Identifying variables affecting product valuation for micro, small, and medium enterprises dedicated to custom software development in Colombia

Identificación de variables que afectarían la valoración de productos de las micro, pequeñas y medianas empresas dedicadas al desarrollo de software por encargo en Colombia

María Isabel Díaz Vega[1]
Manuel José Ospina Ospina[2]

[1] Colombian, M.Sc. in Engineering, with emphasis in Industrial Engineering, Faculty of Engineering, Pontificia Universidad Javeriana Cali, Colombia. Corresponding author: midiaz@javerianacali.edu.co; maria_isabel_diaz33@ hotmail.com.
[2] Colombian, M.Sc. in Engineering, with emphasis in Industrial Engineering, Faculty of Engineering, Pontificia Universidad Javeriana, Cali, Colombia. E-mail: Parquesoft..mjospina@javerianacali.edu. co; manuel.ospina@expertia.com.

Abstract

Variables (needs and factors) that could affect product valuation for micro, small, and medium enterprises (MSMEs) engaged in custom software development in Colombia during the period 2014–2018 were identified through a process involving reflection, consensus–building, and implementation of prospective analysis tools. The performance of Colombia's relatively recent software industry was analyzed. The country's Ministry of Information and Communications Technologies is currently promoting new strategies to strengthen this sector. Prospective analysis tools were used to analyze the situation, identify stakeholders, and review pertinent trends. The strategic prospective workshop and the Delphi method were selected as analytical tools. Based on the results obtained, recommendations are to generate strategies within MSMEs developing custom software that would allow these enterprises to (1) take better advantage of governmental support in terms of legislation promoting entrepreneurship and tax benefits; (2) generate innovation that would increase their competitiveness; (3) manage knowledge so it is properly documented so as to avoid making the same mistakes of the past; (4) revise current economic models whose inefficiency has led many MSMEs to lose their financial viability; and (5) implement technological adaptations accompanied by technology transfer and capacity building, allowing enterprises and their human capital to evolve over time.

Key words: Software engineering; technological prospective; Delphi method; strategy; innovation; technology transfer; technology adaptation. Emphasis specialization

Introduction

The 21st century has been called the information and knowledge era, thanks to the cross-cutting action of information technologies (ITs), including software, the latter being developed for different market niches and generating sector-specific solutions (Ortega, n.d.).

Software plays an important role within organizations in terms of process control and is a key factor for increased competitiveness, facilitating the corporate restructuring necessary to compete in the active global market (Damodaran, 2006). More and more, companies are purchasing custom software packages, tailored to their needs, now being offered not only by large technology firms but also by micro, small, and medium enterprises (MSMEs) of the software industry (Fedesoft, 2011)

Software is developed, not manufactured. Unlike a large industry that invests in machinery and inputs and then sells its products in supermarkets and specialty stores or showcases them in a shop window, the software industry invests in "brains". Its products are intangible. The software industry sells ideas, solutions, and innovation, serving as driving force and support for large industries. The costs of developing software lie in engineering aspects, which means that new software projects cannot be managed as if they were manufacturing projects. A software program can take an average of 12–18 months to develop (Ministerio de Comercio, Industria y Turismo, 2008). Software, however, becomes obsolete, making continuous updates necessary. The useful life of an unmodified software product is only 2–3 years.

The software industry is relatively new in Colombia, but has a rapidly growing market with great potential (Sallstrom and Damuth, 2002). One way to strengthen this sector is by conducting research to provide solid reference data and by taking strategic decisions. Colombia's software industry is composed as follows: 92%, micro and small enterprises; 7%, medium-sized enterprises; and 1%, large companies (Ortega, n.d.). Many new software companies have been formed through strategic alliances and attempts to form clusters of software technology and, although this has lead to an increase in small and medium enterprises, these present a lack of organizational skills, have trouble positioning themselves in the market, do not price their products correctly, and undercut the services they offer, which in turn leads to strong unsubstantiated variation of added value (Ortega, n.d.).

Colombia's Ministry of Information and Communications Technologies (MINTIC, its Spanish acronym) aims to design, develop, adopt, and promote policies, plans, programs, and projects pertinent to information and communications technologies (ICTs), in line with the National Constitution and existing legislation, to contribute to the country's economic, social, and political development. The ICT sector should be expanded and strengthened, research and innovation promoted, and competitiveness and technological progress sought in both the national and international scenarios. This Ministry has an array of norms, including Law 1341 of 2009, also known as the ICT Law, which defines principles and concepts of the information society and the establishment of ICTs, creates the National Spectrum Agency (ANE, its Spanish acronym), and dictates other provisions (Secretaría del Senado, 2009).

Many small and medium enterprises of the software sector have gone out of business due to the lack of efficient management and financial models, high costs, and lack of access to capital. Studies conducted in 2012 by the company Expert Information, which belongs to Parquesoft, showed that capital played a secondary role in ensuring the continuity of software companies (Expert Information, 2012). According to Colombia's Administrative Department of Science, Technology, and Innovation (Colciencias, its Spanish acronym), 96% of the companies in Colombia can be considered as MSMEs, accounting for 76% of the employment nationwide. The software sector follows this trend, with most companies being MSMEs (Colciencias, 2009).

The present study aims to analyze the status of MSMEs engaged in the development of custom software in Colombia using two prospective tools—the Delphi method and the strategic prospective workshop—which would allow the identification of important market factors and the possible evolution of MSMEs engaged in custom software development in the country for the period 2014–2018.

The identification of these variables, taking into account the opinions of experts in the field, would help MSMEs engaged in custom software development in

Colombia address pinpointed weaknesses, begin a process of ongoing improvement in search of software products that can fulfill the current and future needs of software clients, and continue to evolve.

Methodology

Table 1 lists the methodologies used in each phase of the study.

Table 1. Prospective analysis and valuation tools used to analyze the status of MSMEs engaged in the development of custom software in Colombia.

Phase	Tool used	Number of participating experts	Modality
Gathering of information	Prospective workshop	12	Presential
Valuation by experts and streamlining of Delphi prospective tool	First Delphi survey	42	Use of ICTs
Practical application	Second Delphi survey	42	Use of ICTs

Strategic prospective workshop

A strategic prospective workshop aims to open discussion about a specific topic with the help of a group of experts in the field being analyzed. Experts participating in the workshop will help identify and prioritize future challenges so pertinent actions can be taken. The term "workshop" is frequently used to designate organized sessions of collective reflection (International Data Corporation, 1999).

Sampling

In prospective analysis, what's important is not the number of participants but rather their authority in the field and expertise on the topic (International Data Corporation, 2013). Therefore sample size was not determined based on statistical analysis. People considered to be experts with vast experience and authority in the software sector of Colombia were identified with the help of the Colombian Federation of Software Industries and Related Information Technologies (FEDESOFT, its Spanish acronym), were asked to participate. The questionnaire was sent to all managers of companies ascribed to the Federation (Fedesoft, 2011).

Prospective questions

To collect information and identify variables affecting the product valuation model of MSMEs engaged in custom software development in Colombia, 12 experts in the software industry were initially asked two prospective questions to dynamize the consultation:

• What factors are relevant in determining the value of products of MSMEs developing custom software in Colombia during the period 2014–2018?

• What are the needs of MSMEs engaged in custom software development in Colombia during the period 2014–2018?

The results of this panel of experts are not conclusive, not even an approximation of possible answers. The consultation, however, allowed experts in the software industry to identify variables (definition, components, scope), stakeholders, and factors relevant to determining the value of products of MSMEs developing custom software in Colombia. The ideas provided by experts were used as basis to prepare the questions used in the Delphi survey and better devise solutions to expressed concerns.

Delphi method

This method consists in asking a group of experts their opinions about the future behavior of a given set of variables and indicators based on their knowledge, experience, imagination, common sense, and intuition. The outcome is a clearer idea of what the future holds. The Delphi method aims to maximize the advantages of using expert-based methods and minimize the disadvantages, taking advantage of the synergy of group discussion and eliminating undesirable social interactions existing within the group so that the consensus reached by the group of experts is as reliable as possible (Parquesoft, 2011).

Evaluation of experts and streamlining of the Delphi survey

The Delphi survey serves not only to collect information, but also to measure the expertise of the participants in this study.

It was important that all participating experts shared the same concept of custom software development, regardless of their education, position, or hierarchy, and were capable of envisioning the future (International Data Corporation, 2013). Experts accordingly contributed ideas that facilitated the preparation of questions for the Delphi survey, which served to measure the expertise of those participating in the study.

Initial Delphi survey

Delphi survey questions were prepared based on the analysis of the results of the panel of experts as well as pertinent bibliography. Questions provided a short-time horizon to obtain the clearest idea possible of the future scenario described by the experts' answers, considering the dynamics and universality of the software industry. Questions had precise, quantifiable, and autonomous answers (Parquesoft, 2011) and situated the reader in the scenario of 2014–2018.

To facilitate survey tabulation and analysis, respondents could choose from a series of possible answers; however, an open option was included for the respondent to complete and thus gather additional input from the experts.

Matrix-type questions proved the most convenient for the study and helped gather a large amount of information. Experts answer survey questions by assigning a score according to an established range. Matrix responses made it possible to measure each of the test variables for proposed period of 2014–2018. Matrix-type questions in this Delphi survey referred to:

• *Probability of occurrence.* Software experts assigned a score from 0 to 5, where 0 was improbable and 5, highly probable.

• *Level of importance.* Software experts assigned a score from 0 to 5, where 0 was unimportant and 5, very important.

• *Weighting of variables.* Software experts assigned a weight from 0 to 100, where 0 = was the minimum weight and 100, the maximum weight.

In addition to the 12 experts who participated in the strategic prospective workshop, 30 other experts who had not been able to attend the workshop due to location and time factors also participated in the survey.

The questionnaire of 22 questions was accompanied by a cover letter that stated the purpose of the Delphi survey and practicalities (response time, guarantee of anonymity).

To ensure reliable survey results, it was very important to verify that participants were, indeed, experts. The survey accordingly included four questions pertinent to identification that aimed to determine the veracity of the expert's career as well as three control questions that allowed his/her expertise to be measured to ensure accurate survey data.

The questions allowing direct identification of experts and their competence are 1, 2, 3, 4, 5, 6, and 19. In addition, all other questions had the option "Know nothing about it" for ongoing monitoring.

The survey also included three questions that helped identify the factors that determine product value in MSMEs developing custom software in Colombia, as well as 12 questions that helped identify market needs to help determine which products could satisfy these needs and their evolution over a given time period.

The Delphi's survey was placed on a Web site (www.encuestafacil.com), and a Google Group forum was created so the 42 survey participants could ask questions. They had 30 working days to complete the survey. Once the experts submitted the completed surveys, these were analyzed and a second Delphi survey was prepared taking into account the recommendations given in this initial survey.

Although one advantage of applying a Delphi survey is that almost always a consensus is reached regarding the development of successive questionnaires, this unfortunately does not always translate into coherence. In general, valuable and abundant information is gathered during the consultation on events, trends, and breakthroughs in the future evolution of the problem under study (Parquesoft, 2011).

Second Delphi survey

The second streamlined Delphi survey was sent to the same group of 42 software experts, which

included professors of software engineering as well as entrepreneurs affiliated to FEDESOFT, for completion. The survey aimed to identify trends and viewpoints on the development of the software industry.

Results

The results of each one of the questions of the second Delphi survey are analyzed and grouped by theme.

Part 1: Identifying the expert

This section gathers basic information about the expert, place of origin, and area of expertise to determine the degree of relevance of answers.

1. Please indicate your city of origin.

Answers show that experts are concentrated in the city of Cali, where there are numerous software development companies (Table 2).

Table 2. City of origin of survey respondents.

City of origin	Number of answers	Percentage of total
Bogotá	8	20%
Bucaramanga	3	7%
Buga	1	2%
Cali	17	41%
Medellín	9	22%
Palmira	1	2%
Tuluá	2	5%
Total	41	100%

2. Please indicate your country of origin.

All 42 survey respondents are Colombian; however, the information on where they are currently working was not validated.

3. Based on your knowledge of the software industry, please rank yourself in one of the following categories.

According to the answers given by respondents, only 50% considered themselves to be experts in the field; however, experts and knowledgeable in the field totaled 81%, meaning that respondents have a pretty good level of knowledge (Table 3). Other questions

made later on in the survey further validated the level of knowledge of survey respondents.

Table 3. Self-assessment of knowledge by survey respondents.

Self-assessment of knowledge	Number of answers	Percentage of total
Expert	21	50%
Knowledgeable	13	31%
Well-informed	6	14%
Familiar with	2	5%
Informed	0	0%
Total	42	100%

4. Please indicate how long you've been working in the software industry.

According to survey results (Table 4), 64% of survey respondents have more than 10 years of experience in the software sector, which is considered quite long due to sector dynamics and the short time that the Colombian market has been growing. People with more than 5 years in the sector are also an important source of insight and relevant feedback.

Table 4. Years of experience of survey respondents in the software industry.

Years of experience in the software industry	Number of answers	Percentage of total
0–5	7	17%
6–10	8	19%
11–15	11	26%
More than 15	16	38%
Total	42	100%

5. Please mark the sector (or sectors) you currently belong to.

Answers evidenced that most respondents are directly related to the software industry, either working with software development companies (44%), as software producers (19%), or as software distributors (11%), the three sectors accounting for 74% (Table 5).

Other sectors included the following: auditing, marketing companies, direct contractors, service companies, health promotion organizations (known in Colombia as "entidades promotoras de salud" or EPSs), technology sector, and telecommunications. None of these, however, were representative, having been selected by only one respondent each.

Table 5. Sector to which survey respondents belong.

Sector that you currently belong to	Number of answers	Percentage of total
Software development companies	25	44%
Software distributors	6	11%
Software producing companies	11	19%
Academia	7	12%
Government	1	2%
Others (please specify)	7	12%
Total	57	100%

6. Please indicate your position within your organization.

Because this was an open question, there was a broad range of answers as evidenced in Table 6. Positions were accordingly grouped to facilitate analysis (Table 7). Results indicated that 42% of survey respondents occupied managerial positions and 29%, executive positions. Therefore the majority of the experts participating in the survey had decision-making power over study variables.

Part 2: Identifying market trends

This section of the survey aims to analyze the market trends pertinent to the software industry.

7. What are the main reasons why users need or use custom software products developed by MSMEs? Rank each reason from 0 to 5, where 0 is unimportant and 5, very important.

According to survey results, post-sale service support ranks first in importance, while price and innovation are considered by most survey respondents as of intermediate importance (Table 8).

8. Which of the following aspects cause the greatest satisfaction or dissatisfaction when users purchase custom software in Colombia based on their expectations? Rank each option from 0 to 5, where 0 is no satisfaction and 5, high customer satisfaction.

Survey results indicate that many aspects have impact the way customers rank their level of satisfaction (score of 3), including innovation. Price, however, was given a high score in terms of level of satisfaction (Table 9).

Table 6. Position occupied by survey respondents within their organizations

Position you occupy within the organization	Number of answers	Percentage of total
Development analyst	1	2%
Head analyst	1	2%
Advisor	1	2%
External auditor	1	2%
Personal insurance assistant	1	2%
CEO	1	2%
Consultant	1	2%
Coordinator Customer Support Services	1	2%
Dean Faculty of Engineering	1	2%
Developer	1	2%
Director	1	2%
Product director	1	2%
Project director	1	2%
Executive director	1	2%
General director	1	2%
Professor	3	7%
Manager	8	20%
Project manager	1	2%
Software Quality Assurance (SQA) manager	1	2%
General manager	3	7%
General manager	1	2%
Information engineer	1	2%
Head of Corporate Systems	1	2%
Head of Information Solutions	1	2%
Project leader	1	2%
Marketing	1	2%
Chair	3	7%
Vice-chair	1	2%
Total	41	100%

Table 7. Grouping of positions occupied by survey respondents.

Position within the organization	Percentage of total
Software developer	10%
Consultant	7%
Executive	29%
Manager	41%
Professor	7%
Others	5%

Table 8. Reasons why users need or use custom software products developed by MSMEs in Colombia.

Main reasons	Level of importance				Total
	0 = Null	1–2 = Low	3 = Intermediate	4–5 = High	
Post-sale support	0.00%	12.50%	18.75%	68.75%	100%
Innovation	0.00%	25.00%	62.50%	12.50%	100%
Knowledge	0.00%	6.25%	43.75%	50.00%	100%
Confidence	0.00%	18.75%	12.50%	68.75%	100%
Price	0.00%	0.00%	18.75%	81.25%	100%
Another reason	75.00%	0.00%	0.00%	25.00%	100%

Table 9. Aspects causing satisfaction/dissatisfaction among custom software customers in Colombia.

Aspect	Level of satisfaction				Total
	0 = Null	1–2 = Low	3 = Intermediate	4–5 = High	
Broad portfolio of products	0.00%	31.25%	43.75%	25.00%	100%
Innovation	0.00%	18.75%	68.75%	12.50%	100%
Product presentation	0.00%	13.33%	66.67%	20.00%	100%
Usability	0.00%	12.50%	25.00%	62.50%	100%
Speed	0.00%	6.67%	33.33%	60.00%	100%
Price	0.00%	6.25%	12.50%	81.25%	100%
Another aspect	81.00%	0.00%	0.00%	18.75%	100%

9. Which of the following aspects have greater or lesser importance when users select a custom software development company in Colombia? Rank each aspect from 0 to 5, where 0 is unimportant and 5, very important.

Survey results show that aspects such as support and knowledge are considered important as well as the cost-benefit ratio. The company's financial stability and experience are ranked second in importance, receiving 4 as score (Table 10).

10. What importance will the following factors have in custom software development companies in Colombia during the period 2014–2018? Rank each factor from 0 to 5, where 0 is unimportant and 5, very important.

Survey results indicate that 75% of the respondents rank the company's reputation in the Colombian market as well as the company's cost-efficiency as very important. Experts also consider that the company's financial stability and pertinent certifications will become increasingly important (Table 11).

11. In which of the following areas will custom software development companies invest more during the period 2014–2018 in Colombia? Please give an estimate (percentage-wise) from 0 to 100, making sure that the sum of weights for each period is 100%.

Answers to this question were homogenous, with experts giving similar estimates (Table 12). Systems outsourcing and systems integration should, however, be highlighted although few experts did so. Currently this is a trend showed by small software companies in view of the need to offer complementary services in outsourcing the integration of products developed by larger companies.

12. Which of the following will be the main obstacles for MSMEs to market software in Colombia during the period 2014–2018? Please give an estimate (percentage-wise) from 0 to 100, making sure that the sum of weights given is 100%.

According to the experts, fiscal policy will continue to be an impediment; however, trends like free software are beginning to appear, which could be considered a threat if gradually introduced into

Table 10. Importance of aspects considered by users when selecting a custom software development company in Colombia.

Aspect	Level of importance				Total
	0 = Null	1–2 = Low	3 = Intermediate	4–5 = High	
Knowledge	0.00%	0.00%	18.75%	81.25%	100%
Integration	0.00%	12.50%	31.25%	56.25%	100%
Response	0.00%	6.25%	25.00%	68.75%	100%
Innovation	0.00%	6.25%	68.75%	25.00%	100%
Experience	0.00%	0.00%	12.50%	87.50%	100%
Financial stability	0.00%	6.25%	25.00%	68.75%	100%
Cost-benefit	0.00%	0.00%	12.50%	87.50%	100%
Support	0.00%	0.00%	6.25%	93.75%	100%
Another aspect	93.75%	0.00%	0.00%	6.25%	100%

Table 11. Importance of different factors for custom software development companies in Colombia during the period 2014–2018.

Factor	Level of importance				Total
	0 = Null	1–2 = Low	3 = Intermediate	4–5 = High	
Company size	6.00%	25.00%	37.50%	31.25%	100%
International prestige	12.00%	31.25%	25.00%	31.25%	100%
International endorsement	6.00%	43.75%	18.75%	31.25%	100%
Reputation on the Colombian market	0.00%	12.50%	12.50%	75.00%	100%
Financial stability	0.00%	12.50%	18.75%	68.75%	100%
Cost-efficiency	6.00%	6.25%	12.50%	75.00%	100%
Compliance with regulatory aspects	6.00%	6.25%	18.75%	68.75%	100%
Monitoring of service performance	6.00%	12.50%	31.25%	50.00%	100%
Policies of social responsibility/sustainable development in place	0.00%	37.50%	18.75%	43.75%	100%
Pertinent certifications or qualifications (ISO, CMM, CMMI, etc.) in place	0.00%	0.00%	31.25%	68.75%	100%
Another aspect	81.00%	0.00%	0.00%	18.75%	100%

the industry (Table 13).

13. Which of the following market trends will be the main trends of software demand for MSMEs in Colombia for the period 2014–2018? Please give an estimate (percentage-wise) from 0 to 100, making sure that the sum of weights given is 100%.

Experts believe that software for telecommunications will dominate the market (Table 14); however, the telecommunications market tends to be an oligopoly, which contradicts what the experts indicated.

Part 3: Potential market

This section of the survey aims to identify the potential market of small software companies in Colombia.

14. Do you think custom software development companies in Colombia could export their products during the period 2014–2018? Rank each option from 0 to 5, where 0 is improbable and 5, highly probable.

Experts ranked the probability of exporting custom software during this period between intermediate and high (Table 15).

Table 12. Areas in which custom software development companies should invest during the period 2014–2018.

Area of investment	Level of investment				Total
	0 = Null	1–40 = Low	41–79 = Intermediate	80–100 =High	
Consultancy	0%	64%	14%	21%	100%
Outsourcing of information system	7%	57%	7%	29%	100%
Processing services	7%	71%	14%	7%	100%
Outsourcing of applications	7%	50%	21%	21%	100%
Systems integration	7%	43%	21%	29%	100%
Development of software application	14%	57%	14%	14%	100%
Software support and main-tenance	14%	57%	21%	7%	100%
Hardware support and maintenance	14%	71%	7%	7%	100%
Networking consultancy and integration	21%	57%	7%	14%	100%
Outsourcing of desktops and networking	14%	57%	14%	14%	100%
Education and training in information technology	14%	57%	7%	21%	100%
Another area	93%	0%	0%	7%	100%

Table 13. Main obstacles for MSMEs to market software in Colombia during the period 2014–2018.

Obstacle	Level of obstruction				Total
	0 = Null	1–40 = Low	41–79 = Intermediate	80–100 = High	
Piracy	8%	67%	25%	0%	100%
Fiscal policy	0%	83%	8%	8%	100%
Telecommunications	8%	83%	0%	8%	100%
Free software	0%	75%	25%	0%	100%
Positioning of trademarks	8%	67%	25%	0%	100%
Another obstacle	83%	0%	17%	0%	100%

15. Which are the five most important software development companies in Colombia? Indicate in descending order of importance.

This question sought to validate the experts' knowledge about the current software market. Results indicated that the companies indicated by the experts were indeed large media companies and well-known in the sector. These were PSL Software, Open Systems, Softbolivar, Heisonh, and Parquesoft.

16. Based on the following options, what type of company could monopolize the custom software market in Colombia during the period 2014–2018? Please give an estimate (percentage-wise) from 0 to 100, making sure that the sum of weights given is 100%.

The answers to this question sought to reveal a type of company that could potentially monopolize the field of software development; however, the percentages assigned to large Colombian companies, foreign multinationals, and Colombian MSMEs were very similar, indicating that, according to the experts, no monopoly will occur in this sector (Table 16).

Part 4: Public policies

This section of the survey explores experts' opinions on public policies already in place or that will soon be adopted by the Colombian government.

17. Based on the following options, what strategies should be implemented in Colombia to strengthen

Table 14. Market trends for software demand for MSMEs in Colombia during the period 2014–2018.

Trends	Estimate				Total
	0 = Null	1–40 = Low	41–79 = Intermediate	80–100 = High	
Sale and installation of software	11%	78%	11%	0%	100%
Consultancy services in information technology	11%	56%	33%	0%	100%
Customized software development	0%	67%	11%	22%	100%
Software implementation	0%	56%	33%	11%	100%
Systems support	11%	44%	44%	0%	100%
Capacity building in information technology	0%	67%	22%	11%	100%
Systems integration	22%	44%	11%	22%	100%
Project management	11%	44%	44%	0%	100%
Sale and installation of hardware	33%	33%	33%	0%	100%
Outsourcing of technology	11%	44%	33%	11%	100%
Data processing	22%	56%	22%	0%	100%
Telecommunications	11%	33%	33%	22%	100%
Leasing of software	22%	33%	44%	0%	100%
Leasing of hardware	33%	33%	33%	0%	100%
Another trend	78%	11%	0%	11%	100%

Table 15. Probability of custom software development companies in Colombia exporting their products for the period 2014–2018.

Exports	Level of probability				Total
	0 = Null	1–2 = Low	3 = Intermediate	4–5 = High	
Exports of products by custom software development companies in Colombia	0.00%	7.69%	53.85%	38.46%	100%
Practical development (Second Delphi Survey)	42	Use of ICTs			

the MSME software sector during the period 2014–2018? (Departamento Nacional de Planeación, 2007). Please give an estimate (percentage-wise) from 0 to 100, making sure that the sum of weights given is 100%.

Survey results revealed for this time period strategies should mainly address an increase in productivity, followed by a strengthening of the software sector, both already underway in Colombia (Table 17).

18. Based on the following options, which actions should be implemented in Colombia to strengthen the software development industry during the period 2014–2018?. Rank each option from 0 to 5, where 0 is unimportant and 5, very important.

Experts ranked bilingualism as very important, followed by human capital for research (Table 18).

They also considered that public policies should be oriented towards improving access to funding resources as well as adjusting normative and regulatory instruments, which is consistent with the answers they gave to other questions where both access to capital and payment of taxes were ranked as important.

Part 5: Product valuation

In this part, experts were asked about different estimation methods used by projects as well as the most frequently used values.

19. Rank your knowledge about each of the following software development processes from 1 to 5, where 1 means you know nothing about it; 2, you know it exists; 3, you are familiar with the process; 4, you understand the process; and 5, you're an expert in the process.

Table 16. Type of company that could monopolize the custom software market in Colombia for the period 2014–2018.

Type of company	Estimate				Total
	0 = Null	1–40 = Low	41–79 = Intermediate	80–100 = High	
Foreign multinationals	0%	73%	18%	9%	100%
Large Colombian companies	18%	55%	27%	0%	100%
Colombian MSMEs	18%	64%	18%	0%	100%
Colombian public sector	36%	64%	0%	0%	100%
Another type of company	64%	27%	0%	9%	100%

Table 17. Strategies that should be implemented in Colombia to strengthen the MSME software sector during the period 2014–2018.

Strategy	Estimate				Total
	0 = Null	1–40 = Low	41–79 = Intermediate	80–100 = High	
Internationalization of the software sector and associated services	0%	45%	27%	9%	82%
Strengthening of productivity of the software sector and associated services	0%	45%	27%	27%	100%
Positioning in the domestic market	0%	45%	27%	9%	82%
Innovation	0%	36%	18%	18%	73%
Strengthening of the sector	0%	45%	27%	18%	91%
Creation of a national software development center	0%	45%	27%	9%	82%
Another strategy	0%	18%	0%	0%	18%

Answers indicated a lack of experts in different development methodologies. Although survey respondents knew these methodologies existed, none considered themselves to be experts in the field (Table 19).

20. Which of the following software development processes could be used in the custom software industry in Colombia during the period 2014–2018? Please give an estimate (percentage-wise) from 0 to 100, making sure that the sum of weights given is 100%.

Experts believe that Extreme Programming and the Rational Unified Process (RUP) will dominate during the period 2014–2018 (Table 20).

21. Which of the following options can be used to protect custom software against piracy and plagiarism in Colombia's software market during the period 2014–2018? Please give an estimate (percentage-wise) from 0 to 100, making sure that the sum of weights given is 100%.

Copyright was considered as an effective way to protect against software piracy. Although experts also considered other forms of protection, these involved copy protection through hardware and changing the licensing model.

22. Which of the following factors, other than costs, are important in determining the price of your product during the period 2014–2018? Rank each option from 0 to 5, where 0 is unimportant and 5, very important

Experts consider the following factors as important in descending order for the period 2014–2018: the project's impact and accountability; the company's prestige and credibility; and market competitiveness, while less important was given to the type of client (Table 22).

Discussion

A consultation of experts conducted during a strategic prospective workshop and the application of a Delphi survey helped identify market variables

Table 18. Actions that should be implemented in Colombia to strengthen the software development industry during the period 2014–2018.

Action	Level of importance				Total
	0 = Null	1–2 = Low	3 = Intermediate	4–5 = High	
Access to financial resources	0.00%	10.00%	20.00%	70.00%	100%
Connectivity	0.00%	20.00%	10.00%	70.00%	100%
Communications development	0.00%	20.00%	30.00%	50.00%	100%
Infrastructure/Equipment	0.00%	50.00%	40.00%	10.00%	100%
Infrastructure/Public services	0.00%	50.00%	30.00%	20.00%	100%
Infrastructure/Roads and transportation	0.00%	70.00%	20.00%	10.00%	100%
Bilingualism	0.00%	0.00%	10.00%	90.00%	100%
Human capital for research	0.00%	10.00%	10.00%	80.00%	100%
Formation of human capital/Basic skills	0.00%	10.00%	50.00%	40.00%	100%
Formation human capital/Job-related skills	0.00%	0.00%	40.00%	60.00%	100%
Generation of employment	0.00%	0.00%	30.00%	70.00%	100%
Technology innovation, transfer, and adaptation	0.00%	10.00%	0.00%	90.00%	100%
Adjustments and normative and regulatory instruments	0.00%	30.00%	10.00%	60.00%	100%
Rationalization of processes and procedures	0.00%	40.00%	30.00%	30.00%	100%
Other actions	90.00%	0.00%	0.00%	10.00%	100%

Table 19. Level of knowledge of survey respondents about different software development processes.

Development process	Level of knowledge					Total
	1 = Know nothing about it	2 = Know it exists	3 = Am familiar with process	4 = Understand the process	5 = Expert in the process	
Rational Unified Process (RUP)	7.69%	15.38%	23.08%	53.85%	0.00%	100%
Microsoft Solutions Framework (MSF)	30.77%	15.38%	15.38%	38.46%	0.00%	100%
Extreme programming	0.00%	23.08%	15.38%	61.54%	0.00%	100%
Scrum	30.77%	7.69%	23.08%	30.77%	7.69%	100%
Other development processes	0.00%	0.00%	0.00%	15.38%	7.69%	23%

as well as external and internal factors of Colombia's software sector that affect product pricing by MSMEs engaged in custom software development in the country for the study period (2014–2018).

In the specific case of the Delphi survey, the variables identified as pertinent to the valuation of products by MSMEs engaged in custom software development in Colombia for the study period were as follows: product post-sale service support; product price; company expertise, stability, experience, technical support offered, cost-efficiency,

compliance of regulatory aspects, and reputation on the Colombian market; outsourcing; systems integration; obstacles posed by fiscal policies, trademark positioning, piracy, and free software; telecommunications software; export of products developed by custom software companies in Colombia; access to financial resources; connectivity; communications development; infrastructure (facilities, public services, roads, transportation); bilingualism; human capital for research; formation of human capital (basic skills and job-related

Table 20. Software development processes that could be used by the custom software industry in Colombia during the period 2014–2018.

Development process	Estimate				Total
	0 = Null	1–40 = Low	41–79 = Intermediate	80–100 = High	
Rational Unified Process (RUP)	11%	67%	11%	11%	100%
Microsoft Solutions Framework (MSF)	22%	67%	11%	0%	100%
Extreme programming	0%	56%	22%	22%	100%
Scrum	33%	44%	11%	11%	100%
Other development processes	67%	11%	11%	11%	100%

Table 21. Options to protect custom software against piracy and plagiarism in Colombia's software market during the period 2014–2018.

Form of protection	Estimation
Invest in security so its systems are not copied	21%
Invest in copyright	33%
Send developed application with sources included	14%
Other forms of protection	32%

Table 22. Factors determining software product price during the period 2014–2018.

Factor	Level of importance				Total
	0 = Null	1–2 = Low	3 = Intermediate	4–5 = High	
Type of client	0.00%	25.00%	62.50%	12.50%	100%
Prestige and credibility of company	0.00%	25.00%	12.50%	62.50%	100%
Impact and accountability of project	0.00%	12.50%	25.00%	62.50%	100%
Market competitiveness	0.00%	0.00%	50.00%	50.00%	100%
Other factors	75.00%	0.00%	0.00%	25.00%	100%

skills); generation of employment; adjustments and normative and regulatory instruments; rationalization of processes and procedures; innovation; technology transfer; and technology adaptation.

Conclusions

The study and identification of variables affecting the software industry in Colombia allowed a consensual diagnosis of the problems and risks faced by the sector during the period 2014–2018 due to a lack of efficient management and financial models, high costs, and lack of access to capital.

Market trends

• The most important reasons why users need or use software are for post-sales service support, pricing, and innovation, the latter two being ranked as of intermediate importance by most survey respondents.

• Aspects such service support and knowledge are considered important as well as the cost- benefit ratio.

• A company's reputation on the Colombian market as well as its cost-efficiency, financial stability, and certifications are also relevant aspects identified by experts.

• Systems outsourcing as well as systems integration were the areas in which companies invested most.

• The market share of Colombian software development companies will gradually decrease, perhaps because experts do not foresee a growth in this sector or because large information systems developed abroad will be gradually introduced.

• Fiscal policy will continue to be an impediment; however, trends such as free software are beginning to appear, which could be considered by some as a threat if gradually introduced into the industry.

• The market trends of software demand in Colombia indicate that software for telecommunications dominates; however, the telecommunications market tends to be an oligopoly, which contradicts the statement of experts.

• Regarding the main way of distributing software in Colombia, there was a clear tendency for small software companies to sell their products directly, especially if dealing with custom software. There is also a growing trend for packaged software, indicating that the industry is shifting from directly selling information systems to packaging these systems.

Potential markets for custom software

• Experts consider the probability of exporting custom software to be from intermediate to high.

• Very similar scores were given to large Colombian companies, foreign multinationals, and Colombian MSMEs. Therefore experts do not foresee a monopoly in this sector.

Public policies

• As already evident, there is interest in improving productivity, followed by the strengthening of the software sector.

• Experts ranked bilingualism as very important, followed by human capital for research. They also considered that public policies should be oriented

towards improving access to funding resources as well as adjusting normative and regulatory instruments, which is consistent with the answers they gave to other questions where both access to capital and payment of taxes were ranked as important.

Product valuation

• Answers indicated a lack of experts in different development methodologies. Although survey respondents knew these methodologies existed, none considered themselves to be experts in the field.

• Experts believe that Extreme Programming and the Rational Unified Process (RUP) will dominate during the period under study.

• Copyright was considered as an effective way to protect against software piracy. Although experts also considered other forms of protection, these involved copy protection through hardware and changing the licensing model.

• Other than costs, experts consider the following to be important factors in descending order: the project's impact and accountability; the company's prestige and credibility; and market competitiveness, while less important was given to the type of client.

Methodology

• The use of ICTs facilitates the participation of experts across time, breaking time and spatial barriers.

• The Delphi survey appears to be a simple procedure that does not necessarily reflect a consensual view, but does differentiate groups of answers that can then be analyzed for multiple points of convergence. In this case, however, the process proved drawn out and little motivating for participants so the number of participating experts decreased as the study advanced.

• The strategic prospective workshop requires not only the commitment of workshop participants, but also a high investment in terms of time and travelling. As a result, the participation of experts decreased as the study advanced.

- This type of study requires commitment and use of personal time. Therefore resources are needed to motivate experts to participate. These study results should be verified in the future but resources must be invested to motivate experts and ensure their active and ongoing participation through the different phases of the study.

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