

Comparative Advantages of Software Industry in Developing Countries: Study of Structure, Market Strategies and Software Development Approaches in Croatian Software Companies

Nikola Vlahovic, Ljubica Milanovic Glavan and Anja Frankovic

Abstract—During the global economic crises national software industries have proven to be one of the most resilient industries. After initial fall of the market in 2008 and 2009, recovery followed with a period of intensive innovation. Some Asian software industries even reported no influence on the market share, such as Thai software industry. Nevertheless in smaller economics impact was more pronounced but in comparison with other national industries the recovery is generally faster.

In this paper we will concentrate on software companies in developing countries and try to investigate the main characteristics of small and developing software industry that may create resilience in difficult economic setting and serve as a basis for international competitiveness. For the purpose of this paper research was conducted on the case of Croatia.

The goal of this paper is to detect the most important opportunities and sources of comparative advantages that open these companies in global international software markets. Based on the conducted research of software industry structure, market targeting and software development practices guidelines are outlined on how to strengthen the competitive advantage of small national software industries in developing countries on the global software markets.

Keywords—Agile software development, Cloud computing, Comparative advantages, ICT industry, Offshoring, Software development methodologies, Software industry.

I. INTRODUCTION

RECENT global economic crises have witnessed that some industries suffer significantly more from fluctuations in global financial and economic markets during recession than others. One of the most resilient industries has proven to be industries belonging to the ICT sector. Some of these

N. Vlahovic is the associate professor at the Informatics Department of the Faculty of Economics and Business, University of Zagreb in Croatia. Trg. J.F. Kennedyja 6, 10000 Zagreb, Croatia (phone: +385-1-238 3220; fax: +385-1-233 5633; e-mail: nvlahovic@efzg.hr).

Lj. Milanovic Glavan is postdoctoral researcher and assistant at the Informatics Department of the Faculty of Economics and Business, University of Zagreb in Croatia. Trg. J.F. Kennedyja 6, 10000 Zagreb, Croatia (e-mail: ljmilanovic@efzg.hr).

A. Frankovic is bachelor of Economics who graduated the Managerial Informatics Study Program at the Faculty of Economics and Business, University of Zagreb in Croatia. Trg. J.F. Kennedyja 6, 10000 Zagreb, Croatia (e-mail: anja.frankovic@gmail.com).

industries have recorded smaller rates of decline in revenues than other industries, while others reported no influence whatsoever. A good example is Germany where after the initial decline during 2008 and 2009 software and IT industry recovered in short period of time. Thai software industry reported no influence of the crisis as it readjusted its strategies and turned successfully to Asian markets for support [19]. European commission has even relied on these industries (particular consumer electronics, gaming industry, and telecommunications and high technology sector) to lead the path to economic recovery believing that these industries can induce higher personal consumption expenditures.

Developing countries also experienced similar effects on their national software industries. As the national economic stability is primary goal especially in developing and transitional countries of South Eastern Europe investigating the foundations of this comparative advantage in comparison to other industry sector was prompted.

In this paper we will try to investigate specific features of software industry pertaining to structure, market strategies and software development practices and determine how these features contribute to this comparative advantage.

Goal of this paper is to provide the insight in current software development practices that allow small and medium companies, which form the major share of software industry in developing countries, to compete successfully on national and international software markets providing them with additional resilience against local and global market instabilities. Main focus will be on the research of diversification in market coverage and internationalization, as well as innovation since current research indicates that these elements are most important characteristics of software industries that resisted oscillations during global economic crisis.

Structure of this paper is as follows: in Section II we will present background on specific characteristics of global software industry that distinguishes it from other industry sectors. Here special attention will be given to the product and services this sector provides as well as the overview of latest methodologies used in software development. In Section III we will make an overview of recent developments across global software industry and various software industries in

Europe. We will define international economic setting, software markets and software trends. Here the scope of research pertaining to small national industries of developing transitional countries will be defined. In Section IV we will describe conducted research in Croatia, defining the methodology used and obtained results describing the main features of software industry in Croatia. In Section V discussion of results in relation to current trends will be given. We will make a comparative analysis of the research findings in Croatia with software industries in other developed and developing countries in Europe. Finally in Section VI we will present the conclusions and indicate future trends and possibilities of software industry in developing countries.

II. BACKGROUND ON SOFTWARE INDUSTRY FEATURES

Software industry along with information and communication technology is one of the most important sectors of international economics in the information age. Product and services that are provided through this economic sector are of essential importance to overall economic development, business development and scientific research. It provides an essential incentive to both business spending and personal consumption expenditure which in turn generate economic growth. On the other hand software industry has stayed elusive to industry analyzers and financial markets longer than any other sector [13], [14]. This is primarily due to a high level of variation that this industry provides to the constraints exhibited by analytical methodologies and their categorizations. Furthermore this industry is characterized with one of the highest levels of innovation resulting in creation of distinctly varied products and services spanning over not only software industry but also spilling over and expanding to numerous other industries in various forms and approaches. Yet software industry has anchored itself as a unified industry proving to be highly stable and resistant to economic fluctuations and market instabilities.

Some of the most important characteristics of the industry include the fact that its main products are the most complicated man made products and yet intangible in its nature. This fact alone calls for highly skilled professionals that open up a demand for highly trained professionals such as computer programmers, software architects and software designers. In turn, high expectations and use of hi-technology in their work is compensated by above average salaries that for over a decade have positioned these job positions in highest paid job positions rankings. Additionally, with the development of Internet and Internet Services, particularly the World Wide Web service, and due to intangible and digital nature of software products, additional access both to job positions and customer markets was alleviated and raised to international and global level. Currently the most important characteristics that drive the growth of software industry market share along with the innovation potential it offers heavily rely on the definition and repositioning of software products from products to services and efficient organization

of software development process.

A. *Software as a Product or Service*

Software is different from all other types of goods due to its intangible nature. By definition software represents the unity of computer programs and their documentation [1] which allow the computer system to operate and be used by their end users. Computer programs represent an organized set of digitalized instructions intended for computer systems that allows them to perform specific tasks for their users [2]. Software documentation describes program functionalities. It consists of technical documentation and user documentation that is usually part of the software solution presented through user interface during software execution but also in separated form as external resource. Software can also refer to other intangible assets of computer systems, such as database definitions and models and data contained in these systems, as well as various protocols used in computer communication.

Software is a digital good and as such, from an economic perspective it has three fundamental properties: indestructibility, transmutability and reproducibility [3].

- 1) **Indestructibility.** Using software over time does not degrade its quality notwithstanding the length of usage or number of uses. This may lead to conclude that value of created software does not change, but external influences have a decisive influence on software value. In this respect software value may deteriorate over time [4], as technological advancements change working environment of existing software solutions.
- 2) **Transmutability.** Personalization, customization, modification and other altering practices of existing software systems are easily achieved which results in cost-effective production of software variants. This is particularly important for customer segmentation and price discrimination market targeting strategies [5].
- 3) **Reproducibility.** Since high-quality copies of the original software can be produced at low cost may authors agree that the marginal cost of production is almost zero [6]. Structure of production cost for software products contains primarily fixed cost for the software provider. Production of each additional unit does not significantly increase the total cost. In this respect the potential reproducibility deliver to software assets also significantly improves its value.

Chronologically, through these fundamental features of digital goods, software evolved from a particular product delivered recorded on a material medium (such as data disks) towards less materialized forms. This transition was driven by the potential of creating additional value for customers and comparative advantage for its developers. Through habituation of end users developers were able to take advantage of lock-in effects in targeted market segment and build a solid foundation of stable customer base.

In order to achieve these potential advantages software companies started taking advantage of digital distribution of

software using responsive Internet services reduced or even eradicated the costs of logistic and inventory, while additionally promoting convenience for customers, allowing for automatic update of software components.

Finally, dematerialization of software distribution and the further development of Internet's communication capacities lead to creation of cloud computing where software itself is not even delivered to users as a compact set of computer programs and components. Software is radically being transferred to the cloud paradigm and being offered as a service. This transition was also gradual as we can see in Figure 1.

Cloud Service Models

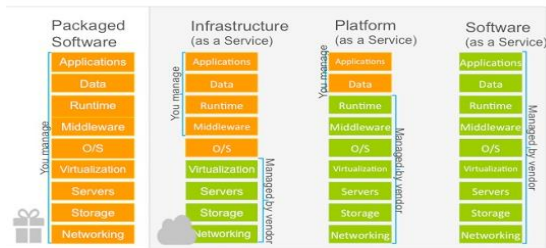


Fig. 1 Comparing stand-alone applications and Cloud computing services

Providing Infrastructure as a Service (IaaS) opened up new opportunities for network and internet provider businesses, providing Platform as a Service (PaaS) opened up new opportunities for software developers and providing Software as Service (SaaS) offered additional benefits for end users.

This radical change has raised the dynamics in the software markets, bringing new concepts for both Internet providers and software developers in terms of decreasing the investment and maintenance costs while improving efficiency. In turn end customers benefit from lower prices for their information needs, more fair pricing models and higher robustness and longevity of their data as ubiquitous computing concepts become implemented.

All of these trends have been recognized not only by large multinational companies but also smaller entrepreneurs that recognized the opportunity to acquire powerful tools and start innovative businesses.

B. Current Software Development Methodologies

With the increase of dynamics in software markets and improved availability of tools changes in approach to developing software were immanent.

Additional pressure in creating fast quality software solutions promoted the use of agile software development methodologies.

There are twelve principles of agile development, as defined in Agile Manifesto [7] that describe the values and standpoint in which agile methodologies for software development should be founded. Primarily, agile approaches focus on individuals instead on the process while promoting improved communication among team members and other stakeholders. Key is the development of working software that can be easily and quickly changed to adapt to changing user

requirements and dynamic environment. Some of the most important agile methodologies include Scrum, eXtreme programming (XP), Kanban, Feature-driven development, etc. [8]. Limitations that all of these methods share is the size of software system developed since agile approach works best with small development teams and systems with limited complexity. Large software systems developed by large development teams which may rely on legacy infrastructure cannot directly benefit from agile approach. This is way combinations of more traditional approaches such as sequential 'waterfall' development, incremental development approaches or unified process approaches, with agile methods tried to implement agile principles to larger complex software systems. Resulting methodologies have been implemented, such as Agile Unified Process (AUP), Scaled Agile Framework and Large-scale Scrum.

Along with Agile development different practices pertaining to one or more of its methodologies have encouraged the development of more recent tools that are based on approaches such as Behavior-driven design (BDD), Domain-driven design (DDD), Continuous Integration (CI), etc.

Still, for legacy systems and large-scale complex heterogeneous system traditional structured approaches are still widely used.

III. RECENT SOFTWARE INDUSTRY TRENDS IN EUROPE

European software market is second largest software market in the world with more than 231 billion EUR of global market share [9]. It is ranked after Northern America and ahead of Asia & Pacific Region (including Japan) (Figure 2).

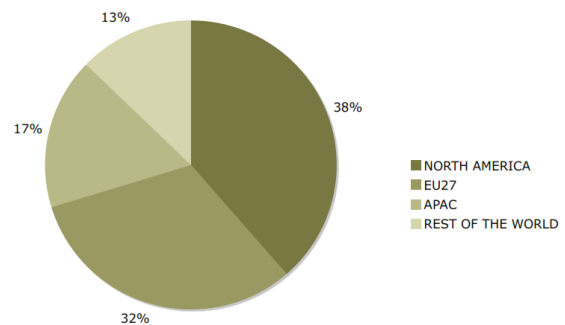


Fig. 2 Global Software Markets by Region

This is the main driving force for software industry that has shown positive trends over the last decade, despite global economic fluctuations and occasional economic crises. Appropriately, R&D spending in software industry is also second largest in the world (after United States and Canada), increasing year after year. In the last five years, though, the rate of market grow is decreasing and profits have fallen below the R&D spending (Figure 3).

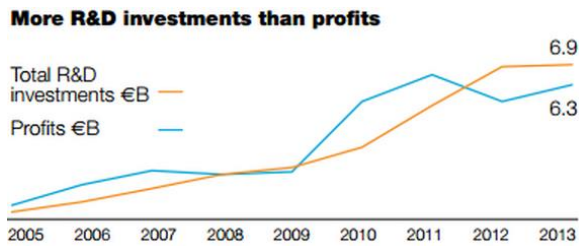


Fig. 3 R&D spending and profits of EU software industry (Source: Truffle Capital)

The main contributor to the EU software market is Germany that accounts for half of the revenues, followed by United Kingdom with 13% revenue share, France 12% revenue share, Sweden with 6% revenue share, The Netherlands with 5% revenue share, and other countries with less than 3% share each [10].

For the most part, software industry along with accompanying ICT sectors was the driving force of resisting the restrictive fluctuations and economic recession during 2008 and 2009. During that period software market lost about 5% but recovered quickly in the following years [11]. This is the exact timeframe for increased innovative spur that took the advantage of new trends in ICT and software. Some of the most important innovative products and services include business intelligence software, IT security software, Enterprise Content Management, SOA and software as a Service (SaaS). Dominant number of innovations relied on cloud computing.

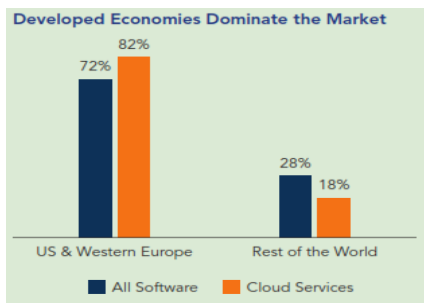


Fig. 4 Global software market shares between developed and developing countries

As we can see in figure 4 globally, developed countries intensified development of cloud based services while developing countries followed. The same trend is seen in European region.

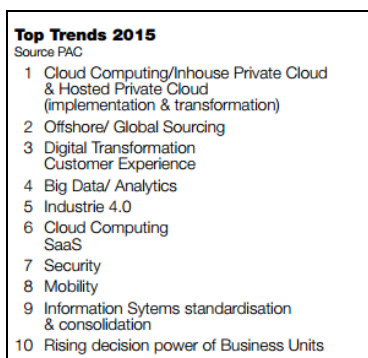


Fig. 5 Top trends in software industry in 2015

As cloud computing constituted only 9% of global software market in 2013 [12] currently it still dictates leading trends in terms of IaaS/PaaS and SaaS challenging the potential for innovation in software industry (Figure 5).

In the past decade developing countries have taken the opportunities for offshoring of software by the leading developed countries [15], [17]. For East and Central European countries this trend was additionally enhanced as they had the opportunity to develop the required information infrastructure using financial support of the EU funds.

Benefits are mutual for both developed and developing countries. Cost of software development reduces for the leading software industries of developed countries while creation of new software producing regions promotes overall economic development in developing countries. It has been also shown that developing countries that were initiating growth of their software industries through direct foreign investment, such as Estonia and Romania, have been able to establish and develop software industries more successfully than countries that relied primarily on domestic investment, such as Bulgaria [16].

These investment circumstances and open possibility for offshoring developed countries in software development tasks provided additional resilience to national economic fluctuations observed in the past 5 to 8 years in transitional countries.

Still features of developing countries' software companies that allow for offshoring and comparative advantage remain unclear, insufficiently investigated and defined. In the rest of the paper we will present a study on the case of Croatia trying to establish the main features of software industry in developing transitional country.

IV. RESEARCHING COMPARATIVE ADVANTAGE OF SOFTWARE INDUSTRY IN DEVELOPING COUNTRIES: A CASE OF CROATIA

In order to understand better the competitive position of software industries in developing countries a research was conducted in Croatia. Subject of the study was focused on active companies that are according to Croatian chamber of economy registered for activities that include computer programming, consultancy and related activities and information service activities services. Also, the study included only companies that have reported a minimum of 12.000 euros of revenue in 2013.

Goal of the survey was to determine the demographics of the companies included in the research, understand the market they are selling their products and services and finally understand their internal organization with additional emphasis on software development methodology that is prevalent in their business operations.

A. Research Methodology

The research was based on acquiring data from secondary sources (i.e. Company Register of the Croatian Chamber of Commerce), and primary source through a survey dedicated to the earlier described goals of the study.

Survey was organized in three sections. First section contained question pertaining to the demographics of companies including size of company, revenue, geographical location and number of employees. Second section of the survey was used to investigate target markets and the ratio between domestic consumer markets and international market segments. Finally, in the third section of the survey information about the methodology used in during the software development life cycle was collected.

The survey was sent electronically to 650 companies, addressed to middle-level management. Exactly 100 of companies sent their responses which equals to 15,4% response rate.

Responses were then processed and descriptive statistical analysis was conducted.

B. Research Results

The average age of companies is 12,6 years as the registration of companies first began in 1990 when Croatia gained independence. Some of the companies registered in first couple of years were actually active even before, but overall we can say that software industry in Croatia is a young industry with average rate of growth of 4 companies with yearly revenues of at least 12.000 EUR each year.

Software companies gravitate towards Zagreb city area as this is the major financial and business area in the country. 63 companies are registered in Zagreb while the others are registered in other cities.

While only two of largest companies had more than 100 employees, majority of 71 companies in 2013 had less than 10 employees, while further 23 companies had between 10 and 50 employees (Figure 6).

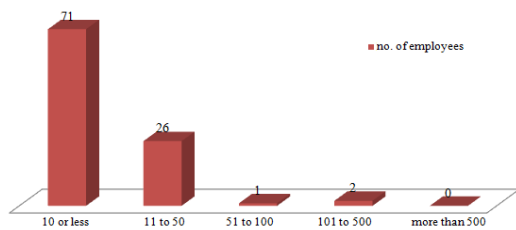


Fig. 6 Software companies by size – number of employees

45% of companies estimated that their revenue in 2014 will remain in vicinity of 100.000 EUR or less.

In Figure 7 we can see that more than 60% of companies produce software i.e. computer programs, 18% provide services in maintenance of computer systems and equipment.

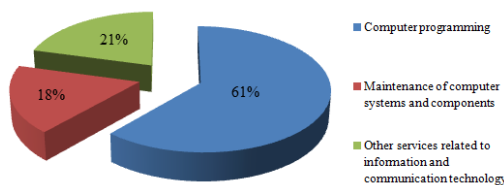


Fig. 7 Software companies by dominant business activity

The rest of the companies provide other types of information services and consultancy.

Companies earn majority of their revenue on domestic markets in 38% while remaining 62% earn their revenue abroad (Figure 8).

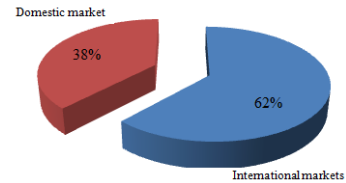


Fig. 8 Ratio of domestic and international markets

Those that export their products and services primarily export to European countries (40%) and countries of the neighboring South-Eastern countries (35%). About one fifth of export is realized on the American market (Figure 9).

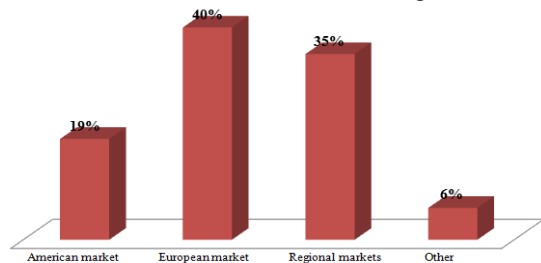


Fig. 9 Software companies exports by region

48% of companies have adopted primarily agile methodologies for the development of their software products.

While Scrum is the methodology most widely accepted, companies in most cases use a combination of agile methodologies such as combinations of Scrum, Adaptive Software Development and eXtreme Programming. There is a significant 15% of these companies that rely on the Open Source development (Figure 10).

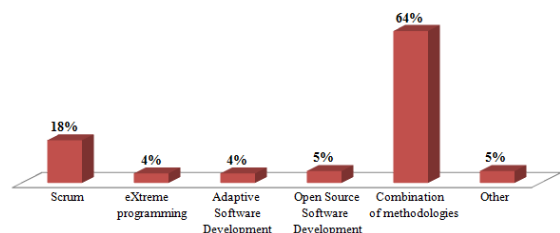


Fig. 10 Companies that adopted agile methodologies and most dominant methodologies used

Rest of the companies (52%) use more traditional approaches to software development. In this case companies mostly use component-based development taking the advantage of reusability (55%) and RUP Methodology (19%). Other methodologies that are used in lesser extent are Joint application design and other rapid software development methodologies (Figure 11).

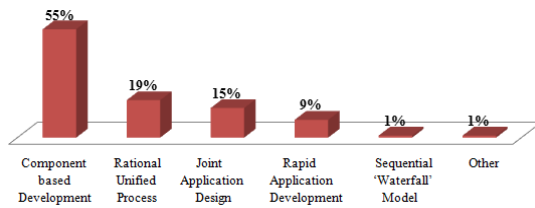


Fig. 11 Companies that use traditional approaches to software development and most dominant methodologies

There is a good representation and diversification of various architectural designs of software solutions covering desktop applications, client-server architecture and service oriented architecture (SOA), but also significant number of solutions of web applications, mobile applications and cloud computing implementations (Figure 12).

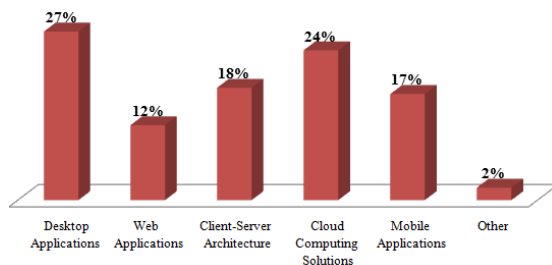


Fig. 12 Dominant Software Architecture of developed solutions

Acquired data also showed that majority, 53%, of solutions companies produce are commissioned custom made software solutions, 34% of solutions are modified Component-of-the-Shelf (COTS) and the remaining 13% belong to Open source solutions.

V. DISCUSSION

According to Croatian Bureau of statistics production of software in Croatia between 2008 and 2012 has been continually increasing following the more general trend in EU software industry, despite global economic crisis (Figure 13).

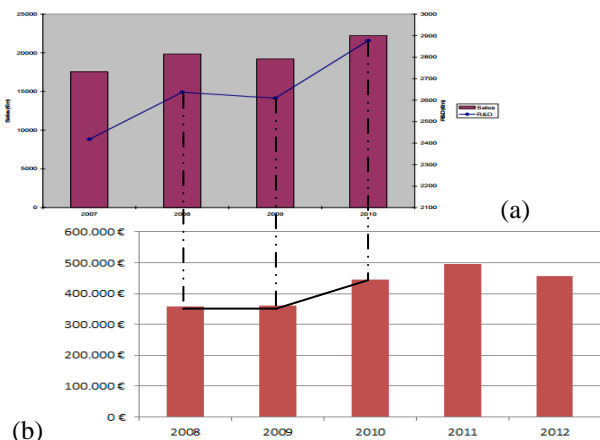


Fig. 13 Comparing trends in revenue from software in (a) EU and (b) Croatia

On the other hand during that same period Croatian GDP had negative growth rate. Hence, software industry showed remarkable resilience to negative global trends. As we can see this is also true for other developing countries in EU that we described earlier. This means that specific nature of software industry, its position and opportunities can be used to alleviate negative trends in economic fluctuations. This opportunity was not fully realized due to overall small fraction of software industry in total national GDP.

Results of the research show that Croatian software industry consists of only several large companies and a group of young small and medium companies (Figure 6). Unlike large companies, these small and medium companies have adopted agile approach to software development as their main competitive edge both in domestic but also in international markets. Fast development, quick-win strategies in discovering and targeting new markets, infrastructural readiness and familiarity with recent technologies are the main attributes that allow dynamics and readiness to follow global trends in software industry.

If we cross-reference the main findings of the research with recent trends in software industry we will see that:

- 1) One third of revenues of Croatian software companies (Figures 8 and 9) comes from two leading software markets (Northern America and Europe in Figure 2), testifying significant level of offshoring to developed economies. This strategy allows for better inflow of international capital in situations when domestic capital is scarce or too expensive. Also offshoring improves domestic knowledge, as well as it may empower domestic companies that can make use of code and components produced as by-products for initiation of propriety software projects and services. This is possible due to reproducibility and transmutability of software.
- 2) Even though packaged/desktop software is dominating Croatian production (Figure 12) as in any developing country (Figure 4), cloud computing is well represented (Figure 12) allowing for participation in global trends (Figure 5) through innovation of these services reassuring continued growth.
- 3) Agile methodologies and high number of small and medium companies make national software industry agile and prepared for dynamics typical to the global markets.
- 4) Strengthening software industry by national strategies and institutional support can help overall initiation of economic activity since all industries rely on ICT in greater or lesser degree. Taking advantage of international support through European institutions offering financing of infrastructural projects, regional development projects and scientific research projects through EU Funding may develop a long-term comparative advantage [18].

VI. CONCLUSIONS

In this paper we have described the main characteristic of the global software markets and software industries. We have indicated current trends in terms of technological innovation but also in terms of business practices and macroeconomic conditions.

Distinction between developed and developing countries and their respective software industries was made. Even though both developed and developing countries have shown a great level of resilience to economic fluctuations in performance of software industries. Developing countries are more suspect to suffer from economic fluctuations so we tried to determine key features of software industries in developing countries that make this type of industry more resilient to macroeconomic conditions than other types of industries.

Through literature overview and secondary statistical data we have shown that there is a continuous growth of software industry on any level, especially during global economic crisis in 2008 and 2009.

In this context research of structure, market strategies and software development approaches was conducted among Croatian software companies.

Results have shown that there is a significant comparative advantage of strengthening software industry in developing and transitional countries since its benefits on the entire economy are valuable. Stabilizing effect during decrease of economic activity, investment potential especially through direct international investment, and innovation are the main benefits detected during the research. The main prerequisite of obtaining these advantages is agile orientation of software companies, openness to international markets and solid infrastructure.

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