Missing Skills Destroy Iron Triangle of IS Purchasing

Närvä Juha, Kärri Timo, Metso Lasse

This is a   Publisher's version   version of a publication

published by Elsevier

in   Procedia Computer Science

Please cite the publication as follows:

Närvä, J., Kärri, T., Metso, L. (2023). Missing Skills Destroy Iron Triangle of IS Purchasing. Procedia Computer Science, vol. 219, pp. 554-562. DOI: 10.1016/j.procs.2023.01.513.

CENTERIS – International Conference on ENTERprise Information Systems / ProjMAN – International Conference on Project MANagement / HCist – International Conference on Health and Social Care Information Systems and Technologies 2022

Missing Skills Destroy Iron Triangle of IS Purchasing

Juha Närvä[a],*, Timo Kärri[b], Lasse Metso[b]

[a]Alkutaival 14, Ylöjärvi, 39160, Finland.
[b]Yliopistonkatu 34, 53850 Lappeenranta, Finland.

Abstract

The required purchasing skills have been evolving due to supply chain globalization, sustainability, and environmental requirements. Modern purchasing skills are also influenced by the expanding adaptation of complex Information Systems (IS) in enterprises. Complex technology purchasing requires the management of multiple organizations and unique competences, hence the needed IS purchasing skills required studies from a different angle. Compared to previous studies, the purpose of this study was to identify the skills required from a purchaser to manage complex IS purchases and address their risks. In-depth qualitative research reveals that the IS purchaser is required to understand SW methodologies and possess strong interorganizational skills in addition to traditional purchasing skills in order to run successful IS purchases. Based on the findings, the study proposes additional technical and project methodological training for educators and purchasing professionals to succeed in IS purchases.

1. Introduction

A lack of skills required for managing an IS purchase process is expected to lead to a situation where the IS purchase requirements are not well understood, resulting in an unwanted outcome of the IS purchase. A very common way of evaluating a purchase project achievement is by looking at the project's schedule, quality, and costs [10]. How the schedule, quality and costs (iron triangle) are achieved in an IS project depends on the different skills of the purchasing

---

* Corresponding author.
  E-mail address: juha.narva@student.lut.fi

team. Complex IS purchases increase the need for social skills. Also, the need for technical skills will be more important in order to understand the phases of the IS purchase project and its deliverables, which have an important influence on quality, schedule and costs. Purchaser skills have been widely studied [14, 4, 5, 1]. However, they are missing essential development methodological skills of the deliverables in order to improve the probability of a successful IS purchase. The purchaser's technological and methodological skills provide over-all understanding of the project. A technically skilled purchaser is able to monitor project development, which forms the base for the commercial and juridical contract negotiations of the purchase, and to monitor project deliverable development ensuring that the project's target requirements are followed.

The purpose of this study was to identify the skills required from an IS purchaser to manage IS purchases and their special risks. The interviewees represented significant IS purchasing experience on a global scale. The representative's know-how provides new and valuable benchmark information for engineering science research to be utilized in purchasing training. Hence this study will set the requirements for new needed IS purchasing skills compared to earlier studies and, therefore, the study produces new interdisciplinary scientific knowledge. The skills needed by a world class purchaser of emerging IS technology were clarified by using the following research questions:

RQ1 How is a successful IS purchase defined in the literature and by experienced purchasing professionals?
RQ2 Which of the purchaser's skills are seen as the most important for achieving IS purchase targets?
RQ3 What are the new required purchasing skills for IS purchases?

2. Literature Review

2.1. Purchasing Skills in the Literature

Networking (social) skills are at the top of the skill set based on Stek and Schiele [14] research. They highlight empathy, honesty, customer orientation, and the ability to solve problems (Table 1). The imagination skill based on them includes willingness to learn. At the bottom of the top skills, they list technical knowhow of products and production, including knowledge of the company's own technical requirements. For some reason, leadership skills are at the bottom of their list, but many of the other social skills, like networking, sellership and cross-functional coordination, could be comprehended as part of the leadership skills.

The top purchasing skills summarized by Giunipero et al. [4] included team building skills (Table 1), leadership skills, decision-making skills, influencing, and compromising skills. The strategical skills they listed included project scoping, goal setting, and execution. Another social type of skill set listed was communication skills, including presentation, public speaking, listening, and writing skills. The technical skills listed included web-enabled research and sourcing analysis. It is noteworthy that they mentioned that the purchaser needs to address the internal and external requirements and exploit the supplier's technological capabilities to add value. However, they did not identify the skills needed for it. The purchaser is in key position to recognize the tactical and strategical value adding opportunities of the technology provided by the supplier. This requires technological awareness from the purchaser.

Earlier studies by Giunipero et al. [5] listed skills required by world class purchasers (Table 1). According to them, the required world class purchaser skill set consist of: "1 strategic thinking, 2 supply base research, 3 structuring supplier relationships, 4 technology planning, and 5 supplier cost targeting". It is true that purchasing has become more strategic over the years [5], but they consider globalization and strategic purchasing, not emerging technological requirements.

Interestingly enough, in the research by Tassabehji and Moorhouse [16], technical skills receive special attention (Table 1). According to their study, the technology base is changing and causing challenges and opportunities for purchasers. This is due to the new technological purchasing systems, including artificial intelligence and data mining, bringing more intelligence into decision making and analysis. They do not address special technological challenges due to the integration of the purchased system. The reason for that may be that qualitative analysis was done on purchasing professionals, who mainly deal with transactional purchases.

In Knight et al. [8] research, social skills are ranked at the top (Table 1). According to their study, the importance of those skills rises when the market risks and complexity as well as product importance rise. To address the risks and complexities, they propose categorizing different purchasing portfolios. According to their study, the categorization

should be implemented based on commercial characteristics rather than technical properties or industry sectors. This may tell that the purchasing professional having participated in the research survey had purchasing responsibilities limited to simple and standard products.

Table 1. Literature summary of top skills.

Source	Skill categories	Top skills
Stek and Schiele, 2021. [14]	*No indicated categories*	*- Networking, result orientation, imagination, sellership, cross-functional cooperation, forecasting skills, cost focus, contracting skills, supplier relationship management, innovation sourcing, analytics, leadership, organizational insight and governance, automation, and technical knowhow of products and production*
Giunipero et al., 2006. [4]	*Team building*	*- Leadership, decision-making, influencing, compromising*
	Strategic planning	*- Project scoping, goal setting, and execution*
	Communication skills	*- Presentation, public speaking, listening, and writing*
	Technical skills	*- Web-enabled research and sourcing analysis*
	Broader financial skills	*- Cost accounting and making the business case*
Giunipero and Pearcy 2000. [5]	*- Strategic skills*	*Strategic thinking, supply base thinking, structuring supplier relationships, technology planning, and supplier cost targeting*
	- Behavioural skills	*- Interpersonal communication, risk taking/entrepreneurship, creativity, and inquisitiveness*
	- Process management skills	*- Organization/time management, tactfulness in dealing with others, written communication, problem solving, and conflict resolution*
	- Negotiation skills	*- Negotiation, customer focus, influencing and persuasion, and understanding business conditions*
	- Team skills	*- Teamwork, leadership, managing change, managing internal customers, salesmanship*
	- Quantitative skills	*- Computational, technical, blueprint reading, and specification development*
	- Decision-making skills	*- Computer literature and ability to make decisions*
Tassabehji and	*- Technical skills*	*- Technical knowledge, basic administrative skills, and advanced procurement process skills*
Moorhouse, 2008. [16]	*- Interpersonal skills*	*- Oral communication, recognizing own strengths, and leadership*
	- Internal enterprise skills	*- Organization-wide financial skills, change management, managing internal customers, and communicating and selling message/strategy internally*
	- External enterprise skills	*- Work in cross-functional team, supplier relationship management skills, and stakeholder mapping proficiency*
	- Strategic business skills	*- Demonstrating the ability to add value throughout the organization, risk management and managing strategic alliances/partnership*
Knight et al., 2013. [8]	*No indicated categories*	*- Communication skills, negotiation skills, influencing and persuasion, decision-making skills, problem-solving skills, coordination skills, conflict resolution, ability to work in teams, leadership, managing internal customers, customer focus, project management, change management, strategic thinking, computer literature, analytical skills, mathematical skills, blueprint reading, technical writing, product knowledge, specification development, understanding manuf. terminology, forecasting skills, cost analysis, quality management, supplier evaluation, supplier cost targeting, understanding business conditions, supplier relationship management, supply base research, managing strategic partnerships, and risk management*

Giunipero et al. [5] mentioned in their article the importance of the strategic category by which purchasing is able to contribute positively to a company's long-term performance. According to their study, interpersonal communication

is considered the most important individual skill by which the purchaser is able to pass ideas and raise concerns and thoughts with others within the company. In a later study, Giunipero et al. [4] saw social skills as the most important skill for the purchaser to be able to add strategical value to the purchase projects. They found that if purchasing is included in the purchase project at a late stage, there is very little opportunities for additional gains by purchaser negotiations. The business administration (BA) category was considered important [1] and, in that category, analytical skills were a top skill because of data driven purchasing, followed by the social category and communication skills.

3. Methodology

The selected strategy for the study was a cross-case study of 12 company cases for a systematic comparison and analysis of their similarities [12]. Each case was analyzed as a single case and compared to each other. The case studies were implemented in 2021–2022 by defining the scope, collecting, and analyzing literature from the selected area, collecting empirical data in two phases, and analyzing them based on theory. For this research, 12 case companies (anonymized) were selected (Table 2).

Table 2. Case company demographics, number of employees, and companies' turnover

Case company	Industry	Company Origin	No. Of Employees*	Turnover in €*	Interviewees position	Experience, years
A	Electronics	Finland	> 50 000	> 10bn	Sourcing Manager	>15
B	Electronics	Sweden	> 100 000	> 1bn	Sourcing Manager	>10
E	Marine	Finland	> 1000	> 0,1bn	IT Manager	>20
G	Electronics	China	> 100 000	> 50bn	Technology Director,	>20
H	Electronics	USA	> 100 000	> 50bn	Engineering Manager	>15
K	Software	USA	> 100 000	> 10bn	Head of Sourcing	>20
L	Electronics	Finland	> 1 000	> 0,1bn	CIO	>20
N	Electronics	Japan	> 10 000	> 10bn	Sr. Principal Scientist ICT	>15
O	Software	Finland	> 1 000	> 0,1bn	Contract Manager	>20
P	Electronics	France	> 50 000	> 10bn	Global Sourcing Manager	>15
R	Electronics	Japan	> 100 000	> 10bn	CIO	>20
V	Electronics	Finland	> 1 000	> 0,1bn	Category Manager	>20

* Based on companies' annual reports 2020. Exchange rates 29.1.2022.

The interviewees were selected based on their position and area of responsibility (Table 2) to ensure that they represented experienced emergent technology purchasing and to get insight into the skills needed for successful IS purchases. In order to find answers to the research questions, the semi-structured interview was divided into four themes: First, identify that the studied case and responder profile are suitable for IS purchase research. The second theme aimed to define a successful IS purchase. The third theme aimed to find the skills for achieving IS purchase targets. The fourth theme was the skills needed in the future.

4. Findings and Implications for Theory and Practice

The results of the semi-structured interviews deviated from previous studies (Table 1) by highlighting the importance of technical skills, which was due to technically complex IS purchases. On the other hand, the results supported the importance of social skills as found in previous studies. The responders highlighted that the importance of social skills will increase, as complex purchases require more internal and external communication, as well as technical project design understanding. Constant learning was seen as important in the future. New skills that were highlighted concerned the General Data Protection Regulation (GDPR). The results are presented in Table 3.

4.1. The Importance of Quality, Cost, and Schedule in an IS Purchase

The case interviews revealed that if the delivery schedule failed, it was due to improper quality (deliverables were not as intended, which required re-adjusting the work) which affected the due costs negatively and increased the amount of work. According to the interviewed company purchasers, quality is closely linked to costs. The common message from the interviewees was that an IS purchase is rarely successful.

An important finding (6 out of 12 cases) was that a purchase is clearly considered as a change, which is supported by the studies of Reich et al. [11]. In addition to IS development change, the change will affect the buyer organization (L), as the purchased system will change the way the company operates, how they are organized, or changes are needed in the company's processes. In this research, the purchaser is seen as a project manager (4 out of 12 cases) ensuring that interorganizational and supplier communications are coordinated, tracing actions, and monitoring progress.

4.2. Business Administration Skills Influencing IS Purchase Achievements

Both seller and buyer aim to reach financially meaningful results from the project, which is one of the basic purchase project objectives. To improve the opportunity to achieve the company's business objectives, coordinated internal and external dialog is needed at the very beginning (K, L, N, P, R) and, thus, it is essential that the project manager is appointed at a very early phase [15, 9]. K stated that "the purchasing manager will be more like the project manager, and I see that the project manager should have good social skills so that the person can come [sic] along with different kind[s] of persons".

In some of the studied IS purchases, there were no separate project managers and hence the person in charge of purchases acted as one. An essential part of the project management task is the ability to build and motivate a network of competent people, which will influence project performance [2, 6, 3]. The interviewees highlighted that it is important to ensure that the project and contract are aligned (K). In order to understand the contractual requirements of the project, both technical and commercial practicalities should be considered at an early phase of the project. The contract should include all essentials from the project, including key processes to manage changes (P). Change management is essential not only in project managerial work, but also in understanding how to take into account the changes in contracts (R, B, K, O, P, E). BA skills ensure that the basics of the supplier projects are in place (B, K, P, R).

4.3. How Social Skills Influence IS Purchase Achievements

In addition to complex IS purchases and supply chain globalization, the Covid-19 pandemic increased the importance of social skills due to the remote work model (L). In the studied companies, interorganizational trust was based on professionalism in project work which brings value to the project team. Professionalism can be either technical, commercial, or project managerial type. In the studied cases, commercial and technological discussion were closely linked, which requires technological understanding in purchasing. According to this research, IS purchase projects are subject to changes and, hence, the environment is not a constant (A, Q, R). The specification is a snapshot in time, which will change along with the project. The purchased IS solution should be competitive in the market when delivered, not when specified (A).

4.4. How Technical Skills Influence a Successful Purchase

A technically skilled person is expected to bring design method understanding and basic technical design principles into the project (H, N). The minimum requirement is to see the big picture of the project and its targets, contractual requirements, and project guidance. The interviewees were highlighting the importance of the marriage of technical and commercial understanding (A, E, G, H, K, N, R). According to the interviews, a successful purchase practitioner is a technically skilled person, who is not necessarily dependent on the person's organization (E). The results of this study highlight the importance of technical skills in project teams for successful IS purchases (A, E, G, H, K, N, R), while also noting that the purchaser often acts as project manager. Technical skills were needed to understand what kind of work and how much work is needed in order to understand realistic costs (G, K).

IS purchasing is a team effort highlighted by the interviewees (L, N, P, V). It is important to collect the people with the right skills together and communicate effectively, which requires strong social skills. This is supported by Kim and Kishore [7], who found in their research that the inaccuracy of information communication and users' inadequate understanding of information systems were in the top ten reasons for failure. Understanding of software design methods (A, G, H, L) and of SW interfaces (N) were considered essential. Purchasers who had a strong technical or software educational background did not need additional technical support elsewhere from the company organization, and they were able to negotiate and combine technological and commercial aspects into the contracts.

Deeper software testing and programming skills may not be seen as a must by P. The reason lies in the fact that the interviewees' roles in the companies were different from each other. In some of the companies, purchasing did receive strong support from the technical specialists (B). However, in these situations the purchasing team was not involved early in the purchase process which limited the negotiation capabilities. The interviewees proposed GDPR as a new skill to ensure personal data is protected and regulative processes are followed in all activities (P), including SaaS purchases. A SaaS contract requires risk management due to the fact that it is hard to get any modifications to standard supplier terms, and hence the contract is a compromise (O).

4.5. Skills Influencing the Quality, Cost, and Schedule of an IS Purchase

Compared to earlier studies, this research highlights the purchaser's design methods and technical skills to manage the iron triangle of an IS purchase and changes in commercial and contractual levels (Fig. 1). Social skills like communication, teamwork and leadership are seen as important for traditional purchasing. According to this study, they are even more important in complex IS purchasing which requires close interaction between internal and external project members.
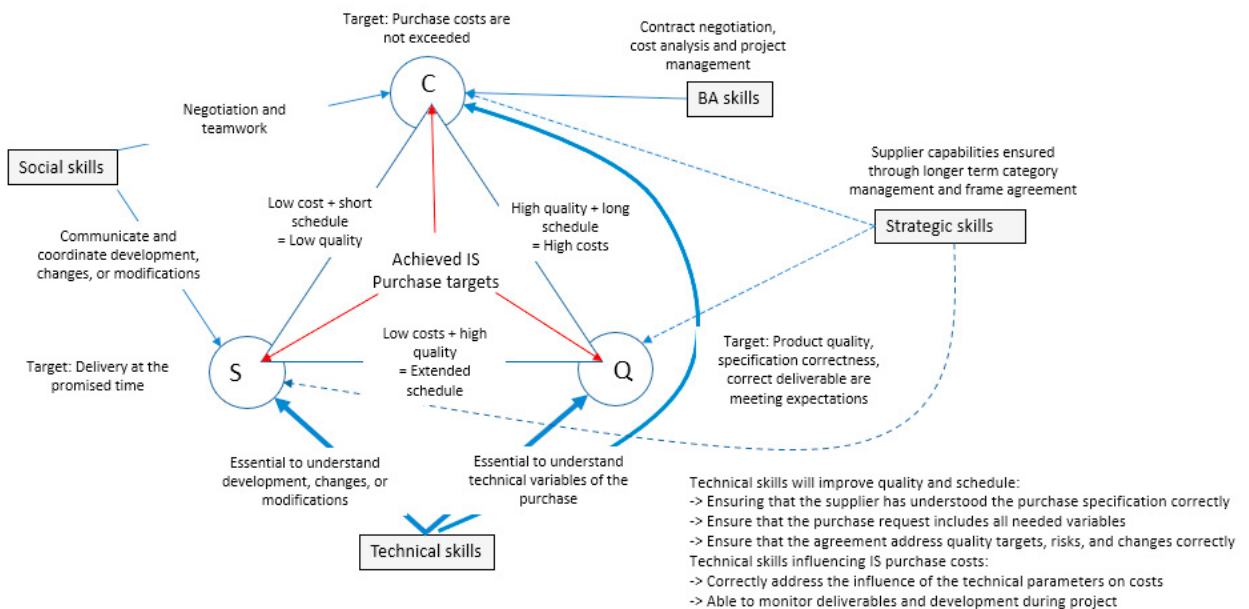

Fig. 1. The influencing mechanism of skills on quality, cost, and schedule based on this study. Picture modified from [10].

Quality, cost and schedule are linked to each other in the iron tringle (Fig. 1). If the allocated cost is low and the set schedule is short, it will deliver low quality. A pre-set high quality combined with a long schedule will cost more, and if the allocated costs are low with the expectation of high quality, the deliverable schedule is expected to be long [10]. As found in this study, technical skills have a strong negative influence on quality and schedule. If the quality requirements are not clarified or understood, it will have an effect on schedule and costs.

5. Discussion

The iron triangle parameters of an IS purchase are influenced by the purchaser's skills; however, this study interestingly enough found that quality is considered to be very important in having a direct effect on the schedule and costs when the project has additional changes made into the specifications or deliverables, which will stretch the schedule and cause the exceeding of costs. Hence, missing quality will destroy the iron triangle balance of the IS purchase. This study also revealed that when quality aspects are weighted and dealt with high priority and early enough in the IS purchase project, the probability of achieving the IS purchase targets increases (RQ1).

The research shows that BA skills are important for the purchaser, which supports earlier studies. It was also noted in this study that an understanding of commercial aspects does not guarantee a successful purchase. The research findings support the earlier findings on the importance of social skills [1, 4, 5], where miscommunications or misunderstandings being either internal or external were common issues in IS purchases.

One important finding based on this study was that the person responsible for purchasing is typically leading the purchase project by managing internal and external communication, scheduling, and action tracking. The purchaser-in-charge must get along and interlink with different kinds of people in order to achieve common goals with technical, legal, and business people. The findings suggest that leadership, influencing, and persuasion skills are essential to be able to communicate the status and needs clearly. Overall, change management is one important element of IS purchases as they undergo changes by nature, which affects project management and contractual items.

Table 3. The key skills ranked by the interviewees influencing successful IS purchases.

Social skills	Communication	Technical skills	Problem solving
	Leadership		Purchase management
	Teamwork		Execution
	Conflict management		GDPR
	Influencing		SW and Lean development procedure
Business Administration skills	Contractual understanding	Strategic skills	Change management
	Risk management		Managing internal customers
	Cost analysis		Supplier relationship management
	Understanding general business conditions		Supplier evaluation and analysis
	Time management		

The main finding of this research was that IS purchases fail due to quality, which has been caused by technical issues, because of understanding too late that the operational capabilities of the purchased system do not meet the expectations. The failure in technical issues is caused by a limited understanding of technical variables: misunderstanding specifications and miscommunication over technical requirements and/or proposed deliverables. Insufficient understanding of project technology and SW development methodologies makes it difficult to monitor the project, its risks, and changes, which will eventually cause a failure in updating the contract accordingly. Compared to earlier studies, this research proposes some level of understanding of software development procedures, software methodology, and software interfaces as new skills for an IS purchaser. With additional software procedure skills, the purchaser gains the opportunity to manage the IS purchase as a whole (Table 3).

6. Summary, Conclusions, and Implications

This research focuses on the role of the required purchasing skills in complex IS purchases to achieve a company's purchase targets. The finding was that the different skills needed in IS project purchases need to be linked seamlessly to each other to achieve the expected quality, schedule, and cost of purchase. Missing technical skills would have a negative effect on project costs and schedule through quality, supporting the importance of quality in achieving a successful IS purchase as defined by experienced purchasing professionals (RQ1).

Technical understanding of the intended IS purchase was a must skill to have in many of the case companies. When the iron triangle of the IS purchase was destroyed, it was either due to the required technological skills missing from the purchasing team, or the technical preparations having been done insufficiently. The study reveals that even good communication and BA skills did not guarantee successful IS purchases, if the purchaser did not have a basic understanding of development methodology. The missing technical skills have a negative influence on the IS purchase contract and its quality, cost and schedule. The technology skills highlighted by the interviewees were problem solving, purchase management, execution, and value chain understanding (RQ 2).

The new skills identified (RQ 3) in this research were lean development, SW development procedure, contractual understanding, and GDPR. Skills separately highlighted by the interviewees were artificial intelligence understanding, security know-how, use case specification, continuous learning ("learningship"), proof of concept understanding, hybrid-agile development, supplier engagement (SRM when using SaaS), and change adversity.

In this research, the IS purchaser has been seen as a commercially and technically skilled person playing a project managerial role ensuring interorganizational and supplier communication coordination, tracing actions, following the progress of the IS purchase, and ensuring its quality, cost, schedule, and contract correctness.

6.1. Limitations and Future Research

The scope of this research included large multinational companies from a limited industry, thus providing an in-depth view of that particular industry. A larger view of other industries could provide additional information on how they see the challenges of IS purchases. Additional information would create a larger study on the seller's views on IS purchases and how they see purchasing skills influencing successful IS purchases.

References

[1] Bals L., Schulze H., Kelly S., Stek K. (2019). "Purchasing and supply management (PSM) competencies: Current and future requirements." *Journal of Purchasing and Supply Management* **25**: 1-15.

[2] Blijleven, V., Gong Y., Mehrsai A. Koelemeijer, K. (2019). "Critical success factors for Lean implementation in IT outsourcing relationships." *Information technology & people* **32**: 715-730.

[3] Cram A. W., Brorman K., Gallupe B. R. (2014). "Information Systems Control: A Review and Framework for Emerging Information Systems Processes." *Journal of the Association for Information Systems* **17** (4): 216-266.

[4] Giunipero L., Handfield R. B., Eltantawy R. (2006). "Supply management's evolution: key skill sets for the supply manager of the future." *International Journal of Operation & Production Management* **26** (7): 822-844.

[5] Giunipero L. C. and Pearcy D.H. (2000). "World-Class Purchasing Skills: An Empirical Investigation." *The Journal of Supply Chain Management: A Global Review of Purchasing and Supply* **36**: 4-13.

[6] Hughes D. L., Dwivedi Y. K., Rana N. P., Simintiras A. C. (2017). "Information systems project failure - analysis of causal links using interpretive structural modelling." *Production planning & control* **27**: 1313-1333.

[7] Kim J. U. and Kishore R. (2018). "Do we Fully Understand Information Systems Failure? An Exploratory Study of the Cognitive Schema of IS Professionals." *Information systems frontiers* **21** (6): 1385-1419.

[8] Knight L., Tu Y-H., Preston J. (2013). "Integrating skills profiling and purchasing portfolio management: An opportunity for building purchasing capability." *Int. J. Production Economics* **147**: 271–283.

[9] Merikoski H., Savolainen P., Ahonen A. J. (2016). "Suppliers' software development project start-up practices." *International Journal of Managing Projects in Business* **10** (4): 880-896.

[10] Pollack J., Helm J., Adler. (2018). "What is the Iron Triangle, and how has it changed?" *International Journal of Managing Projects in Business* **11**: 527-547.

[11] Reich B. H., Gemino A., Sauer C. (2014). "How knowledge management impacts performance in projects: An empirical study." *International Journal of Project Management* **32**: 590-602.

[12] Ridder H-G. (2017). "The theory contribution of case study research designs." *Business Research* (10): 281-305.

[13] Standish Group. (2019). "Digital transformation Project." Available at: https://www.standishgroup.com/news/32

[14] Stek K. and Schiele H. (2021). "How to train supply managers – Necessary and sufficient purchasing skills leading to success." *Journal or Purchasing & Supply Management* **27**: 1-14.

[15] Sundararajan S., Marath B., Vijayaraghavan P. K. (2019). "Variation of risk profile across software life cycle in IS outsourcing." *Software Quality Journal* **27**: 1563–1582.

[16] Tassabehji R. and Moorhouse A. (2008). "The changing role of procurement: Developing professional effectiveness." *Journal of Purchasing & Supply Management* **14**: 55–68.