logic. In other words, the sample was chosen because the data from the companies could be used for replication — producing contrasting results (Yin 1994) — rather than because the enterprises were representative of the population (Chetty 1996). The four case companies represented different areas: nanotechnology, electrical equipment, measurement instruments and communications security and navigation products. They had different sizes and owners and their years of foundation and main export markets also varied.

In the following section, the case descriptions are provided. To increase the validity and reliability in studying these firms' internationalization, several data sources were used. They included newspapers and journals, the firms' homepages and annual reports.

Case Descriptions

Case 1. Mikromasch, a leading Estonian nano-technological company, dedicated to development and industrial application of micro mechanical devices — pressure sensors, optic alignment chips, microbolometers, SPM (scanning probe microscopy) probes and calibration standards — was founded in 1998 by five Estonian private researchers with backgrounds in physics and microelectronics. By 2004, the firm's number of employees grew to 15. The company has an annual turnover of about 0.8 million EUR, and almost all profits are reinvested into R&D. It has registered the following trademarks: Mikromasch, Ultrasharp, Rite Probe, Focus Probe, Eesti Lina, HI'RES, Dataprobe and Sting, some of them internationally (in the EU, USA and Japan). Mikromasch has achieved a 15 percent market share in the world. The firm has several well-known customers: for instance, Seiko, Jeol, SI, Olympus and Biersdorf. The majority of clients are found in the researcher and scientist community, but approximately 40 percent of the customer stock consists of the worldwide microelectronics, chemical,

bio- and polymer industry. Its products have been used in several scientific experiments in Denmark, Germany, Switzerland, Holland, UK, France, Greece, Romania, Russia, Israel, Canada, USA, Australia, Japan, China, Korea, Mexico, Brazil and other countries and the results have been published in international journals. The company's representatives actively participate in international trade fairs and exhibitions. During the next three years, the firm plans to double its turnover and pay even more attention to its largest market USA. So, it tries to find some more partners in distribution and for franchise.

The firm has contracts with two distributors (ANFATEC and SCHAEFER Technologie GmbH) in Germany, three (AXESS TECH S.a.r.l., ScienTec and SCHAEFER Techniques) in France, one (ElbaTech srl) in Italy, one (Valitech) in Sweden, one (SCHAEFER-TEC AG) in Switzerland and Austria, one (Martech Scientific) in Benelux countries, four (Nanocore Technology Corp., Scientek Corp., Omega Scientific Taiwan Limited and Advantage Scientific Inc.) in Taiwan, one (B.G. Technical Support Ltd.) in Israel, one (JEOL ACTIVE Co., Ltd.) in Japan, one (Shanghai HaiJiang NanoSci&Tech Co. Ltd.) in China and Hong-Kong, one (Biofrontier Technology) in Singapore and one (Group Scientific Pty Ltd.) in Australia and New Zealand. In addition, it has established a logistics center in Spain that maintains stock of products in the EU, and a sales office in USA that is responsible for the USA, Canada and Mexico. It also has an online store (<http://www.spmtips.com>). In addition, it has acquired a small company Silicon-MDT, a Russian manufacturer of commercial silicon cantilevers and calibration gratings for Scanning Probe Microscopy (it has 10 employees). All of its products are currently manufactured and developed in co-operation with Mikromasch and distributed under Mikromasch trademark only.

Mikromasch hopes that they can help to create a good infrastructure for nanotechnology projects in Estonia by participating in the Estonian Nanotechnology Competence Centre, established in December 2004 by Mikromasch, Tartu University, Evikon MCI, Maico Metrics and NexTech Supply from Estonia and K-TEK International (US distributor for Mikromasch; the companies have co-operated since 1998) and the University of North Carolina at Chapel Hill from the USA. The main orientations of the centre are nano-tools, materials research techniques, and nano-metrology. Through the centre, Mikromasch hopes to develop new innovative products, suitable for mass production.

Case 2. Estel Pluss, mainly specializing in development, manufacturing, sale, adjustment and technical maintenance of electrical equipment — semiconductor converters, transformers, current-limiting and smoothing reactors — was set up in 1994 with a view of developing and manufacturing of power converter devices. The company was established on the basis of a research-and-production association Elektrotehnika, which, in turn, was founded in 1870 under the name Revel Railway Workshops. After the dissolution of the Soviet Union, Estel Pluss had to reorganize completely. As it managed to retain only some of its previous customers, its number of employees decreased from about 4000 to 100. In 1998, the first orders from the West came. Since then, the company has managed to find many regular customers, including firms from Russia, China, Ukraine, Belarus, Germany, Poland, Korea and Egypt. It has also exported to the United Kingdom, Lithuania, Cuba, Ireland, Israel, Vietnam and the United States. Its products are successfully used in different fields of industry, power engineering, at iron-and-steel works and metal working factories.

In 1997, the firm founded a local subsidiary Estel Met (manufacturing metal products, forging, pressing, stamping and roll forming of metal, treating and coating metals). The firm exports over a half of its production. A year later, Estel Pluss established a daughter company Estel Elektroonika (producing diodes and thyristors, heatsinks and modules). This firm has sold its products to many countries, including China, Latvia, Lithuania, Poland, Bulgaria, Romania, South Africa and the Commonwealth of Independent States (CIS). It co-operates with firms from the UK, Latvia and Poland. In 2000, another subsidiary — Estel Elektro (producing and developing construction blocks, electrical appliances, machinery and equipment) was established. In 2003, Estel Pluss established a joint venture VNIITVCH-Estel in Russia with All-Russia Vologdin Research Institute of High-Frequency Currents for selling and developing metal treatment technologies for Russian and other plants (the firms have a long history of co-operation: they had dense contacts already before the dissolution of the Soviet Union; the co-operation stopped for a short period after the dissolution, but was restored soon). Estel Pluss also co-operates with several universities in Estonia and abroad. In 2003, it received the ISO 9001:2000 certificate. Its products have several patents.

Estel Pluss has managed to obtain foreign market knowledge and find partners due to its top

managers' personal contacts (for instance, they have participated in several international conferences and seminars and restored some of their previous contacts with companies and research institutes from the former Soviet Union) and its marketing department's active participation in international trade fairs and exhibitions. As some Asian companies still tend to seek contacts through Russia, it is especially important to be present there. In some cases, Estel Pluss has also contacted local consultation or marketing firms to reduce its sales risk: for instance, in Russia, there are still many firms that tend to order some products without having any means or even intention to pay for them. As a result of its activities, the firm's number of employees has increased to over 200 and its turnover has grown to 3.2 million EUR, but Estel Pluss plans to increase it substantially in the near future.

Case 3. Aswega, active in designing, manufacturing, installing and servicing heat, water and other flow meters and adapters and testing equipment (the products are used both by manufacturing enterprises and housing associations), was founded in 1994. Its predecessor, Tallinn Measurement Instrumentation Corporation, also called Prompribor (a company well-known in the former Soviet Union and Eastern Europe: the first ever heat meter in the Soviet Union was developed by Prompribor in 1960), was established in 1945. With privatizing the enterprise, the local owners — the managers, current and former employees of the firm — also acquired its unique technology (the managers have stated that to develop it from zero would require several years), know-how (including the knowledge of the market conditions in Russia and other CIS countries) and some expensive real estate in the centre of Tallinn. Naturally, they had to develop the technology and products further: improve their quality, ergonomics and design, make it possible to connect the system to a computer and so on. The company always tries to use the newest technology and materials. It has its own R&D unit, but it also co-operates with other firms and scientific institutions. In 1999, it received the ISO 9001 certificate.

The firm started exporting since its establishment. Sales in Estonia were impossible until the end of 2002 because the company's products were not accredited on the Estonian market. The problems ended after it built its own laboratory (the first one in Estonia) and received official accreditation. Currently, Aswega exports 98 percent of its turnover (3.7 million EUR) and it has 250 employees (in the Soviet time, the number was six times higher, but several important relationships ended after the dissolution of the Soviet Union and the Russian crisis in 1999-2000 also damaged the company: its turnover decreased twice). It has established subsidiaries in Russia (a sales office AO Aswega, a trading house Aswega and a production subsidiary Aswega-M; it was established because Russia made several impediments to foreign companies; in addition to product assembly, Aswega-M is also active in calibrating, checking and developing products and offering after-sales service) and Ukraine (a production subsidiary Aswega-U), but it also exports to these countries (for instance, in Ukraine, one of their partners and representatives is a research-production company Techprilad) and also to Kazakhstan, Hungary, Bulgaria, Latvia, Moldova, India and other markets. Its largest market is Russia. For instance, Aswega has sold thousands of water and heat meters in Moscow (in some years, even 80 percent of those sold in the Russia capital were produced by the firm). The company uses subcontracting actively. It has a wide network of after-sales service in 38 regions of the CIS. Its managers actively participate in international trade fairs and exhibitions.

Case 4. Cybernetica, an R&D institution, active in developing communications security products and specialized solutions, application software, visual navigation, signaling and telematics systems and offering a variety of services supporting the development process of customer's information system, was established in 1997 after a merger of departments of the Institute of Cybernetics involved in applied research and of the R&D department of EKTA (a company founded in 1976 as a department at the Institute of Cybernetics of the former Estonian Academy of Sciences). Cybernetica also offers office and production spaces in Tallinn Technology Park — the Cybernetica House (housing about 80 R&D and production companies). Moreover, it owns a Cybernetica Conference Centre. Since 2000, the firm belongs fully to the Tallinn Technology Park Development Foundation. It has a wide range of clients, including public organizations, banks, telecommunications companies, ports, and private enterprises. The company has 90 employees. Its annual operating income is about 2.9 million EUR.

Cybernetica is the first Estonia's information technology company whose software development process has been certified. In 1999, it obtained the ISO 9001:2000 "Hardware development and production" certificate. In 2002, it received the certificate in hardware and software development, manufacturing and systems integration. The firm is continuously working on quality system improvement, by complementing it with role-based user links and automatically generated reports. It also conducts regular quality-related training and internal auditing of the system.

In 2003, the firm's main markets were the UK (35% of total exports) Russia (31%), Latvia (18%), Lithuania, Sweden and Holland. Cybernetica has also managed to find some foreign partners in Japan, Singapore, Israel and the USA. Under the trademark of EKTA, Cybernetica's sales of visual navigation, signaling, and telematics systems have also been successful in the international market: Great Britain, the Netherlands, Russia, Latvia, Lithuania, Singapore, USA, Sweden and other countries. In April 2000 Cybernetica (its share was 11.05%), together with Baltic Cresco Investment Group, established Privador, offering communication security products and solutions. Outside Estonia the company has distributors in France, Belgium, Germany, Denmark and cooperation partners in Latvia. In November 2002 Privador's branch office was registered in Finland. In September 2004, IT Grupp obtained Privador's whole security products business division through a sales contract.

Cybernetica is very active in co-operating with other companies and scientific institutions. In 2003, it set up a consortium with Abobase Systems: one of Estonia's largest companies of information system development. At the beginning of 2003, the consortium won the competition for a long-term development project offered by the Estonian Tax and Customs Board. In cooperation with Cell Network (also an Estonian firm), Cybernetica develops the Xtee project (secure cross-referenced use of public databases), which has received high international recognition, including a special prize from the EU Commission: "eEurope Award for eGovernment 2003". As a new initiative, Cybernetica participates in the Competence Centre Program announced by Enterprise Estonia. In 2003, a consortium was set by Cybernetica as a development partner and Abobase Systems, Cell Network, Privador and Voicecom (also an Estonian enterprise) as business partners up to establish the Information Security Centre. In addition, Cybernetica has received some research grants from the Estonian Science Foundation and participated in some EU programs (OpenEvidence, RESET, DASPTOOL and Estonian eVikings II) and co-operated with some scientific institutions: for example, the Riga Institute of Electronics and Computer Science, the University of Tartu (they developed a data security laboratory) and the Tallinn Technical University (with the latter and some other partners, it founded a technology centre in 2004). Moreover, it has developed some software for the international GOFREP project committee, set up for developing the monitoring and guidance system for vessel traffic in the Gulf of Finland.

Cybernetica is a member of the Estonian Technical Committee for IT Standardization (EVS TK4) and the International Association of Marine Aids to Navigation and Lighthouse Authorities and the Estonian representative of the ISO/IEC JTC1 SC27 (a subcommittee of a joint technical committee, formed by the International Organization for Standardization and the International Electrotechnical Commission for developing standards for the digital signature, time-stamping and security administration; it has 42 member states from different continents).

Discussion

It was concluded from the literature review that internationalization of some firms may be a slow and incremental process, but there might be some exceptions. For example, if a company manages to acquire necessary (foreign market) knowledge and technology, it may internationalize faster: skip some simpler market entry modes and start its internationalization from farther markets.

The case results demonstrate that the four companies have used several means for acquiring knowledge and developing their technology: visiting international trade fairs and conferences, creating and retaining personal contacts, forming strategic alliances, establishing joint ventures and subsidiaries and participating in international committees. As a result, their internationalization has been relatively successful: they all have managed not only to export to several foreign countries (including those outside Europe), but also to establish some sales or production subsidiaries abroad.

Comparing the empirical results with theoretical conclusions, it becomes evident that the case firms' internationalization process has been quite different from the one predicted by U- and I-models: all the four enterprises managed to expand internationally very quickly and they all succeeded in exporting outside Europe in less than 10 years after their establishment without necessarily concentrating on Estonia's closest markets at the beginning. Moreover, these firms could be hardly classified as large or resourceful and for them, market conditions were quite unstable, as the Soviet Union dissolved in 1991, the Russian crisis occurred in 1999/2000 and Estonia joined the European Union in 2004. On

the other hand, there was some support on the U-model's claim that experiential foreign market knowledge is important for internationalization: the history of three case firms (Estel Pluss, Aswega and Cybernetica) dates back to the Soviet period or earlier, although in the current form, they were established in the 1990s, and two of them (Estel Pluss and Aswega) have widely announced that this has helped them to internationalize, as they know the ex-Soviet market well.

The I-models', the Finnish model's, the born global literature's and some other authors' statement that the existence of modern technology and patents can motivate a company to internationalize received some support from the case evidence: all the enterprises had modern technology. As it clearly was one of their competitive advantages, they all internationalized quickly.

Some authors, following the industrial organization approach or the Finnish model or doing research on the relationships between FDI and host country exports, have stated that technological development should be easier for foreign-owned enterprises. The case firms were locally owned. Despite of that, they managed to develop their technologies fast. Consequently, the lack of foreign owners does not have to be an impediment. On the other hand, three case companies (Mikromasch, Estel Pluss and Aswega) had a foreign subsidiary with which they also co-operated in technological development. Consequently, it can be said that the research emphasizing the role of foreign owners received some support from the case study evidence.

The case results also support the idea of the network approach, the Finnish model and some other literature on internationalization and technological development that network relationships can be sometimes very helpful for an enterprise that wants to develop its technology. All the four case companies managed to do so. They all co-operated with some other enterprises and scientific institutions in Estonia and abroad (Cybernetica was especially active in this area).

The importance of network relationships for internationalization has been emphasized in some form in almost every research stream (except the early work on the Uppsala model). These relationships have indeed helped the case companies to internationalize. So, instead of internationalizing slowly, they entered foreign markets in leaps. Mikromasch could be even called a born global (the other firms also have some characteristics of such enterprises, but they also had some earlier history, and thus, they are not pure born globals): since its foundation in 1998, it has managed to reach a 15 percent market share and its main markets are the USA and Japan, followed by the EU. There was also some evidence on de- and re-internationalization: Estel Pluss and Aswega had some temporary problems on the Russian market but later, they regained and even strengthened their positions.

As the number of case firms is small, it is not possible to tell which way of obtaining (foreign market) knowledge and technology and internationalizing is the most effective and if there is such a universal way at all. Still, it is apparent that sometimes, it might be rational to use several ways at once, not select only one of them. For instance, Mikromasch has actively participated in trade fairs and exhibitions, co-operated with its Russian subsidiary and several local and international firms and scientific institutions. Estel Pluss has internationalized through its managers' personal contacts, by creating a joint venture, visiting trade fairs and exhibitions and using the services of legal consultation and marketing firms. It has also actively co-operated with several scientific institutions. Aswega has also actively participated in trade fairs and exhibitions, co-operated with its Russian subsidiary and several local and international firms and scientific institutions. Cybernetica has actively participated in trade fairs and exhibitions, co-operated with several local and international firms and scientific institutions, participated in several EU programs and joined some technical committees. The firms experienced some problems during their internationalization (for instance, Aswega's turnover decreased twice because of the Russian crisis, as some previously successful network relationships ended), but, in general, they are currently all successful.

Managerial and research implications

Although the paper is based only on four cases, from them, still, some managerial implications can be made. If a company wishes to internationalize quickly, it should try to obtain (foreign market) knowledge and develop its technology very actively through different channels. Some of them (for instance, creating joint ventures) might be also beneficial for acquiring ideas and raw materials, developing products and raising a company's efficiency. Some others (for example, visiting trade fairs)

might not instantly bring such benefits, but in the future, might also prove very useful.

Still, it is also necessary not to forget that having knowledge and technology in itself will not guarantee a company's automatic success on one or more foreign markets. This might depend on many factors both controllable and uncontrollable by the enterprise. Moreover, sometimes, despite having made large efforts, internationalization may fail. Of course, the market knowledge gathered before de-internationalization might later be at least partially used for re-internationalization (the evidence from Aswega and Estel Pluss supported that), but de-internationalization in itself might be very costly. It is also very important to remember that dissolution of relationships with foreign partners might sometimes harm a company much more than just reducing its potential on a particular foreign market. Thus, both foreign markets and sources of knowledge and technology should be selected with great care.

As the paper is based only on four cases and the subject has still not been very widely researched, it is important to study the ways of knowledge acquisition and technological development and their impact on internationalization further. Without a doubt, more cases should be examined. It might be interesting to compare different countries, firms and industries: for example, if enterprises from smaller countries tend to use more ways of knowledge acquisition and technological development; is there a difference between more and less developed countries, smaller and larger, older and more recently established firms; if some industries are, in general, more international than some others, then do they obtain knowledge and develop their technology differently (for instance, do they co-operate more or are they more active in using the services of governmental agencies), and if they do, then how much this has impacted their international success. The cases might go deeper than those used in this paper (for instance, try to map certain firms' network relationships and analyze how they were created and developed and how the companies exactly benefited from each of them), but some survey evidence might also be useful for making more general conclusions.

The type of necessary (foreign market) knowledge and technology is another important subject: it might determine the way of their acquisition and development. The costs and benefits of knowledge acquisition and technological development might also be studied: it is evident that taking over a company abroad should cost much more than visiting a trade fair, but which way of obtaining knowledge and developing technology would bring larger benefits in a particular situation, is not always clear. The importance of inward internationalization as a way for knowledge acquisition and technological development might also be studied further: this paper only included those case companies that did not involve foreign investors (but three of them had such subsidiaries abroad that tried to develop technology with them), but there are other ways for inward internationalization (like buying a license).

Moreover, it is very important to examine the failures of knowledge acquisition, technological development and internationalization: for instance, whether a company has de-internationalized because of not knowing enough about the particular market, lacking modern technology or other resources, having conflicts with co-operation partners or whether this has been caused by some factors totally uncontrollable by it (like a severe economic crisis in some foreign market). Moreover, the subject of measuring the level of internationalization might be raised: if there is no agreement how to do it (whether it is important to take into account a number of markets or their cultural and geographic distance, the complicity of entry modes, firm and decision-maker characteristics or other variables), then how could there be an agreement how the success in foreign market knowledge acquisition could impact this variable? Only after examining these subjects, it becomes possible to offer more specific managerial suggestions.

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