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Technological Capabilities with Different Degree of Coherence: A Comparative Study of Domestic-Oriented vs. Export-Driven Bulgarian Software Companies

Rossitza Rousseva[1]

Abstract

The paper makes an attempt to examine systematically the capabilities for software production in a latecomer context and to propose an approach for analysing the technological capabilities (TC) in a latecomer software industry. Taking the analysis one step further than identifying capabilities, the study introduces the notion of coherence of TC and suggests that in analysing the TC the analysis needs to take into account also the coherence among the capabilities. The analysis of the accumulation of individual TC in the Bulgarian software industry reveals that significant differences emerge between the TC of domestic-oriented vs. the export-driven companies. The analysis of the coherence of TC proves capable of disentangling the deeper disparities in the accumulation of capabilities and it reveals that strong coherence occurs only in 'export' TC. The paper concludes by bringing back the discussion about the prospects and the entry strategies for developing latecomer software industries. Based on the results the study contests the 'walking on two legs' hypothesis and also points that the optimistic forecasts about the possibilities for leapfrogging by the latecomer countries by developing indigenous software industries have been overestimated.

Keywords: technological capabilities, software industry, leapfrogging
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1. INTRODUCTION

In the last two decades a group of studies has been emphasising that the information technologies (ITs) present a 'window of opportunities' for latecomer countries to catch-up by developing indigenous software industries (Soete, 1985; Steinmueller, 2001). It has been outlined that the availability of skilful human capital creates a solid base for development of an IT industry by the latecomers. The software industry is, in principle, low-capital but knowledge and skill-intensive industry, and the international market for software is big and growing (OECD, 2004; Steinmueller, 2004). For this reason, the discussion about developing indigenous software industries in the latecomer context has gained particular attention both in academic and policy literature for more than a decade (Schware, 1989, 1992; Soete, 1985; Steinmueller, 2001; UNIDO, 1988).

However, developing a software industry in a latecomer or less-advanced context is not a straightforward task. To be successful and sustainable in time the development of the industry needs to involve accumulation of technological capabilities. Technological capabilities for software development are difficult to accumulate in a latecomer context, and the difficulties arise from the very nature of technological knowledge and the complexity of the learning process in a latecomer context. The success in building capabilities depends entirely on the latecomer companies' deliberate efforts to upgrade, and in this sense, development of technological capabilities is a challenge for the latecomers. Very few latecomer companies have managed to enter the international markets and this fact amplifies the need to scrutinise the technological capabilities, which the companies have been able to develop.

Despite the significance, which has been prescribed to the development of indigenous software industries in the latecomer context, the question of what types of technological capabilities the indigenous latecomer software companies need to develop, to be able to compete on international markets, has not been addressed systematically in the literature so far.

The discussion about capabilities building can be traced back to the seminal works of Schware (1989; 1992), Correa (1996) and Heeks (2002), which were discussing the entry strategies for latecomer software industries. Despite their mentioning of capabilities as an important driver in this development, neither of the studies provides a framework for analysing capabilities in a latecomer software industry.

The recent spectacular outbursts of software development activities undertaken by indigenous software industries in a number of developing countries, like India, China and Brazil, have

attracted particular attention for research (see for example among many others, for all latecomer countries (Arora, 2005; Carmel, 2003; Heeks, 2002; Minevich, 2005), for India (Arora, 2001; Athreye, 2005; Tschang, 2001), for China (Tschang, 2005), for China vs. India (Contractor, 2004; Tschang, 2003), for Brazil (Botelho, 2005). Some analyses have mentioned capabilities as an important driver in the latecomer software industries development, but few of them had positioned the discussion in the context of technological capabilities building and few of them had attempted to provide analytical framework for investigating capabilities in a latecomer software industry. Those that did so did not achieve adequate outcomes, as the review in section 4 reveals.

This paper attempts to address the abovementioned gaps in the existing body of literature by positioning the discussion about development of a latecomer software industry within the existing literature in the field of technological development in the latecomer context. The aim of the paper is to suggest an approach for analysing technological capabilities in a latecomer software industry, taking into account its specifics. The focal points of the analysis are only the capabilities for software production in a latecomer context, while the rest of the capabilities will be presented in further research. Further, the paper introduces the notion of coherence of technological capabilities, which has not been done in the literature so far. It argues that if we are to make a comprehensive account of the technological capabilities building, the analysis needs to explore not only the accumulation of individual capabilities but also the level of coherence of technological capabilities.

The paper is structured as follows. The following section 2 makes an overview of the concept of technological capabilities building. Section 3 presents taxonomy of technological capabilities and introduces the notion of coherence of technological capabilities. Section 4 disentangles the specifics of studying the technological capabilities building in a latecomer software industry and makes an attempt to examine systematically the technological capabilities, which the latecomer software companies need to develop. The analysis in section 5 explores the accumulation of individual technological capabilities in the domestic-oriented vs. the export-driven companies. Section 6 investigates the level of coherence of the ‘domestic’ vs. the ‘export’ technological capabilities. The final section 7 concludes by bringing back the debate about prospects for development of latecomer software industries and outlines directions for further research.

2. THE CONCEPT OF TECHNOLOGICAL CAPABILITIES BUILDING

It has been acknowledged that to be successful and sustainable over time the technological development in a latecomer or less-advanced context needs to involve technological capabilities building (Bell, 1993; Ernst, 1998; Hobday, 1995; Kim, 2000; Lall, 1992). Technological capabilities building involve a deliberate process of learning and technology upgrading by the latecomer companies directed at the accumulation of knowledge and skills and their commercial application.

Being the driving force in the process of technology upgrading in the latecomer companies, the accumulation of technological capabilities deserves considerable attention for understanding the complexity in the process of technological development in the latecomer context.

The technological capabilities can be defined as 'the great variety of knowledge and skills which firms need so that they can acquire, assimilate, use, adapt, change and create technology' (Ernst, et al, 1998, p. 17).

In defining the technological capabilities the studies encompass the wide array of skills and abilities, which the latecomers need to build in order to develop mastery over the new technologies. These involve the capabilities to acquire and use new technologies, but also, and more importantly, the capabilities to generate innovation to a certain degree – from generation of incremental change and modification in acquired technologies to introducing new technologies (Bell, 1993; Ernst, 1998; Marcelle, 2004).

Building technological capabilities is by no means a passive, mechanistic or automatic process. Rather, it is a deliberate process of learning and accumulation of various knowledge and skills, and their combination, in attempt to develop mastery over the new technologies (Bell, 1993; Ernst, 1998; Hobday, 1995, 2000; Kim, 1997). The initiation of a process of technological capabilities building comes as a result of a deliberate learning effort by the latecomer companies aimed at technological upgrading. Building upon a foundation of production experience, a further set of skills and capabilities are required for companies to embark on a technological capabilities building trajectory. Building knowledge and understanding about modern technologies is a cumulative, firm-specific and context-specific process, and it requires accumulation of tacit and codified knowledge, in order to develop mastery over new technologies (Dosi, 1988; Pavitt, 1987). This makes the process of technological capabilities building in a latecomer context and the development of 'higher level' technological capabilities particularly difficult.

Studies (Bell, 1993; Figueiredo, 2001; Hobday, 2000; Kim, 1997) have emphasised that it is crucial to distinguish between production and innovative capabilities, as these reflect completely different set of accumulated skills by the latecomer companies. Developing production capabilities involve accumulating skills and abilities to operate new technologies, while building innovative capabilities is a far more cumbersome task. To build innovative capabilities the latecomers need to deepen their knowledge and understanding about the new technologies to the extent that they will be able to change and modify the new technologies, and eventually to introduce new technologies.

Being embedded in a latecomer context, the latecomer companies are facing rather difficult task in developing innovation capabilities for a couple of reasons. First, being away from lead-users, the latecomers do not have access to information and knowledge about the latest technological developments. Second, the demand on the latecomer domestic market is less sophisticated technologically than the demand on the lead markets, which makes it difficult for the domestic market to become a training ground for technological capabilities building, which subsequently to be deployed on the international markets. Third, the domestic research and education infrastructure often does not provide the latecomers with well-trained graduates, and also information and knowledge about the frontier technological developments. All these make the process of technological capabilities building a difficult task for the latecomer companies.

3. TAXONOMY OF TECHNOLOGICAL CAPABILITIES AND THE NOTION OF COHERENCE OF TECHNOLOGICAL CAPABILITIES

This section will present a brief description of taxonomy of technological capabilities, with the attempts being placed on deriving the notion of different levels of coherence of technological capabilities out of it.

3.1 Taxonomy of technological capabilities

Several approaches exist in the literature aiming to classify the technological capabilities. For the purposes of this paper the taxonomy will be reviewed only with respect to the distinction between production and innovative capabilities. The seminal studies have identified three major technological capabilities: production, investment and innovative capabilities (Westphal, 1985), and production, investment and linkage capabilities (Lall, 1992). While another study has emphasised that the most important remains the distinction between capabilities to operate new technologies vs. capabilities to innovate (Bell, 1993).

Building upon these initial classifications, a more recent study (Figueiredo, 2001) focussed on the transition from production to innovative capabilities. It elaborated the taxonomy by disaggregating routine production capabilities and innovative capabilities, and identifying the intermediate capabilities within them. To build innovative capabilities the latecomers need to pass through a number of intermediate capabilities, starting from basic routine capabilities, passing through pre-intermediate innovative capabilities, to reach extra basic innovative capabilities, and eventually build advanced innovative capabilities. The underlying idea behind this model is the sequence in building innovative capabilities, and the cumbersome transition from routine production capabilities towards accumulating innovative capabilities.

3.2 The notion of coherence of technological capabilities

Building on the distinction between production and innovative capabilities, the studies outline that clear stages emerge in the process of technological capabilities building: the latecomers begin with building production capabilities and later on embark on building more sophisticated capabilities, which would allow them to introduce changes in the technologies and eventually to innovate (Bell, 1993; Figueiredo, 2001; Westphal, 1985).

The research emphasises that a clear sequence occurs between these stages of development of technological capabilities. Having accumulated basic capabilities, and deepened and broaden further their skills, the latecomer companies attempt to build higher level capabilities, which would allow them to 'move upwards' the technological ladder (Hobday, 1995). Building upon a foundation of basic production capabilities, the latecomer companies need to develop deeper engineering skills. Learning-by-doing and learning by imitating are the major drivers in this stage, backed up by reverse engineering efforts. Once the latecomer company has developed ample engineering skills, it has the potential to move on to the next stage of technological capabilities of initiating minor and major changes to the technology. To do so, the latecomer companies need to further broaden and deepen their capabilities, and acquire additional knowledge and skills, which would allow them to develop a set of 'higher level' capabilities of initiating minor and major changes to the technology. The final stage in the process of technological capabilities building involves reaching mature capabilities, which allow the companies to innovate themselves.

In this sense, we can envisage the process of technological capabilities building as a process of developing a set of essential capabilities to manage new technologies, followed by a process of acquiring deeper and broader knowledge and skills to develop 'higher level' technological capabilities of introducing minor and major change, and eventually reaching mature technological capabilities enabling the latecomers to innovate and introduce new technologies themselves. The transition from simple OEM/subcontracting to ODM (own design manufacture) and in some instances, to OBM (own brand manufacture) is an example of climbing the technological ladder. This has been the logic of the transition from imitation to innovation, which the successful latecomers in East Asia managed to perform (Hobday, 1995; Kim, 1997).

While deepening the technological capabilities, the latecomer companies pass through subsequent stages of technological sophistication, which can be pictured as a 'technological ladder'. In this sense, we can portrait the process of technological capabilities building as a subsequent process of developing capabilities with higher level of technological sophistication.

The notion that latecomer companies need to 'climb up' the technological ladder suggests that different companies occupy different positions in the technological ladder. In other words, the latecomer companies have different success in their attempts to build technological capabilities, which reflects on the degree of sophistication of the accumulated technological capabilities. Following that perspective we can distinguish different levels of accumulation of technological capabilities, when we analyse the technological capabilities in the latecomer companies, which would be an indicator of different levels of technological maturity among companies.

Building innovative capabilities is a cumbersome task, as innovative capabilities encompass an array of skills and abilities with high complexity. Development of a mastery over a whole set of skills and capabilities is not an automatic process, and this is particularly difficult in the case of highly intricate skills. It may well happen that the latecomer companies succeed to develop some of the skills and abilities in the set better than others. This will result in a situation, where latecomer companies have developed different abilities to a different degree. Subsequently, disparity may occur among the degree of development of the capabilities constituting the set.

Disparity among the level of development of the capabilities in the set, in result will produce 'looseness' of the fit among the capabilities in the set. Respectively, a set of capabilities, which are all developed to a high degree, can be expected to generate a high level of 'tightness' of the fit. In other words, depending on the degree of development of the constituent capabilities in the set, different level of coherence will accrue in the technological capabilities. We define these phenomena as different levels of coherence of technological capabilities.

Are different levels of coherence of technological capabilities manifest in practice? This question has not been addressed in the literature so far. Studies have emphasised that technological capabilities building involves development of an array of skills and capabilities. The analysis has been directed at the type of capabilities, which the latecomer companies need to develop. Studies about technological capabilities have adopted both qualitative and quantitative assessment, but none of them have detected so far the phenomena of different levels of coherence of technological capabilities. A few comparative studies have been undertaken. Some of them focus on the development of individual capabilities and comparison between different companies (Figueiredo, 2001; Marcelle, 2004), or different industries (Ernst, 1998), or search for contrast between capabilities of developed and developing countries (Tremblay, 1994); others compare domestic-oriented vs. export-driven companies (Kim and Lee, 2002; Marcelle, 2004). But so far, no study had identified different levels of coherence of technological capabilities, which is the aim of this paper.

Exploring the coherence of technological capabilities in a latecomer software industry presents another challenge. So far, studies analysing the process of technological capabilities have been predominantly focussed on the industrial sector, studying development of the electronics industry (Gee, 1998; Hobday, 1995, 1995; Kim, 1997; Kim and Lee, 2002; Mytelka, 1998), textiles (Gee, 1998; Lall, 1987), pulp and paper industry (Figueiredo, 2001; Tremblay, 1994), steel industry (Dutrenit, 2000; Lall, 1987), telecommunications (Marcelle, 2004), etc. Very few studies have been exploring the development of a latecomer software industry, placing capabilities as a point of the analysis (Athreye, 2005; Heeks, 1998; Tschang, 2001, 2003). Their contributions and shortcomings are outlined below, as well as the fact that so far, the concept of the technological capabilities building has not been applied to the software industry, which is

the aim of this paper. As the predominant part of the studies have been directed at exploring technological capabilities in industrial sector, the analytical framework developed in the field so far has been reflecting the specifics of the industrial sector. However, a study investigating the technological capabilities in a latecomer software industry needs to take into account the specifics of the software industry, which is discussed in the following section.

4. SPECIFICS IN ANALYSING THE TECHNOLOGICAL CAPABILITIES IN THE SOFTWARE INDUSTRY

A study about the technological capabilities building in the software industry needs to reflect the specific characteristics of the industry. First, software production, more than any other industrial activity, is almost by definition an innovation activity because it aims to produce new products or new ways of executing known tasks and functions (Torrisi, 1998). Therefore, when analysing the technological capabilities in the software industry, the distinction between production and innovative capabilities becomes blurred. To produce software solutions latecomer companies need to possess capabilities to innovate to some extent. As the production of software solutions involves innovation to a certain degree, the array of skills that are needed to produce a software solution, i.e. the production capabilities, embrace also innovative capabilities. Therefore, to explore the production capabilities in the case of software companies, the analysis needs to incorporate also the innovation-generating capabilities. The degree of novelty may vary in the software production process. This point holds even for software companies in developed countries context but it is particularly relevant in analysing the latecomer software production, and it is addressed at a later point in the analysis.

Second, the degree of innovativeness depends on companies' abilities, but also on customers' requirements. If a latecomer software company operates in a market with less sophisticated technological demand, it may produce software solutions, which are innovative for that market, but behind the frontier technological developments on the international markets. Hence, accepting the inherent innovative nature of the software production, it is also meaningful to distinguish between innovation for international markets and innovation for the domestic market, especially when the latter is a latecomer context.

Third, the software industry is a human capital-intensive industry, rather than a physical capital-intensive industry. Development of successful software products or services depends on the deployment of skills and capabilities of the computer engineers. The challenge, which the latecomer software companies face, is to build technological capabilities enabling them to produce software, which can be commercialised abroad, based on the skills and abilities, which computer engineers have acquired in a latecomer context.

Due to the specifics of the software production, we need to scrutinise each of the constituent capabilities in the set of the technological capabilities. So far, not a single study has been undertaken to systematically explore the technological capabilities, which the latecomer software companies need to develop. The development of a software industry has gained a

particular attention in the literature recently, due to the spectacular outbursts of software development activities in a number of latecomers. Some analyses have mentioned capabilities as an important driver in the latecomer software industries development, but none of them had provided an analytical framework of how to analyse them. Review of the main studies about development of latecomer software industries is done below, outlining their contributions and shortcomings.

The discussion about capabilities building can be traced back to the seminal works of Schware (1989; 1992), Correa (1996) and Heeks (2002), which were discussing the entry strategies for latecomer software industries. Despite their mentioning of capabilities as an important driver in this development, neither of the studies provides a framework for analysing capabilities in a latecomer software industry.

The recent spectacular outbursts of software development activities undertaken by indigenous software industries in a number of developing countries, like India, China and Brazil, have attracted particular attention for research (see for example among many others, for all developing countries (Carmel, 2003; Minevich, 2005), for India (Arora, 2001; Athreye, 2005), for China (Tschang, 2005), for China vs. India (Contractor, 2004), for Brazil (Botelho, 2005). Some of these analyses have mentioned capabilities as an important driver in the latecomer software industries development, but none of them had provided an analytical framework of how to analyse them.

Attempts to provide a framework for analysing the capabilities, which the latecomer software companies need to develop, have been done by Tschang (2001; 2003) and by Heeks (1998). Although certain merit needs to be given to these papers for their pioneering efforts, all of them have significant limitations.

While discussing the development of the Romanian software industry Heeks (1998) adopts the theoretical framework about technological capabilities building and makes an attempt to provide taxonomy of the software technological capabilities. The study outlines different software production activities representing different phases in climbing the technological ladder to perform more sophisticated software production. However, it remains focussed only on the range of software activities, rather than on the capabilities underlying these activities or the array of software capabilities needed to produce software in a latecomer context. Further, the theoretical framework seems decoupled from the empirical section, which explores predominantly the institutional foundations (and their transformation) and briefly touches upon the development of software activities in the latecomer software industry in question, and thus does not provide a clear approach of how to apply the proposed framework.

The study of Tschang (2001) derives the capabilities from the software development model itself. Such an approach is insufficient to provide a systematic account of the range of capabilities, which latecomer software companies need to develop in order to compete on the international markets. In Tschang (2003) the author abandons the first approach of deriving the capabilities from the software development model. Rather, it provides a list of capabilities, which although relevant, is far from systematic and does not provide a clear description of the listed capabilities nor does it exhaust the array of capabilities, which the latecomer software companies need to master.

A recent book by Arora and Gambardella (2005) have analysed the underpinnings of the successful development of the software industries in several latecomer countries, among them India, China and Brazil. Alongside the specific developments in the individual countries, the study outlines the driving forces in the development of a software industry in a latecomer context. The capabilities emerge as an important driver underlying the success of these latecomers, as emphasised in the individual countries' chapters (see (Athreye, 2005), in particular; also (Botelho, 2005; Tschang, 2005) and the conclusions (Arora, 2005).

Despite the explicit emphasis about their importance, the analysis does not provide a framework for analysing capabilities. In the individual chapters, the analysis about the capabilities is combined with the rest of the factors affecting the industry development and it is the sources of incubation of capabilities that remain the focal points of the analysis, rather than a detailed analysis of the capabilities themselves (Athreye's chapter presents a good exception). Similar logic applies to the conclusions, which emphasise the importance of firms' capabilities but remain focussed on the sources of firms' competences (Arora, 2005). An explicit framework about the specifics of technological capabilities building in the latecomer context and a connection with the literature in the field of technological development in the latecomer context is absent.

The study by Athreye (2005) deserves attention. Although it had not provided an analytical framework nor had explored the issue systematically, it had captured the underlying idea of capabilities building. Exploring the development of the Indian software industry and the success factors contributing to its development, Athreye (2005) outlines that the evolutionary development of capabilities indeed underpins the Indian success. The study reveals that the Indian companies had entered the international markets by providing basic programming skills, but later on they have developed skills for software process control and large-scale projects management, to respond to the competitive pressure on the international outsourcing markets.

The identified skills by Athreye and their development over time reflect the skills and capabilities necessary to develop successful outsourcing software industry in a latecomer

context. But these present a limited number of capabilities and they are highly insufficient to exhaust the list of capabilities, which latecomer software companies need to develop to be able to compete on the international markets. The aim of this paper is to look at the variety of capabilities, which the latecomer software companies need to build, enabling them to develop software products and services based on indigenous efforts.

A range of paths, like developing own products and services for domestic or international markets, lay before latecomers, and outsourcing software products and services is just one path in this development. In the latter case the capabilities building would be heavily influenced by learning spillovers from multinational enterprises. Different paths may well require and call upon different capabilities, which latecomer companies need to master. For example, outsourcing will require a set of skills, which will be limited and significantly more narrow than the set of skills required for companies to produce their own products and services. This issue, however, will be explored in further research and is beyond the scope of this paper, which makes an attempt to identify the capabilities that latecomer software companies need to build in general, and this applies to the case of building capabilities with indigenous resources to produce own products and services.

A study, which had investigated the capabilities that software companies need to master, is Torrisi (1998). However, this study analyses the European software industry, and thus, it explores a software industry in developed countries context. As underlined above, development of a latecomer software industry is rather different from that in developed countries context. To develop successfully, latecomer companies need to compensate for the environment, in which they are embedded in, and to do so, they need to put deliberate efforts in developing an array of technological capabilities, starting from the basic technical capabilities.

In analysing the capabilities, which European software companies possess, Torrisi has outlined five capabilities: capabilities in mathematics, computer science, system engineering, experience with application server, and marketing (Torrisi, 1998, p. 136). However, if we are to explore in-depth the technological capabilities of latecomer software companies, this list of technological capabilities is rather limited for two of reasons. First, it does not exhaust all technical capabilities, which companies need to master to be able to produce software products and services. Torrisi seems to assume that the basic technical capabilities are sufficient to ensure competitive performance. The author of this paper believes that software companies need to master a wider array of technical capabilities and Torrisi's list is limited and does not exhaust the capabilities associated with software production neither in a latecomer context nor in advanced context. Second, if they are to become successful, the latecomer software companies in particular need to develop mastery over a wide array of organisational capabilities, which go well beyond the only one organisational capability, listed by Torrisi, the marketing capability.

The proposed approach for analysing technological capabilities suggests that software companies need to master a wide range of technical and organisational capabilities to ensure competitive performance. These holds equally for software companies in a latecomer and advanced context but the emphasis here is placed on the latecomers, as for them developing technological capabilities is particularly challenging.

The analysis below makes an attempt to identify the technological capabilities, which latecomer software companies need to develop. As underlined above, the development of the production capabilities will be the focal point of this paper, while the other capabilities will be explored in future research.

5. APPROACH FOR ANALYSING TECHNOLOGICAL CAPABILITIES IN A LATECOMER SOFTWARE INDUSTRY

To be able to produce software product or services, a latecomer company needs to develop an array of capabilities. Table 1 below summarises the capabilities constituting integral parts of the production technological capabilities, which the latecomer software companies need to develop. The subsequent section provides an overview of each of the listed capabilities and a discussion about the challenges for latecomer software companies to build them.

Capabilities for software design
Capabilities for software programming
Capabilities for network applications
Capabilities in various operating environments
Capabilities for high quality assurance
Capabilities for prompt delivery
Capabilities to develop specialised expertise in a particular domain
Capabilities to diversify the products and services offered
Capabilities for minor, moderate and major innovation

Table 1. Production technological capabilities for latecomer software companies

The first capability, which the latecomer software companies need to develop, is the capability for software design. It is associated with the phase of inception of a software development, when software companies need to design how the software will look and perform based on identified clients' needs. To develop expertise in software design the latecomer software companies need to develop understanding about system architecture design. They need to design an architecture that reflects and balances the different needs of its stakeholders; to focus on architecturally significant aspects of design, including frequently overlooked areas such as performance, resilience, and location; to use perspectives to ensure that their architecture exhibits important qualities such as performance, scalability, and security. Alongside these, the latecomers need to develop deeper understanding about design techniques, which involves building knowledge and expertise about graphics design, website design, multimedia solutions, etc. All these activities illustrate the range of capabilities and skills, associated with software design, which latecomers need to develop.

The next capability, the capability for software programming, is associated with the next phase in the production of a software product or service, which is the actual writing of the software. Knowledge about software programming languages and techniques, and platforms creates the base for actual writing of the software. However, latecomers need to develop deep

understanding about software programming. They need to build expertise about algorithms, software programming languages, etc. Building expertise in modern software programming languages requires developing understanding about Java, XML, JavaScript, HTML, CSS, XSL, XSLT, C++, C and Object-C. Further, mastering one of these languages requires developing deeper understanding about it. For example, to develop excellent programming skills the latecomers need not only to learn the syntax of the Java programming language, but also object-oriented programming with the Java programming language; creating graphical user interfaces (GUI), exceptions, file input/output (I/O), threads and networking. The capabilities for software programming embrace intrinsically expertise in system analysis. The purpose of the system analysis is to produce a list of functionality that the system should provide, which describes the functions the system should perform, business logic that processes data, what data is stored and used by the system, and how the user interface should work. To develop capabilities for system analysis the latecomers companies need to develop deep understanding about different platforms, functionality, user interface, and also good understanding of the underlying business process, which the software solution is to support.

Creating a modern software product or service requires also capabilities for networking applications. The networking applications include any kind of software solution, which operates in a network environment. A wide range of software solutions nowadays involve networking. For example, the information system in a company represents a network (i.e. intranet). Simultaneously, the companies are using software solutions operating in Internet (i.e. web-based solutions), while executing their every day operations for document sharing, coordination, communication, payment, etc. Therefore, the software company, which develops a new software solution for a client, needs to take into account the access by multiple users to the network resources such as files and to ensure security over the access. To be able to develop reliable networking applications the latecomer software companies need to build expertise in security engineering. They need to develop understanding about the network operating systems, security protocols, techniques for specifying and implementing a security policy, etc. This may present a cumbersome task for the latecomers, as network security is among the most dynamic fields, which has been rapidly developing recently.

Alongside building capabilities for software design, programming and networking, the latecomer software companies need also to build capabilities in various operating environments, to become capable of responding to various clients' needs and requirements. Although Windows operating system is the dominant computer platform, other operating systems like Linux, Unix or Mac are also used. Therefore, the latecomer software companies need to learn software design, programming and networking not only in one platform, but to build expertise in all

existing platforms and to be able to use Windows, Linux, Unix or Mac platform, depending on customers' requirements.

Applying all of the above capabilities, the latecomer companies need to deliver high quality products and services, if they are to be successful. In order to deliver high quality products and services, the latecomers need to build capabilities for software quality assurance. The major challenge in developing software products and services refers to the reliability of the software. Therefore, software quality assurance is a critical factor in developing software products and services. Developing capabilities for software quality assurance has become an extensive focus of attention among practitioners and academics, resulting in creation of quality assurance guidelines, reflected both in ISO certification scheme and Capability Maturity Model (CMM) assessment scheme. Being certified in one of these, or not, the latecomer software companies need to apply software quality assurance techniques, so to insure the quality and reliability of the software they deliver. Rigorous testing, de-bugging and defect elimination are critical steps in insuring the quality of the produced software.

The next important capability, which the latecomer software companies need to develop, is the capability for prompt delivery. Meeting deadlines is crucial, as failure to do that result in increasing costs of the project. Delivery on time is extremely important on lead international markets, whereas in some latecomer countries clients might be more lenient toward delays. This by it self, creates a challenge for latecomer companies to execute projects meeting strictly the deadlines. To be able to do that, they need to develop abilities and skills for project management, tracking the work progress throughout the project, clarifying project requirements at the very beginning, effective communication between parties throughout the project, etc.

If the latecomer companies are to climb the technological ladder, they need to be also capable of developing specialised expertise in a particular domain. A challenge, which the latecomers face in software development, and especially if they are to develop their own products or services, is associated with the depth of understanding they have about the domain, for which the software is created. Developing a deep understanding and expertise about frontier technologies is particularly challenging for latecomer companies as they are embedded in a latecomer context, as mentioned above, and therefore, developing expertise by focussing on a particular domain appears to be a more realistic strategy for the latecomer companies to secure their attempts for technological upgrading.

For instance, good knowledge and understanding of finance and banking system is required, if a software company is to create finance or banking software solution. The task becomes even more cumbersome, if a latecomer company is willing to develop finance or banking solution for international markets, where the operations are far more complex and sophisticated; and

therefore, the latecomer company needs to put deliberate efforts to develop deeper understanding about its specifics. A second example is the development of an ERP system. To be able to build an ERP system, a latecomer software company needs to develop an understanding about the structure of the ERP systems. Once the latecomer company had developed an expertise in the ERP domain, it needs to augment it with knowledge and understanding about the corporate practices in the particular market and particular industry, for which it is to be developed.

The capability to diversify their products and services is perhaps the most difficult to achieve by the latecomer software companies. The software companies are specialised suppliers according to Pavitt's (1984) taxonomy, i.e. companies providing specialised products. Being specialised suppliers do not preclude diversification. Companies can diversify their products and services within their specialised niche. Diversifying the range of products and services, which a company offers, creates an opportunity for companies in lead economies to reap greater benefit of their knowledge base. The same holds for the prospects of latecomer companies to reap greater benefits by diversifying the range of their products and services, but, at the same time, it remains much harder for latecomer companies to succeed in diversification, due to the limited access to frontier technological knowledge they have, being embedded in a latecomer environment.

Once the latecomer companies have developed expertise in a particular domain, they may decide to broaden the range of products and services they offer, based on the experience and knowledge they have, or market opportunities they perceive. The degree of diversification may vary. Diversifying by introducing new products or services, which require the latecomer company to enter a new domain, which is completely separate from the domain, in which the company has accumulated expertise so far, is associated with high risk for any company, especially latecomers. Diversifying by introducing new products or services, which are close to the existing range, and respectively, to the already accumulated expertise in a particular field, is far less risky endeavor for companies, especially when they are latecomers. For example, developing a modular web-based platform for automated billing, invoicing and customer management for the one spectrum of services, for example Voice-over-IP involves lower technological efforts and leads to lower degree of diversification in a company, which have developed to that moment a modular web-based platform for automated billing, invoicing and customer managements for the whole spectrum of services, like Voice over Broadband, Internet, triple play, WiMAX and regular voice communication services. Introducing the same development will require significantly higher technological efforts and will result in a higher degree of diversification in a company, which has just decided to enter the field of automated billing. Diversification is a pretty difficult task for latecomers, given that they need to maintain

the depth of expertise in a particular domain and at the same time to broaden the range of the products and services within that domain, or to broaden the expertise in different domains.

Last but the most important capabilities in the set are the capabilities for minor, moderate or major innovation. The extent to which a latecomer company has been able to accumulate a variety of skills and abilities to master new technologies reflects on its innovative capabilities. As underlined above, innovativeness is an intrinsic characteristic of the software production and yet the degree of innovativeness may vary. This point is particularly important in studying the latecomer software industry, as it calls the research to disentangle the software innovation process and to classify the software production in terms of its degree of innovativeness. So far this has not been done about the software production in latecomer context and the following analysis attempts to address this point.

The innovative component is inherent to the very nature of software production, as outlined by Torrisi (1998). However, different types of software production activities involve different level of innovative efforts and respectively, result in software products and services with different degree of innovativeness inbuilt in them.

Software services like re-coding legacy applications into more modern computer languages, data migration, or resolving specific incompatibilities between similar systems, etc, bear small innovative component. On the other hand, producing software customised services and software packages usually involve higher degree of innovativeness. For example, to successfully launch an ERP or CRM system, or e-commerce solution, a latecomer software company needs to deploy sophisticated knowledge and expertise, and to offer a solution, which is comparable to the frontier technological developments in that particular domain. Therefore, it is meaningful to distinguish between capabilities for minor, moderate and major innovation, when studying the degree of innovative efforts associated with producing particular software products or services.

The proportion of activities like re-coding, data migration, resolving incompatibility, etc. can be expected to account for a significant share in the software services offered by latecomer companies. On the other hand, the presence of major innovative activities, like creation of packages or customised services, despite their small share in the latecomer software developments, notifies the existence of potentially significant innovative capabilities in the latecomers. This makes it important to analyse the type of software activities, which the latecomer companies offer, and the type of innovative capabilities (i.e. degree of innovativeness) they involve.

It holds for all above mentioned capabilities that qualitative assessment needs to be undertaken to provide a comprehensive picture about the technological capabilities, which the latecomer software companies have been able to develop, but for the innovative capabilities it is

particularly the case, as it is virtually impossible the analysis of the innovative capabilities to be based on quantitative assessment. For this reason, the quantitative assessment of the capabilities will leave aside the analysis of innovative capabilities, as well as the analysis of capabilities for networking applications and capabilities in different environments.

In the following section we apply the above classification of the production technological capabilities by undertaking quantitative analysis of the capabilities, which the companies in the indigenous software industry in Bulgaria have been able to develop. The analysis is based on a survey and the capabilities are explored on a five-point scale, where 1 stands for poor, 2 for modest, 3 for good, 4 for very good, and 5 for excellent.

6. TECHNOLOGICAL CAPABILITIES IN THE INDIGENOUS SOFTWARE INDUSTRY IN BULGARIA

6.1. Overview of the development of the Bulgarian software industry and the conducted survey

The Bulgarian software industry reveals a clear 'bifurcation' pattern with respect to its export intensity: the predominant part of the companies (around 80%) operates only on the domestic market, while the rest of the companies work predominantly on the international markets, and very few companies position in the middle of the scale. Furthermore, most of the companies that are involved actively in exporting had entered the international markets straight from the very beginning, without serving the domestic market beforehand, as previous studies based on a survey and interviews revealed (Rousseva, 2001; 2003; 2005).

On the domestic market the indigenous software companies provide the whole range of software activities, like system integration, computer system software, networking software and web-design, CAD/CAM/CAE software, intermediate telecommunications and wireless development software, application software, firmware. On the international markets the Bulgarian companies appear to have developed far more narrow range of software activities: some companies are outsourcing and few companies succeeded to enter the international arena by offering their own products and customised services.

The analysis of the technological capabilities in the indigenous Bulgarian software industry is based on a survey conducted in the period September-November 2004 among 38 leading indigenous software companies. Out of them 78% operate only on the domestic market. The rest 22% of the companies have 50% and above export intensity (i.e. sales abroad account to 50% and above of the total turnover). The group of exporters comprises a diverse set of companies. The biggest group, representing 16% of the whole sample are companies having 90% and above export intensity. The rest of the exporters are single or few companies to position in the scale between 50-89% export intensity.

The analysis below will be directed at comparing and contrasting between the performance of the domestic-oriented vs. the export-driven companies. The analysis is undertaken in a comparative manner, but the percentages reported refer to the share in the sample as a whole, not within the sub-groups. All companies included in the sample are companies considering

themselves to offer new products or services[2], and thus the database is a fruitful base for comparing 'domestic' vs. 'export' technological capabilities.

6.2 Analysis of the individual technological capabilities accumulated in domestic-oriented vs. export-driven companies

In this section, the analysis is directed at exploring the difference in the individual capabilities of the domestic-oriented vs. the export-driven companies. Capabilities, like software programming, software design, quality of products and services, prompt delivery, specialised expertise in a particular domain, and diversified expertise are assessed with respect to their deployment on the domestic and the international markets.

The analysis begins by focussing on the basic technical capabilities, like the capabilities for software design and software programming.

Most of the surveyed companies feel confident that their capabilities for software design meet adequately the requirements of the local market, as the mean of 4.86 reveals. All exporters consider that they have excellent capabilities for software design for the needs of the domestic market. The predominant part of the domestic-oriented companies, representing 64% of the companies in the sample, shares the same opinion. While the rest of domestic-oriented companies, comprising 14% of the sample, assess their software design capabilities as very good as compared to the needs of the domestic market.

The difference in the technological capabilities of the domestic-oriented vs. the export-driven companies becomes more obvious when assessing the extent to which the capabilities for software design allow the companies to compete on the international markets. The mean of 3.07 and the mode of 3 reveal that the prevailing number of companies considers their capabilities for software design as average as compared to the requirements of the international markets. Moreover, this is the only variable within the set of the narrow technical capabilities, which appears with a mode lower than 5. Only 21.6% of the companies assess their capabilities for software design as excellent and adequate to respond to challenges on the international markets. These are all exporters, while among the domestic-oriented companies only two companies reveal the same confidence. Among the exporters the confidence in the excellence in their own capabilities prevails, and only two companies find their capabilities as good rather then excellent. The latter are again companies having 90% export intensity, and this group remains modest in the assessment of their own performance. Apparently this sub-group of exporters faces difficulties in building technological capabilities and despite being actively involved in the

[2] To be able to analyse technological capabilities of latecomer software companies operating only on domestic market, it is important to distinguish between companies offering innovative

international markets, still remains unsure that it is capable to perform as its foreign competitors do. This sub-group of exporters presents a special case of among exporters and we will devote special attention to it later on in the analysis.

The overall assessment of the software design capabilities of the domestic-oriented companies is far less optimistic than the one for the exporters. Apart from the two companies, which assess their capabilities as excellent, the rest of the domestic-oriented companies are far less confident and consider that their capabilities for software design are average and below the average, when compared to the performance requirements on the international markets. Nearly 30% of the domestic-oriented companies find that their capabilities for software design are average, when compared to the needs of the international markets. Another 29.7% find their capabilities as modest, while 13.5% of the companies access their capabilities as poor.

Further, the assessment of the capabilities for software design on the international markets for the sub-group of the domestic-oriented companies drops down to a mean of 2.4 and a mode of 3, which when compared to the mean of 4.75 and mode of 5 for the exporters, provides compelling evidence about the divergence in the capabilities for software design between the exporters and the domestic-oriented companies.

Next we focus on the capabilities for software programming. All companies are confident that they possess capabilities for software programming, which adequately meet the needs on the local market (the mean is 4.92). Only 5.4% of the companies consider their capabilities as very good, and these are domestic-oriented companies, while all the rest of the companies, both domestic-oriented and exporters consider their capabilities for software programming as excellent. Similarly to the previous results, most of all Bulgarian software companies feel confident that their capabilities reflect adequately the requirements on domestic market. Nevertheless, the percentage of companies, which are more confident, is slightly higher, when assessing the capabilities for software programming rather then capabilities for software design.

However, companies' assessment of whether their software programming capabilities are adequate to the requirements of the international markets appears less favourable. Although the mode remains 5, the mean of 3.25 reveals that a large number of companies possess limited capabilities for software programming to match the needs of the international markets. Only 22.2% of the companies in the sample consider their capabilities for software programming as excellent for executing international projects. All exporters but one believe that their capabilities for software programming match perfectly the requirements on the international markets. Among the domestic-oriented companies there is a single company, which considers itself of

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solutions for the domestic market and to separate them from 'garage'-type software services, which may be flourishing in latecomers.

possessing excellent capabilities for software programming on international projects, and the rest of the companies position down the scale: 13.9% very good, 27.8% good, and two groups of equal size of 16.7% modest and poor, respectively. Overall, 64% of the companies evaluate their capabilities for software programming as average and below the average as compared to the requirements of the international markets, and these are all domestic-oriented companies, except one. The domestic-oriented companies appear to possess significantly lower capabilities for software programming as compared to the requirements on the international markets, which is also indicated by the mean of 2.6 for this sub-group. These results suggest that a substantial part of the domestic-oriented companies fail to develop capabilities for software programming, respective to the frontier technological development and at this point the gap between the technological capabilities of domestic-oriented companies vs. the exporters begins to unravel.

The results provide us with a clear picture of an indigenous software industry, in which a limited number of companies possess capabilities for software design, which allow them to compete on international markets, while the predominant part of the companies (above 70 percent) possess average and below average capabilities for software design, which prohibit them from entering the international markets. As this reflects the capabilities of the Bulgarian companies in one of the basic software engineering skills, it raises grounds for serious concerns about the potential, which the domestic-oriented companies have to enter the international markets, as it reveals that the Bulgarian companies face limitations even in the basic technical skills. Most of the Bulgarian companies appear to have limited technical capabilities for competing on the international markets, and the capabilities for software design appear to be more problematic than the capabilities for software programming. These results also confirm the existence of a difference in the capabilities for software programming between exporters and domestic-oriented companies, which we also see with respect to the capabilities for software design.

The results also raise an interesting point. There has been a wide held belief that due to the very good education in mathematics and sciences the East European computer engineers possess excellent software programming skills. This belief was confronted by studies about development of the software industry in CEE, which called for reconsideration of the myth about strong capabilities for software programming, which CEE programmers have (Dyker, 1996; Katkalo, 1993). The results of our survey show that a significant number of companies (around 64 percent) consider themselves of having average and below the average skills in software programming, when compared to the international standards. These results evoke concerns about the level of education in computer engineering in Bulgaria and the extent to which it provides knowledge about the latest technological developments, and corroborate with the results of previous studies (Rousseva, 2001; 2003; 2005).

The level of expertise in software engineering and design reflects upon the quality of the products and services, designed by the companies. Next we assess the confidence, which companies have in the quality of products and services they offer. Most of the Bulgarian software companies are certain about the quality of the products and services, which they offer on the domestic market, which reflects in the mean of 4.70. The predominant number of the companies feel confident in the excellence of the products they offer, except few domestic-oriented companies, representing 19.4% of the sample, and only two exporters, comprising 5.6% of the whole, which assess the quality of their products and services as very good. The latter group of exporters are companies having 90% of export intensity, which continues to reveal lower level of performance than the rest of the exporters.

Companies' assessment about the quality of the products and services they offer on the international markets reveals greater heterogeneity. Although the mode remains 5, the mean drops down to 3.44. All export-driven companies, but one, are confident in the excellence of the quality of their products and services. While the answers of the domestic-oriented companies spread into in all categories, from poor to excellent quality. Of interest, 19.4% of the companies find that they have a potential to offer products and services on the international market with an excellent quality, and yet these are companies, which operate only on the domestic market.

The question, which arises, is whether these companies overstated the confidence in their products and services. We need to bear in mind that the assessment is based on respondents' subjective assessment and this may have an impact on the results. Respondents may speculate and provide results which put them in a more favourable position than the real situation, or they may provide answers, which reflect their subjective perception about the situation. Apparently, this holds for this part of the assessment, which can be considered as overrated. This group of companies may assume that it is capable of producing high quality products and services for the international markets. However, as these companies do not actually work on international markets, this assessment is more likely to reflect their perception rather then the reality.

Companies assess themselves that they do not possess excellence in software programming and design capabilities to compete on the international markets, and therefore it is very unlikely that they have the potential to offer high-quality products and services on the international markets. Otherwise, being capable of offering high-quality products and services on international markets and bidding on their low labour costs advantage, these Bulgarian companies must have at least some level of export intensity. A more realistic treatment of these results would be to say that 19.4% of the companies in the sample, which are companies operating only on the domestic market, hold high esteem about the products and services they offer and perceive their quality to be comparable to similar products on the international markets. Another 19.4% of the companies share completely the opposite view, assessing the quality of their products as poor

compared to the international markets' standards. The rest 33% of the companies position in the middle of the scale.

These results reveal that domestic-oriented companies form three distinct groups, somehow polarised in their assessment about their ability to generate products and services with a quality respective to the quality standards on the international markets. While some of the companies are highly confident, another group of equal number of companies is far negative and a third group position in the middle. The predominant part of the domestic-oriented companies, representing 55.6% of the companies, consider that the quality of the products and services they can offer on international markets is average and below the average. Correcting the answers by downgrading the potentially unrealistic high answers will add up extra numbers. These results are another indication about the extent to which the domestic-oriented companies have been successful in building technological capabilities. The interesting point they reveal is that a significant part of the domestic-oriented companies are aware of the moderate quality of their products and services and the limitations of their own capabilities.

Prompt delivery is the next capability to be investigated. The predominant part of the companies delivers on time on the domestic market (a mean of 4.53). The exporters appear to perform better than the domestic-oriented companies. 75% of the exporters, representing 15.6% of the companies in the sample, point out that meeting deadlines is an integral part of their excellence, while 25% of the exporters outline that the promptness of delivery on the domestic market is very good rather then excellent. 75% of the domestic-oriented companies, representing 58.3% of the sample, also reveal excellence in the delivery on time on the domestic market, but the rest of them, representing 11.1% of the sample, are failing to deliver on time and consider that they have modest capabilities for prompt delivery on the domestic market.

With respect to the promptness of delivery on the international markets companies diverge completely. All exporters but one reveal excellence in prompt delivery on the international markets. Interestingly enough, some of the exporters allow themselves to be more lenient in meeting deadlines while working on projects for the domestic market, while they appear to be very prompt on the international markets. This is an interesting fact by itself and it has its cultural grounds, as tolerance towards small delays is still an inherent part of the Bulgarian business culture. The difference in business cultures, and particularly the detrimental effect of lenient towards delays Bulgarian culture, becomes more apparent, when analysing the extent to which the domestic-oriented companies manage (or would be able to manage) to meet the deadlines in international projects. 40% of domestic-oriented companies, comprising 31.4% of the whole sample, consider themselves as having excellence in meeting deadlines in international projects, while two equal-size groups of domestic-oriented companies, each representing 17% of the whole sample, cluster around the two ends of the scale, having

respectively very good and poor delivery on the international markets, and a limited number of companies position in the middle of the scale.

These results are provoking, as companies currently operating only on the domestic market provide answers about their performance on the international markets. The grounds for these are twofold. Some domestic-oriented companies had already made attempts to enter the international markets, which obviously were with no success, but on these grounds they are able to provide an assessment of their capabilities to perform on the international markets. Second, as discussed above, these results reflect companies' subjective perception, and this may differ to an extent from the real situation. Further, the lowest score for domestic market is 2, while for international is 1. In other words, some of the domestic-oriented companies have outlined that they do not have the capabilities for prompt delivery both in domestic and international projects, with their skills for meeting the deadlines in international projects being considerably lower than in domestic projects.

This raises serious concerns. It brings back the point about the prevailing business culture in Bulgaria. Apparently, those companies, which had adopted a more lenient approach towards meeting deadlines in the domestic projects, subsequently find it extremely difficult to cope with requirements in the international projects. Transition from domestic to export orientation appears to be a cumbersome task, with project management skills emerging as one of the hurdles on the way. This comes to suggest that even building capabilities for prompt delivery appears to be a problem and the latecomer companies need to tackle it.

Next we look at how companies develop their knowledge base. Companies are asked to assess their specialised expertise in a particular domain on the domestic and international markets, and the diversification of their expertise.

Bulgarian companies reveal confidence that they possess specialised knowledge and expertise about the local market, which is reflected by the mean of 4.41. 63.9% of the companies consider their knowledge as excellent, and the rest of the companies are equally distributed among answers very good and good. All exporters except two claim that they possess specialised expertise in a particular domain on the local market. The other two, however, present an interesting case. One of the companies considers itself as having very good expertise, but the other one claims that it possesses poor specialised expertise in a particular domain on the local market. This represents the only company having no specialised expertise in a particular domain on the local market within the whole sample. The reason for this perhaps lay in the fact that this company has 90% export intensity and it does not put special efforts in developing specialised expertise for the local market.

The domestic-oriented companies also appear to have developed specialised expertise about a particular domain on domestic markets. 47.2% of them consider themselves as having excellent specialised expertise about a particular domain on the domestic market, 13.9% very good and 16.7% good respectively. Overall, most of the companies had developed specialised expertise about a particular domain on the domestic market. When compared to the rest of the variables in the set, there are very few answers in the lower end of the scale. Apparently companies perceive it mandatory to develop specialised expertise for a particular domain for to be able to compete.

The situation seems rather different when companies evaluate their specialised expertise in a particular domain on the international markets. Although the mode remains 5, the mean drops down to 3.44. Interestingly enough, the mean, which the indigenous software industry attains, for having specialised expertise in a particular domain on international markets, is higher than the mean, which the industry obtains for its capabilities for software programming and software design on international markets. This again, raises concerns about the basic technical capabilities, which the indigenous software companies possess.

Coming back to the results about the expertise in a particular domain on the international markets, the analysis confirms the previous patterns. All exporters have managed to develop specialised expertise about a particular domain on international markets, whereas the domestic-oriented companies reveal greater divergence. 16.2% of the companies, which operate on the domestic market, outline that they possess specialised expertise about a particular domain on the international markets. The rest of the companies but one are clustered around the average and below average points of the scale. 16.2% of the companies consider themselves of having poor specialised expertise for a particular domain on the international markets, the rest of companies form two groups of 21.6% each by assessing their expertise as good and modest. Further, all exporters come up with a mean of 5, while the domestic-oriented companies attain a mean of 2.8, which again reflects the difference in the specialised expertise in a particular domain in the international markets, which the companies of these two major groups have been able to develop.

The number of companies having specialised expertise in a particular domain in the domestic market is 80%, which is considerably greater than the number of companies having specialised expertise in a particular domain in the international markets, which account to 50%. Perhaps the latter number needs correction downwards, as 16% of the companies consider themselves to have specialised expertise in a particular domain in the international markets but these are companies operating only on the domestic market and therefore, it is not realistic that they have adequate expertise to deploy on the international markets. Further, the number of companies, which have not been able to accumulate specialised expertise in a particular domain, is greater for the international markets than for the domestic one (nearly 40% of the indigenous companies

consider themselves as having below the average specialised expertise for a particular domain in the international markets). All these follow the domestically oriented profile of the industry, and suggest that a transition from the domestic to the international markets will be a challenging and perhaps impossible task for the majority of the companies. Nevertheless, it is worth noting that 50% of the Bulgarian software companies claim that they possess specialised expertise in a particular domain in the international markets. Perhaps this figure needs to be treated with caution, as mentioned above, and yet, when compared with the actual export intensity figures, this suggests that about 30% of the companies indicate that they have competences, which they were not able to utilise to the moment.

Finally, we focus on the extent to which the companies have been able to diversify the products and services, which they offer on the domestic and international markets. This appears to be the least developed capability among all, as both means are the lowest within the set. Companies diversify their products and services in the domestic market to a great deal, as the mean of 4.11 reveals, whereas they have not been successful in diversifying their products and services in the international markets, as the mean of 2.64 suggests. 49% of the companies in the sample reveal excellent diversification of their products and services in the domestic market, another 30% - very good and 14% - good diversification. Only 8% of the companies appear to have poor diversification of their products and services in the domestic market.

Unlike the previous variables, this one does not suggest a strong distinction between the performance of the domestic-oriented vs. the exporters. The exporters occupy the two ends of the scale - 70% of them perform a high level of diversification in the domestic market, while the rest reveal poor diversification. Parallel to this, there is no clear relation between the export intensity and the level of diversification. Nevertheless, a pattern emerges among the exporters. Exporters seem to reveal similar levels of diversification in the domestic and international markets, i.e. if an exporter has diversified its products and services in the international markets, it applies the same level of diversification of its products and services also in the domestic market. Respectively, low level of diversification in the international markets is coupled with low level of diversification in the domestic market.

Whereas the domestic-oriented companies reveal better diversification in the domestic market than in the international markets. 41.7% reveal excellent diversification in the domestic market, 22.2% very good and the rest 13.9% good diversification. The diversification in the international market differs completely. Only 2.7% outline that they have diversified products and services in the international markets, while 32.4% have good, 24.3% modest and 16.2% poor diversification. These results suggest that companies do attempt to diversify. But they achieve good diversification only in markets on which they have the capacity to compete, i.e. they have respective capabilities for software programming and software engineering, to

develop specialised expertise in a particular domain, ability to deliver on time, etc. Second, we again face the problem of having answers about performance on the international markets by companies, which operate only on the domestic market. In this case, we need to consider the answers as reflecting potentials. Some Bulgarian companies have made attempts of entering the international markets and these results may be considered to reflect the strategy of entering the international markets. Overall, the results reveal that Bulgarian companies have limited, if any, ability to diversify products and services, which they eventually would offer on the international markets.

A final point in the analysis of the individual capabilities of the exporters vs. the domestic-oriented companies is to be raised with respect to the group of exporters. All the exporters reveal excellence in their performance in all the above studied technological capabilities, with a mean of 5. There is only one sub-group of exporters, the companies with 90% export intensity, which reveal lower level of performance, with a mean ranging from 3.7 for capabilities in software programming, mean of 4.3 for capabilities in software design, mean of 4.7 for abilities to produce high quality products and services, and mean of 4.7 for capabilities for prompt delivery. The performance of this sub-group affects the assessment of the overall performance of the exporters, and therefore, it should be noted that the low performance is due to only that group and is not spread among all the exporters. At this point we are not in a position to outline the reasons for the lower performance of that particular group, and further investigation of the possible reasons on the basis of case studies is to be undertaken.

6.3 Concluding remarks about the individual technological capabilities

The analysis of the individual technological capabilities reveals that Bulgarian software companies appear confident in all of the outlined abilities, when deployed on the domestic market. Nevertheless, not all companies reveal the same levels of accumulation of capabilities, as the standard deviation reveals (table 1 in the Appendix). For some capabilities the companies reveal similar levels of accumulation, like the capabilities for software design and software programming. However, in the rest of the capabilities in the set companies' performance deviates significantly. Standard deviation of (.520) emerges in the capabilities for producing high quality products and services, followed by high levels of deviation of (.971) and (.956) in the capabilities for prompt delivery and building expertise in a specialised domain respectively, and the highest deviation appears in the capabilities to diversify products and services (standard deviation of (1.173).

Even greater deviation occurs with respect to companies' abilities to perform on the international markets (table 1 in the Appendix). Companies appear to deviate significantly in

their capabilities to perform on international markets and this hold for all capabilities (all standard deviation coefficients range from (1.257) to (1.532).

If we are to summarise the results of the analysis a clear distinction emerges between companies' abilities to perform on the domestic and the international markets. Both the domestic-oriented companies and the exporters have managed to build capabilities for the domestic market, and they appear confident in the whole array of skills and capabilities, including the skills for software engineering, project management and expertise about the local market. Nevertheless, despite the strong performance of both groups on the domestic market, a slight distinction between the capabilities of the domestic-oriented companies and the exporters emerges, as the domestic-oriented companies reveal slightly lower coefficients for all capabilities than the exporters.

This difference becomes far more noticeable when we compare the capabilities of the domestic-oriented companies vs. the exporters to compete on the international markets. While all exporters reveal strong capabilities and expertise to perform on the international markets, the domestic-oriented companies appear far less successful in developing the necessary skills, expertise and capabilities to execute international projects. Thus, for example, when comparing the capabilities of the Bulgarian companies for software engineering and specialised expertise on the international markets, the exporters come up with coefficients, which are nearly twice higher the coefficients, which the domestic-oriented companies get. Further, for these capabilities the domestic-oriented companies position below the middle point of the evaluation scale, i.e. by obtaining means below 3.

An interesting point emerges, when we compare the overall patterns of technological capabilities building of the exporters vs. the domestic-oriented companies. Both groups of companies are aiming to develop excellent capabilities for software engineering, good quality and prompt delivery, and specialised expertise in a particular domain in the market they serve. Developing excellence in all these capabilities for the market they serve appears to be a common pattern within these two groups of companies. However, the degree of diversification of the products and services, which the companies offer, seems to depend on the type of the market, in which the companies operate. In comparison with the exporters, the domestic-oriented companies appear to have greater diversification in their products and services.

This fact is most likely to be based on the following two pieces of evidence. First, the customers on the domestic market require products and services with lower technological sophistication than the international markets. This allows the companies to offer greater variety of products and services. Second, Bulgarian software companies are small and with little experience, and they have limited resources to deploy. To be able to enter the international markets, they attempt

to build highly specialised expertise about a particular domain rather than to diversify. This appears to be the pattern, which most of the exporters are following. Therefore, depending on their export intensity, the Bulgarian companies reveal different patterns of technological capabilities building and developing a knowledge base.

Overall, the results of the analysis of the development of the individual technological capabilities of the domestic-oriented vs. the exporter-driven companies reveal sharp inter-group differences in the level of accumulated capabilities and the abilities to compete on the domestic and the international markets.

These results have been also supported by the results of the ANOVA test, comparing the accumulation of capabilities in domestic-oriented companies vs. exporters. The ANOVA analysis confirms that significant differences exist between the exporters and the domestic-oriented companies with respect to their capabilities for software programming for the international markets (coefficient (.000), capabilities for software design for the international markets (coefficient (.000), abilities to offer high quality products and services on the international markets (coefficient (.001), and also with respect to the capability to develop specialised expertise in a particular domain in the international markets (coefficient (.000) (table 3).

These results are also confirmed by the correlation analysis of the export intensity and the technological capabilities of the companies (table 4). The correlation analysis reveals that the exporters possess significantly higher capabilities for the international markets than the domestic-oriented companies. The difference holds for all capabilities, respectively capabilities for software design (.608), software programming (.640), high quality (.539) and specialised expertise in a particular domain (.584) (the correlation coefficients for all these are significant at .01 level), and abilities for prompt delivery (.404) (the only correlation coefficient, which is only significant at .05 level).

Significant differences between the capabilities of domestic-oriented vs. exporters appear in the whole array of skills and abilities necessary to compete on the international markets and higher level of accumulation appears in all technological capabilities in the group of the exporters. In this sense, the bifurcation pattern, which the industry performs in its export intensity, is underpinned by a bifurcation pattern in its technological capabilities. This also suggests that building technological capabilities to compete on the international markets involve greater technological efforts in all aspects and all levels of technological capabilities. A fact, which notifies that the domestic market requires less-sophisticated technological efforts to compete, and thus, offers very limited opportunities for the domestic-oriented companies to accumulate capabilities, which subsequently they will be able to deploy on the international markets.

These results contest the ‘walking on two legs’ proposition, suggesting that the latecomer software companies need to pay more attention to the domestic opportunities because of their high returns in terms of gaining experience and innovation in software production and providing training opportunities that allow a broadening of software exports (Schware, 1992). The case of Bulgaria, and most of the latecomer countries, shows that technological development in the domestic market does offer learning opportunities for software production and yet they remain far away from the frontier developments and do not enable the latecomer software companies to enter the international arena.

On the grounds of this evidence, it appears that a dualistic pattern of capabilities emerges. Most of the companies operating on the domestic market seem to have managed to build technological capabilities for the domestic market, but not for the international markets. On the other hand, all exporters seem to possess technological capabilities enabling them to compete on the international markets and also on the domestic market. Thus, two separate sets of technological capabilities emerge: ‘domestic’ technological capabilities and ‘export’ technological capabilities.

The ‘domestic’ technological capabilities represent the capabilities necessary for a company to compete and innovate on the domestic market. As the domestic market requires products and services with lower technological sophistication, the innovations, which the domestic-oriented companies introduce can be considered as new only to the domestic market, not necessarily to the world markets. Therefore, the ‘domestic’ technological capabilities can be seen as half-way built technological capabilities, when compared to the technological capabilities, which the latecomer companies need to perform in order to compete on the international markets. Apparently, the domestic-oriented companies are still half-way through ‘climbing up’ the technological ladder.

Very few studies have been exploring the differences between the technological capabilities of companies, which have managed to build technological capabilities enabling them to compete on the international markets and the technological capabilities of companies, which are half-way through that process. In this sense, it is appealing to explore whether any other differences emerge between the ‘domestic’ technological capabilities and the ‘export’ technological capabilities, apart from the differences in the level of accumulated constituent capabilities enabling the companies to compete on the international markets. The investigation about the differences between the ‘domestic’ technological capabilities and the ‘export’ technological capabilities continues in the following section, looking at the level of coherence of the capabilities.

7. COHERENCE OF TECHNOLOGICAL CAPABILITIES

7.1. Methodological note on exploring the coherence of technological capabilities

In this section the analysis will focus on the level of coherence of technological capabilities, which the companies perform on the domestic and the international markets. As underlined above, the exporters reveal significantly higher technological capabilities to compete on the international markets than the domestic-oriented companies (as confirmed by the ANOVA test and the correlation analysis).

This section takes the analysis one step further in exploring the differences in the technological capabilities, which companies perform on the domestic market vs. the international markets. This analysis does not discriminate between the technological capabilities of the domestic-oriented vs. the export-driven companies, although the exporters are responsible for the capabilities performed on the international markets, whereas the capabilities on the domestic market are entertained both by domestic-oriented and export-driven companies.

Instead of distinguishing between the capabilities of the domestic-oriented and the export-driven companies, the analysis in this section investigates the difference between the technological capabilities, which the Bulgarian companies perform on the domestic vs. the international markets, to explore the coherence among the 'domestic' and 'export' technological capabilities.

The analysis investigates the correlation between all capabilities, explored in the analysis so far, and compares the fit amongst them with respect to the market on which they are deployed. For example, the study looks at the fit between the capabilities for software programming and the capabilities for software design, which companies produce to compete on the domestic market, and compares them with the fit between the capabilities for software programming and the capabilities for software design, which companies produce to compete on the international markets.

Taking into account the fit among the pairs of the individual capabilities, the analysis draws conclusions about the level of coherence among the capabilities performed on the domestic and international markets. Based on that, conclusions are derived about the level of coherence of the technological capabilities, which the companies perform on the domestic market (to what the analysis refers as 'domestic' technological capabilities) vs. the level of coherence of the technological capabilities, which the companies perform on the international markets (to what the analysis refers as 'export' technological capabilities).

The analysis below explores pair wise the fit between the capabilities, performed on the domestic market and then compares with fit between the same types of capabilities but performed on the international markets, and subsequently draws conclusions about the level of coherence among the 'domestic' vs. the 'export' technological capabilities. The results are based on Spearman correlation analysis, provided in table 3 in Appendix. The higher the correlation among the capabilities, the higher the fit amongst them, and respectively the higher the coherence in the aggregated technological capabilities performed on the domestic and the export markets. The correlation coefficients have been corroborated with the results of partial correlation controlling for size, export intensity, etc. and the latter show that the correlation coefficients remain largely unaltered, i.e. different levels of coherence emerge indeed.

7.2 Degree of coherence of 'domestic' vs. 'export' technological capabilities

The analysis of the level of coherence among capabilities is divided in two parts. The first section presents the capabilities, which reveal high level of coherence pair wise, while the second section looks at the capabilities with lower degree of coherence pair wise.

7.2.1 Technological capabilities with high degree of coherence

The highest degree of coherence within the set of capabilities pair wise appears between the capabilities to maintain specialised knowledge in a particular domain and the capabilities to produce high quality products and services. Companies that have been able to develop specialised expertise in a particular domain in the international markets appear to have been able to produce high quality products and services in the international markets, and the fit between the two appear to be extremely high (coefficient (.909). A comparable strong fit, although slightly lower, occurs between the capabilities to maintain specialised expertise in a particular domain in the domestic market and the ability to produce high quality products and services in the domestic market (coefficient (.740). Companies' ability to produce high quality products and services is coupled in a tight fit with their capabilities for software programming and the capabilities for prompt delivery, but it's extremely tight fit with the capabilities to maintain specialised expertise in a particular domain confirms that learning and accumulating expertise pays off utmost.

Strong alignment occurs between companies' abilities to maintain specialised expertise in a particular domain and the skills to deliver on time. Prompt delivery is a capability, which has been less deployed on the domestic market, as the analysis above revealed. It appears, however, that companies that have developed specialised expertise in a particular domain on the domestic market possess also strong skills for prompt delivery on the domestic market (coefficient (.679).

Moreover, the fit between these capabilities when performed on the domestic market is comparable to the fit between them, when deployed on the international markets (coefficient (.756). In other words, companies having specialised expertise in a particular domain appear to have developed strong skills for prompt delivery, and this hold equally for the domestic and international markets. This case represents the smallest distance between the fit of the 'export' vs. the 'domestic' technological capabilities.

Exploring the coherence between the capabilities for software programming and software design, it appears that the fit between them when performed on the international markets is extremely strong (correlation coefficient .842). Although the fit between the capabilities for software programming and software design performed on the domestic market is also significant at .01 level, with the correlation coefficient (.604), the coefficient, or the fit between these two capabilities, when deployed on the international markets is 1.4 times higher than the fit on the domestic market.

Similar parallelism emerges with respect to the fit between the capabilities for software programming and capabilities for producing high-quality products and services, which companies perform on the domestic and the international markets. Despite the high significance of the coefficients, the fit for the international markets (coefficient (.843) is 1.6 times higher the fit for the domestic market (coefficient (.528).

Comparable correspondence emerges between the fit among the capabilities for software programming and the skills for prompt delivery, which companies execute on the domestic and international markets. Notwithstanding the high significance of both coefficients, the fit between the capabilities, which companies achieve so to compete on the international markets (correlation coefficient (.844) is 1.7 times higher the fit, which companies achieve, when competing on the domestic market (coefficient (.493).

Similarly, capabilities for prompt delivery appear to be strongly coupled with the capabilities for producing high quality products and services. A strong fit between them occurs, when performed on the domestic and the international markets, and yet the fit on the international markets (coefficient (.817) is 1.7 times higher than the fit on the domestic market (coefficient (.468).

7.2.2 Technological capabilities with low level of coherence

The differences in the fit of the domestic vs. the export technological capabilities begin to emerge, when comparing the following pair of capabilities. The fit between the capabilities for software design and the capabilities to master specialised expertise in a particular domain, which companies perform on the domestic market, is with a correlation coefficient (.394).

Despite being significant at .05 level, this fit is 2 times lower then the fit, which companies perform between the capabilities for software design and the capabilities to master specialised expertise in a particular domain, when competing on the international markets (correlation coefficient (.796). The fit between these capabilities on the domestic market is less tight than the fit on the international markets. Apparently, when operating on the international markets, the companies find it mandatory to develop excellence in both capabilities and to align them to a great extent, while for companies operating on the domestic market this is less the case.

Overall, in all cases above a clear fit occurs among the capabilities, which companies achieve on the international and the domestic market, although the fit of the capabilities on the domestic market appears to be a bit lower although significant.

However, this tendency is not sustained throughout all capabilities. In the rest of the cases the disparity between the fit of the domestic vs. the export technological capabilities emerges clearly.

Notwithstanding the different levels, the fit among the capabilities for software design and the capabilities to maintain expertise in a particular domain exists, as shown above. Whereas in the case of capabilities for software programming and the capabilities to master expertise in a particular domain a wider disparity in the fit emerges. When performing on the international markets, companies find it compulsory to develop excellence in both capabilities and to align them to a great extent (correlation coefficient (.779), whereas this appears not to be the case for companies operating on the domestic market (coefficient (.246). Apparently, developing specialised expertise in a particular domain is not necessarily coupled with excellent capabilities for software programming, when companies are to perform on the domestic market.

Similar disparity appears with respect to the fit among the ‘export’ vs. the ‘domestic’ capabilities for software design and the capabilities to offer high quality products and services. While the fit amongst them is highly significant when companies perform on the international markets (correlation coefficient (.800), the fit among these is rather low when companies operate on the domestic market (correlation coefficient (.325). It is striking that companies may operate without having aligned their basic technical capabilities, like capabilities for software design, with their capabilities to offer high quality products and services. This discrepancy appears to hold only on the domestic market and it serves to indirectly indicate that the domestic market maintains lower technological sophistication in comparison to the international markets.

Even greater divergence appears in the fit among the ‘export’ vs. the ‘domestic’ capabilities for software design and the capabilities for prompt delivery. The capabilities for software design and the capabilities for prompt delivery, which companies execute on the international markets, appear to reveal a strong fit (with correlation coefficient (.848), whereas a fit amongst these

capabilities, when deployed on the domestic market, is non-existent (correlation coefficient (.189). The analysis of the individual capabilities revealed that prompt delivery does not appear to be a strong capability on the domestic market. Furthermore, at this point the analysis reveals that companies do not find it necessary to align their capabilities for software design with their abilities to deliver on time, when performing on domestic market, while for the export markets the strong fit between the two appears to be a must.

The strongest disparity between the 'domestic' and the 'export' technological capabilities emerges in the fit between companies' capabilities to diversify their products and services and the rest of the capabilities in the set. The ability to diversify appears to be unrelated to companies' export intensity (this is the only capability in the set, which is not positively correlated to the export intensity). But interestingly enough, a strong positive correlation appears between the capability to diversify and all the rest capabilities in the set, when these are deployed on the international markets. In other words, companies appear to diversify their products and services both on the domestic and the international markets, but it is only the exporters who appear to make a deliberate effort to develop a strong fit between the excellence in diversification and the rest of the capabilities. The exporters reveal a strong fit among the capabilities to diversify and the rest of the capabilities in the set, and this holds for all capabilities in the set. Whereas no such fit occurs when diversification skills are deployed with the rest of the capabilities on the domestic market.

In order to compete on the international markets companies find it necessary to develop a strong fit between their capabilities for software design and the capabilities to diversify products and services (coefficient (.691), while this is not the case, when deploying the same capabilities on the domestic market (coefficient (.122).

Similarly, when competing on the international markets companies perform a strong fit between their capabilities for software programming and the capabilities to diversify products and services (coefficient (.736), while this is not at all the case, when deploying the same capabilities on the domestic market (coefficient (020).

The same pattern persists with the rest of the capabilities in the set. Executing international projects companies perform equally strongly their diversification skills and their capabilities for producing high quality software (coefficient (.742), while no such alignment occurs in companies' performance on the domestic market (coefficient (.267).

Similarly, offering diversified products and services on the international markets is coupled with their prompt delivery (coefficient (.702), while similar coupling does not occur at all on the domestic market (coefficient (.026).

Producing diversified products and services on the international markets is strongly coupled with having specialised expertise in a particular area (coefficient (.685), whereas this does not hold for the domestic market (coefficient (.258).

7.3 Conclusions about the degree of coherence of export vs. domestic technological capabilities

Perhaps the most important and striking point, which emerges out of the analysis, is that very high level of coherence occurs among all capabilities, when they are deployed on the international markets. Not even a single exception of low or medium high level of coherence exists in the case of the export technological capabilities. It is striking that although capabilities for diversification do not appear to be correlated with the export intensity, i.e. exporters do not necessarily have greater diversified range of products and services they offer, the skills for diversification do appear to be highly correlated with the rest of the capabilities, when they are deployed on the international markets. This by itself is revealing of how tight must be the fit among all capabilities to enable latecomer software companies to compete internationally.

While operating on the domestic market, the companies appear to perform a high degree of coherence among some capabilities, representing a half of the whole set of capabilities, and yet the level of coherence appears to be lower than the level of coherence of the same capabilities deployed on the international markets. But in the other half of the cases, the companies perform a low level of coherence among the capabilities in the set. Apparently, when deploying their technological capabilities on the domestic market, the software companies do not find it necessary to develop a strong level of coherence among all technological capabilities. Respectively, this suggests that the demand in the domestic market is relatively unsophisticated and allows companies to serve customers without performing a tight fit among all technological capabilities.

The strongest divergence between the domestic vs. the export technological capabilities emerges in the fit among the capabilities for diversification of products and services and the rest of the capabilities. Unlike the case of the export technological capabilities, where a high level of coherence emerges between the capabilities to diversify and the rest of the capabilities, the same tendency does not occur in the case of domestic technological capabilities. Despite the fact that most of the companies, operating on the domestic market reveal high degree of diversification of the products and services they offer, the level of coherence between the capabilities to diversify and the rest of the capabilities is very low in absolutely all cases. This perhaps is coming to suggest that a strategy of diversification on the domestic market is more likely to be an ad hoc strategy of utilising all available opportunities rather than a deliberate attempt to broaden companies' knowledge base and align it with the rest of companies' technological

capabilities. This comes as another piece of evidence about the relatively unsophisticated demand on the domestic market, which allows companies to provide a range of software services without necessarily ensuring a strong fit between these and the rest of the technological capabilities.

8. CONCLUSIONS

The paper makes a number of contributions. First, it makes an attempt to examine systematically the types of capabilities, which the latecomer software companies need to develop, if they are to develop internationally competitive software industries based on indigenous resources. Second, it introduces the notion of coherence of technological capabilities. It emphasises that if we are to make a comprehensive account, in analysing the accumulation of technological capabilities we need to investigate the degree of coherence among the constituent capabilities. The degree of coherence depicts the deeper structures in the process of the technological capabilities building. Successful technological building requires not only accumulation of individual capabilities but it also necessitates development of high degree of coherence among the capabilities. Third, it brings back the debate about development of indigenous software industries by the latecomers.

As the case of the Bulgarian software industry reveals, the accumulation of individual capabilities to perform on international markets appears to be a difficult task. The demand on the domestic market is technologically less sophisticated and the companies find the shift to international markets difficult, even when they had already developed excellent capabilities to perform on the domestic market. Due to the low performance requirements on the domestic market the latecomer companies do not find it necessary to develop high degree of coherence among the capabilities in the set, when performing on the local market. This appears detrimental to their attempts to develop capabilities to compete on the international markets.

This is a revealing case that building technological capabilities in the latecomer software industry is indeed a cumbersome task. The latecomer companies need not only to accumulate a set of separate individual capabilities, but more so to build a strong level of coherence among them. This seems to be the major distinction between the technological capabilities, which are deployed on the domestic vs. the international markets.

These results contest the ‘walking on two legs’ proposition, suggesting that the latecomer software companies need to pay more attention to the domestic opportunities because of their high returns in terms of gaining experience and innovation in software production and providing training opportunities that allow a broadening of software exports (Schware, 1992). The case of Bulgaria, and most of the latecomer countries, shows that technological development in the domestic market does offer learning opportunities for software production and yet they remain far away from the frontier developments and do not enable the latecomer software companies to enter the international arena.

This point bring us back to the argument of Steinmueller (2001) about the possibilities for leapfrogging by the developing countries, where the discussion is centered on an optimistic perspective about the possibilities for production and use of information and communication technologies (ICTs) by the developing countries, and the software and information services in particular are outlined as one of the prospective areas for technological leapfrogging. The author emphasises that to be able to embark on a leapfrogging trajectory the latecomer companies need to develop 'absorptive capacities' to acquire expertise to produce and use the ICTs (Steinmueller, 2001, p. 197).

The results of our analysis reveal that a modest number of Bulgarian software companies have been able to build technological capabilities to compete on the international markets, whereas the predominant number of the companies acknowledges that the capabilities, which they have accumulated, are insufficient to allow them to compete in the global arena. Furthermore, the analysis reveals that the companies, which serve the domestic market and represent the predominant part of the industry, have not been able to develop a high level of coherence among the capabilities they master, despite their success to develop very good expertise in the individual capabilities.

All these suggest that developing absorptive capacities remains a challenge for the latecomer companies. Therefore the optimistic forecasts about the possibilities for leapfrogging by the latecomer countries by developing indigenous software industries have been overestimated. This is not to contest the optimism about the potential of the latecomer companies to develop mastery over new technologies and eventually to generate new technologies, but rather to suggest that it is most likely that a limited number of latecomer companies will be able to develop leading-edge capabilities. Perhaps latecomer countries like India, China and Brazil, which have been able to mobilise their potential in harnessing the benefits from the ICTs, present optimistic examples (despite the fact that the software industries in China and Brazil remain predominantly domestic-market oriented, the domestic demand is sophisticated, as it is represented by MNEs). Whether other cases would provide grounds for optimism or rather the experience of the rest of the latecomers would provide evidence for a counter argument, is still to be seen. The case of the Bulgarian software industry itself presents a case for moderate optimism. It is optimistic that a group of companies, although representing a relatively small share in the industry, has managed to enter and compete on the international markets. Nevertheless, the questions remain whether any of the domestic-oriented companies will be able to make a shift to the international markets and how sustainable the development of the domestic-oriented companies will be in the future.

This paper needs to be complemented by further research in three directions. The first direction of research is to expand the framework of capabilities. In order to take a comprehensive account

of the capabilities, which the latecomer software companies need to muster, the proposed framework should be elaborated further to distinguish between technical and organisational capabilities, which is done in (Rousseva, 2006). Second, the analysis of the capabilities in this paper had been based predominantly on quantitative data. This has been done deliberately to emphasise the significant inter-group difference in the level of accumulation of technological capabilities and to reveal the different degree of coherence in capabilities. The analysis can be complemented by qualitative research to depict further details. Third, further research needs to be directed at investigating the learning process underlying the accumulation of different levels of technological capabilities, to disentangle the complexity of technological capabilities building in the latecomer context. In this part of the analysis it would be appealing to explore the impact of organisational capabilities in the process of technological capabilities building and whether organisational congruence foster development of technological capabilities with high level of coherence.

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APPENDIX

Capabilities	Mean	Mode	Std. Deviation	Std. Error Mean
Design capabilities for local market	4,86	5	0,351	0,058
Design capabilities for international markets	2,84	3	1,305	0,212
Programming capabilities for local market	4,92	5	0,273	0,044
Programming capabilities for international markets	3,08	3	1,381	0,23
High quality on local market	4,7	5	0,52	0,085
High quality on international markets	3,42	5	1,519	0,253
Prompt delivery on local market	4,53	5	0,971	0,162
Prompt delivery on international markets	3,56	5	1,517	0,256
Specialised expertise in domain in local market	4,41	5	0,956	0,157
Specialised expertise in domain in international markets	3,24	5	1,532	0,249
Diversified products and services in local market	4,11	5	1,173	0,193
Diversified products and services in international markets	2,59	3	1,257	0,207

Table 1. Accumulation of individual capabilities in the Bulgarian software companies

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Design capabilities for local market	Between Groups	.226	1	.226	1.793	.190
	Within Groups	4.038	32	.126		
	Total	4.265	33			
Design capabilities for international markets	Between Groups	26.389	1	26.389	24.587	.000
	Within Groups	34.346	32	1.073		
	Total	60.735	33			
Programming capabilities for local market	Between Groups	.036	1	.036	.627	.434
	Within Groups	1.846	32	.058		
	Total	1.882	33			
Programming capabilities for international markets	Between Groups	28.889	1	28.889	24.427	.000
	Within Groups	37.846	32	1.183		
	Total	66.735	33			
High quality on local market	Between Groups	.002	1	.002	.011	.917
	Within Groups	6.615	32	.207		
	Total	6.618	33			
High quality international markets	Between Groups	23.308	1	23.308	13.630	.001
	Within Groups	54.721	32	1.710		
	Total	78.029	33			
Prompt delivery on local market	Between Groups	.654	1	.654	.657	.424
	Within Groups	31.846	32	.995		
	Total	32.500	33			
Prompt delivery on international markets	Between Groups	10.928	1	10.928	5.193	.029
	Within Groups	67.337	32	2.104		
	Total	78.265	33			
Specialised expertise in domain in local market	Between Groups	.005	1	.005	.005	.943
	Within Groups	31.760	32	.992		
	Total	31.765	33			
Specialised expertise in domain in international markets	Between Groups	29.403	1	29.403	17.411	.000
	Within Groups	54.038	32	1.689		
	Total	83.441	33			
Diversified products&services in local market	Between Groups	2.851	1	2.851	2.576	.118
	Within Groups	35.413	32	1.107		
	Total	38.265	33			
Diversified products&services in int markets	Between Groups	11.245	1	11.245	7.998	.008
	Within Groups	44.990	32	1.406		
	Total	56.235	33			

Table 2. ANOVA analysis of differences between technological capabilities of domestic-oriented vs. export-driven companies

Spearman's rho Correlations		Domestic oriented	Export driven	Design C local market	Design C international markets	Programming C local market	Programming C international markets	High quality local market	High quality international markets	Prompt delivery local market	Prompt delivery international markets	Specialised expertise in domain in local market	Specialised expertise in domain international markets	Diversified products &services local market	Diversified products &services international markets
Domestic oriented	Coefficient	1	-1.000(**)	-0.213	-.607(**)	-0.15	-.640(**)	-0.039	-.539(**)	-0.015	-.404(*)	-0.097	-.583(**)	0.153	-0.315
Export driven	Coefficient		1	0.213	.608(**)	0.124	.640(**)	0.008	.539(**)	0.015	.404(*)	0.109	.584(**)	-0.182	0.316
Design C local market	Coefficient			1	0.137	.604(**)	-0.037	0.325	0.026	0.189	0.005	.394(*)	0.065	0.122	0.133
Design C international markets	Coefficient				1	0.107	.842(**)	0.059	.800(**)	-0.093	.848(**)	-0.029	.796(**)	-0.187	.691(**)
Programming C local market	Coefficient					1	0.114	.528(**)	0.099	.493(**)	0.172	0.246	0.093	-0.02	0.159
Programming C international markets	Coefficient						1	-0.003	.843(**)	0.068	.844(**)	-0.018	.779(**)	-0.314	.736(**)
High quality local market	Coefficient							1	-0.13	.468(**)	0.067	.740(**)	-0.182	0.267	0.112
High quality international markets	Coefficient								1	-0.176	.817(**)	-0.26	.909(**)	-.392(*)	.742(**)
Prompt delivery local market	Coefficient									1	0.029	.679(**)	-0.228	0.026	0.145
Prompt delivery international markets	Coefficient										1	-0.084	.756(**)	-.422(*)	.702(**)
Specialised expertise in domain in local market	Coefficient											1	-0.307	0.258	0.037

Specialised expertise in domain international markets	Coefficient	1	-.425(**)	.685(**)	
Diversified products &services local market	Coefficient		1	0.054	
Diversified products &services international markets	Coefficient			1	

** Correlation is significant at the .01 level (2-tailed).

* Correlation is significant at the .05 level (2-tailed).

Table 3. Spearman's correlation coefficients for the degree of coherence among domestic vs. export technological capabilities

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