

Supervised Professional Practice and Agile Methodologies: Learning Opportunities in Information Systems Engineering

Ariella Quesada Rosales, Katty Vásquez Ávila, Róger Antonio León Brenes,
Carolina Gómez Fernández

Escuela de Informática
Universidad Nacional – Heredia – Costa Rica

{ariella.quesada.rosales,katty.vasquez.avila,roger.leon.brenes,
carolina.gomez.fernandez}@una.cr

Abstract. *The software industry increasingly demands professionals able to work in agile environments, yet limited evidence exists on their implementation in university education, particularly in Supervised Professional Practice (PPS) within Information Systems Engineering. This study analyzes agile methodology implementation in PPS and its opportunities and challenges for student learning. A quantitative, descriptive design was applied through a questionnaire to 49 PPS supervisors at Universidad Nacional de Costa Rica in early 2025. Results show 73% of organizations use agile methodologies, more so in multinationals (94%) than the public sector (50%), while AI, cloud computing, and cybersecurity as key technologies.*

Keywords— *Agile methodologies, Costa Rica, Information systems engineering, Supervised professional practice*

1. Introduction

The expansion of the software industry and digital services has increased the demand for technological solutions across various productive sectors. According to Gartner (2026), global spending on enterprise software will grow from US\$1.25 trillion in 2025 to US\$1.44 trillion in 2026, an estimated increase of 15.1%. This scenario has led to increasingly dynamic environments characterized by frequent changes in requirements, shorter delivery cycles, and greater demands for adaptation and innovation.

Under these conditions, software development requires methodologies that support project management throughout the software development lifecycle. Traditionally, organizations have used planning- and control-based approaches, grounded in linear and predictable activities. However, these approaches have limitations when responding to changes and unforeseen events during project execution [Arzuaga Mejía 2025; Gemino et al. 2020; Insuasti Vidal 2021; Reaiche and Papavasiliou 2022].

In response to these needs, agile methodologies emerged, grounded in the principles of the Agile Manifesto [Beck et al. 2001], which promote collaborative work, adaptation to change, and the continuous delivery of value through iterative and incremental cycles. Their adoption has led organizations to demand professionals capable of working effectively in multidisciplinary teams and operating in highly uncertain environments [Afshari and Gandomani 2021; Welsch et al. 2024].

This reality challenges universities to adapt their educational programs to develop competencies aligned with the demands of companies in the technology sector. Previous studies highlight the relevance of incorporating agile methodologies into academic projects and professional preparation settings, stressing their contribution to collaboration, adaptation to change, and exposure to authentic professional contexts [Fonseca Santos et al. 2024; Khabbali et al. 2023; Martínez et al. 2023; Neumann and Baumann 2021; Tenhunen et al. 2023; Wlodarski et al. 2022].

At the Universidad Nacional de Costa Rica (UNA), the course Projects and their Application in the Organization (code EIF408), offered during the final year of the Bachelor's Degree in Information Systems Engineering, provides an academic setting in which students undertake their Supervised Professional Practice (“Práctica Profesional Supervisada”, referred to as PPS from hereafter), in real organizations [Universidad Nacional 2026]. This experience enables students to apply the knowledge acquired throughout the program while becoming familiar with the methodologies, tools, and ways of working used in different organizational settings.

Although the literature has extensively documented the adoption of agile methodologies in organizations and software development projects, there is limited evidence on how these approaches are implemented in university-based professional education, particularly through PPS experiences in Information Systems Engineering programs. In the Costa Rican context, it is therefore relevant to understand how these approaches are implemented in authentic professional environments, as well as the opportunities and challenges they represent for students' professional development.

The objective of this article is to analyze the implementation of agile methodologies in the PPS course for the Information Systems Engineering students and to examine the learning opportunities and challenges these approaches present for their further professional development. The study focuses on the PPS experiences carried out during the first academic term of 2025 by students enrolled in course EIF408 at Universidad Nacional, Benjamín Núñez Campus. The study adopted a quantitative approach with a descriptive, non-experimental cross-sectional design based on data collected through a questionnaire administered to 49 PPS supervisors.

2. Literature Review

2.1. Agile Methodologies in Software Development

Agile methodologies have been widely adopted in the technology industry due to their ability to support collaboration, iterative development, continuous feedback, and adaptation to changing project needs [Al-Saqqa et al. 2020; Bambauer-Sachse and Helbling 2021]. Frameworks such as Scrum, Extreme Programming (XP), and Kanban share these principles and can be applied across different work environments [Arzuaga Mejía 2025; Gemino et al. 2020; Insuasti Vidal 2021; Reaiche and Papavasiliou 2022]. According to the 15th State of Agile Report, their adoption increased significantly between 2020 and 2021, reaching 86% among software development teams and 60% among information technology teams [Digital.ai 2021].

The successful adoption of agile methodologies depends not only on technical knowledge of these frameworks but also on organizational, cultural, and human factors, including organizational needs, maturity, and existing work practices [Abdelrahman

2020; Afshari and Gandomani 2021; Arcos-Medina and Mauricio 2020; Imran and Soomro 2022; Mantovani Fontana and Marczak 2020; Merchán-Narváez et al. 2024; Utami et al. 2024]. When these conditions are favorable, agile methodologies help enhance communication, collaboration among teams, improve communication, collaboration, knowledge sharing, and adaptability to change, which benefits more participative work environments oriented towards continuous feedback [Armijos et al. 2024; Chaudhari and Joshi 2021; Digital.ai 2025; Welsch et al. 2024]. However, in Latin America, factors such as rigid structures, resistance to change, and technology gaps continue to limit their implementation [Arzuaga Mejía 2025].

Despite their advantages, agile methodologies also have limitations that must be considered according to the characteristics and needs of each project. Chaudhari and Joshi (2021) point out that the speed of software development and delivery can affect design quality during the process. They also note that the emphasis on continuously adapting requirements can cause some errors to go undetected in time due to the limited depth of certain tests. Likewise, they warn that the dynamic of constant meetings, periodic reviews, and continuous adjustments can generate burnout among teams and affect productivity.

The authors also note that the implementation of agile methodologies becomes more challenging in large-scale projects, especially when multiple teams are involved, when there are high levels of dependency, or when more structured coordination is required. Finally, in complex or highly regulated projects, hybrid approaches that combine the flexibility of agile methodologies with more formal management structures may be necessary [Gemino et al. 2020; Imran and Soomro 2022; Insuasti Vidal 2021].

In summary, agile methodologies are widely used in software development due to their ability to support adaptation, collaboration, and continuous value delivery. However, their success depends on both team competencies and organizational conditions that enable their effective implementation.

2.2. Agile Methodologies and Learning in Professional Practice

The incorporation of agile methodologies into engineering education plays a key role in facilitating students' transition into professional environments. The integration of these approaches into capstone projects and PPS settings fosters learning experiences related to collaborative work, project management, and the application of methodologies used in industry, aspects that are widely valued in the technology sector [Caeiro-Rodríguez et al. 2021; Cico et al. 2021; Tenhunen et al. 2023].

More recent studies show that agile methodologies in education favor teamwork, communication, group cohesion, productivity, and the capacity to adapt to changing environments [Fonseca Santos et al. 2024; Khabbali et al. 2023; Neumann and Baumann 2021; Wlodarski et al. 2022].

With respect to professional practice, Martínez et al. (2023) describe it as an educational strategy that favors students' insertion into real software development environments, which supports students' professional development and the connection between the university and productive sectors. Along these lines, experiences developed in Mexico highlight the importance of incorporating projects with real clients to promote teaching that is more contextualized and closer to the needs of the professional environment [Martínez et al. 2023]. In a similar vein, a study conducted at the

Universidad Nacional de Misiones (Argentina) notes that, although methodologies such as Scrum and Kanban are part of education, there remains a need to deepen these approaches and consolidate knowledge in technical areas such as programming and databases [Rambo et al. 2018].

These findings indicate that agile methodologies in university education can strengthen students' preparation for professional environments by promoting collaboration, adaptability, and problem-solving skills. This connection between university education and practice settings can also be understood from the perspective of experiential learning, which holds that knowledge is constructed through participation in concrete experiences, reflection on practice, and the application of acquired knowledge [Kolb 2015]. Complementary, situated learning maintains that professional development occurs through active participation in authentic contexts and communities of practice, where students progressively acquire the knowledge, skills, and ways of acting characteristic of the workplace [Lave and Wenger 1991].

In this context, the PPS constitutes an authentic learning environment that enables students to participate in real projects and organizational practices. When conducted in organizations that adopt agile methodologies, students experience collaborative work, continuous communication, iterative development, and adaptability, strengthening the connection between academic preparation and contemporary software development practices.

2.3. Agile Methodologies in Project Development in Costa Rica

According to the characterization conducted by the Costa Rican Foreign Trade Promotion Agency (Procomer) and the Costa Rican Chamber of Information and Communication Technologies (CAMTIC) [Procomer and CAMTIC 2019], software development is one of the leading activities within Costa Rica's information and communication technology (ICT) sector.

Studies conducted in Costa Rica indicate a growing adoption of agile methodologies in software development projects [Aymerich et al. 2018; Carballo 2019; Díaz-Oreiro et al. 2019; Vargas 2018]. Along these lines, the results of the international HELENA project indicate that Scrum is the most widely used framework in the country, ahead of traditional approaches such as the Waterfall methodology, and has become established as a common practice in companies dedicated to software development, technology consulting, and digital services [Aymerich et al. 2018; Díaz-Oreiro et al. 2019]. Likewise, national research has documented the incorporation of agile practices in both private companies and university institutions [Carballo 2019; Vargas 2018]. Collectively, these findings reflect a growing orientation toward more flexible and adaptive approaches to respond to the demands of digital transformation.

In addition, these approaches have moved beyond the technology field and have been incorporated into other productive sectors of the country. Studies conducted in areas such as construction, services, and institutional management highlight the use of agile and hybrid approaches for their flexibility, adaptability, and contribution to improved communication, activity tracking, and decision-making [Fuentes 2023; Guzmán 2022; Hernández 2021]. These results suggest that the choice of working methodologies is related to the characteristics, needs, and levels of uncertainty of each productive sector.

Regarding current labor dynamics, the most recent survey by the Costa Rican Investment Promotion Agency (CINDE) [CINDE 2026a] indicates that multinational companies established in Costa Rica have consolidated hybrid work schemes and more flexible operating models oriented toward productivity, collaboration, and continuous adaptation. Similarly, the Vital Statistics study on the Careers in Highest Demand indicates that the corporate and digital services sector requires specific profiles in systems engineering, information technology, and computer engineering, as well as competencies associated with digital scalability, cloud infrastructure, and agile project management [CINDE 2026b]. Consequently, knowledge and application of agile frameworks become relevant for employment in multinational technology companies.

In Costa Rica, agile methodologies are increasingly present in software development and digital services. This context requires professionals capable of working collaboratively, adapting to change, and participating in agile processes. Therefore, professional practice settings provide valuable opportunities for students to engage in real work dynamics and develop competencies aligned with industry demands.

2.4. Outlook for Software Development Projects

Artificial intelligence (AI) has emerged as a transformative force that is redefining roles and work dynamics in software development [Downie and Finio 2024; Relyea and Harrysson 2026; Sauvola et al. 2024]. Its incorporation has an impact on both individual productivity and project management, since generative AI tools and large language models (LLMs) support activities such as drafting requirements, user stories, and acceptance criteria, as well as planning and tracking based on the analysis of historical data [Downie and Finio 2024; Gurgul et al. 2026; Mohammad and Chirchir 2024; Pow-Sang and Zapata 2025]. Predictive analytics also facilitates the early identification of risks and the automation of routine tasks, aspects that are especially relevant in agile environments [Adamantiadou and Tsironis 2025].

From a methodological perspective, the integration of these technologies is driving the evolution of agile practices toward what some authors call augmented agility, in which AI-based tools complement activities such as coding, testing, security analysis, and documentation, allowing teams to focus on decision-making, coordination, and the validation of results [Assalaarachchi et al. 2026; Gurgul et al. 2026; Relyea and Harrysson 2026]. Along these lines, the 18th State of Agile Report notes that the incorporation of AI is reorienting organizations toward the original principles of agility, centered on the capacity for rapid adaptation to change and the drive for innovation [Digital.ai 2025].

This scenario also transforms the competencies required in the professional field. The developer's role is no longer limited to programming, but also includes coordination, oversight, and validation of work generated by intelligent systems [Downie and Finio 2024; Relyea and Harrysson 2026]. Consequently, skills such as prompt engineering, a comprehensive understanding of the systems involved, and the ability to provide instructions, constraints, and references that appropriately guide the results produced by AI are gaining relevance [Gröpler et al. 2025; Gurgul et al. 2026; Pow-Sang and Zapata 2025; Relyea and Harrysson 2026].

Despite the opportunities offered by AI, it also poses challenges. The probabilistic nature of these models requires mechanisms of human oversight to identify errors, vulnerabilities, or biases that could go unnoticed in automated processes [Downie and Finio 2024; Gurgul et al. 2026]. In addition, excessive reliance on these tools could reduce interaction among team members, favor the creation of knowledge silos, and limit the development of critical thinking and the understanding of technical fundamentals, particularly among professionals still in training [Downie and Finio 2024; Gröpler et al. 2025].

In the long term, AI is expected to continue expanding its role in software development processes and to drive new forms of work organization and management, with human intervention increasingly oriented toward governance, oversight, and the resolution of complex problems [Gröpler et al. 2025; Kokol 2024]. In this setting, competencies such as critical judgment, decision-making, and the ability to work effectively with intelligent systems are becoming increasingly important for the professional practice of systems engineering. These changes reinforce the need for higher education and PPS settings to prepare students to operate in environments where AI will be a regular part of software development processes.

3. Methodology

As previously mentioned, this study analyzes the PPS projects undertaken by students registered in the course EIF408 of the Information Systems Engineering program, and enrolled at the Benjamín Núñez Campus, during the first academic term of 2025. The course places students in real organizations, where they apply the knowledge acquired throughout their previous coursework, while becoming familiar with agile and traditional methodologies used in professional practice.

The study adopted a quantitative approach with a descriptive, non-experimental cross-sectional design to analyze the implementation of agile methodologies in the PPS. The study population consisted of 49 PPS placements in that semester. Given the size of the population, a census was carried out, including all supervisors responsible for overseeing students at the participating organizations. All supervisors completed the questionnaire, resulting in a 100% response rate.

Data were collected through a questionnaire administered to PPS supervisors. The questionnaire included items on organizational characteristics, the project management methodologies used, emerging technologies considered most relevant to software development, and the competencies required for professional practice. The questionnaire was reviewed by a panel of experts composed of two faculty members from the program and two representatives from the business sector, who assessed the relevance and clarity of the questions. Each questionnaire was completed by the supervisor responsible for overseeing the student's PPS within the organization. When the same supervisor oversaw more than one student, the same questionnaire was completed separately for each PPS experience.

The data were analyzed using descriptive statistics and, for the open-ended questions, an inductive thematic classification process. This approach made it possible to characterize the implementation of agile methodologies across participating organizations and to identify trends related to emerging technologies and supervisors' perceptions of students' learning needs.

4. Results and Discussion

This section presents the findings based on questionnaires completed by PPS supervisors during the first academic term of 2025.

4.1. Characterization of the Organizational Context

Organizations were classified according to their number of employees as follows: microenterprises (up to 5 employees), small companies (6–30 employees), medium-sized companies (31–100 employees), and large companies (more than 100 employees). Regarding the size of the participating organizations, large companies represented the largest share (57%), followed by medium-sized companies (23%), small companies (16%), and microenterprises (4%). As shown in Fig. 1, the distribution by size presents important differences across the sectors analyzed. The multinational sector consisted mainly of large companies (83%) and, to a lesser extent, medium-sized companies (17%). A similar pattern was observed in the public sector (70% large and 30% medium-sized) and in the academic sector (100% large). In contrast, the national business sector showed a more heterogeneous composition, including large companies (20%), medium-sized companies (13%), small companies (53%), and microenterprises (13%). The financial sector consisted entirely of medium-sized companies (100%). These results indicate that most students completed their PPS in medium-sized and large organizations characterized by more formalized work structures and well-defined project management processes. In addition, multinational and national companies constitute the primary settings for students' professional learning experiences [Aymerich et al. 2018; CINDE 2026b].

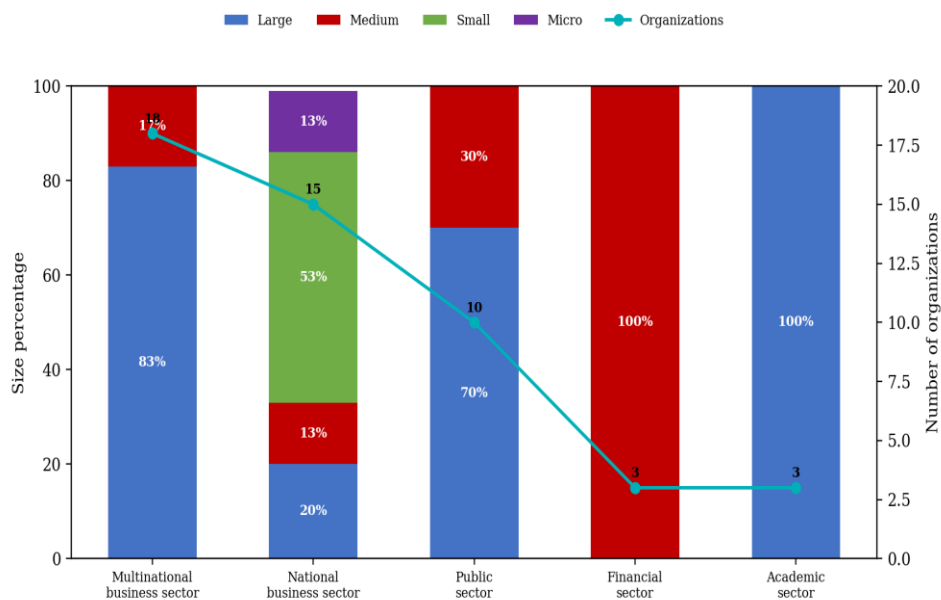


Figure 1. Distribution of organizations by sector and size

Regarding students' areas of professional practice during the PPS, Fig. 2 shows that software development was the primary area of activity during the PPS (57%), followed by web development (24%). To a lesser extent, projects related to information security, artificial intelligence, and machine learning were identified (6% each), as well as activities linked to project management, database management, and quality

assurance. This distribution indicates that PPS experiences were concentrated in software development, in line with the widespread adoption of agile methodologies internationally [Digital.ai 2021, Digital.ai 2025] and with the relevance of this activity within the Costa Rican ICT sector [Procomer and CAMTIC 2019].

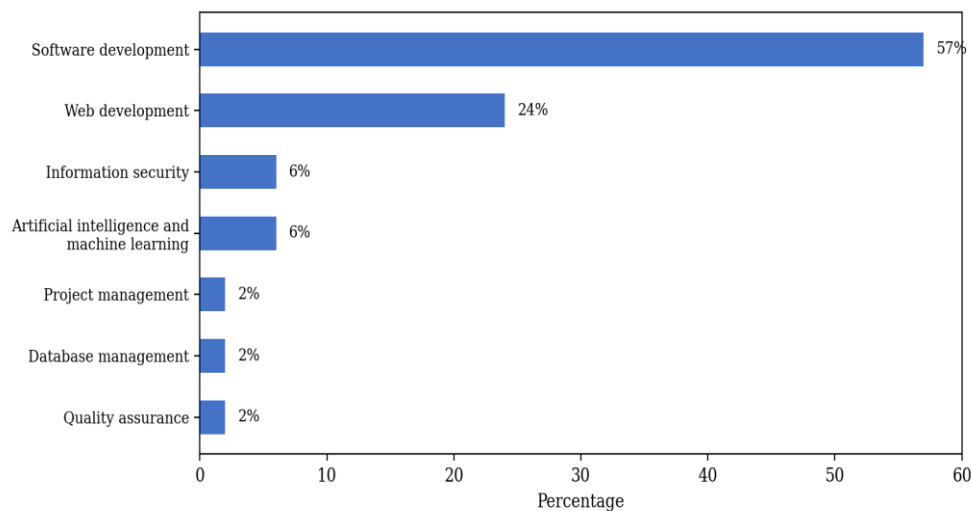


Figure 2. Areas of student performance in the PPS

4.2. Implementation of Working Methodologies in Supervised Professional Practice

The results indicate that agile methodologies are the main project management approach. Of the total organizations analyzed, 73% reported using agile methodologies, while 25% used traditional methodologies, and only 2% reported using hybrid approaches. This finding is consistent with trends noted in the international literature, which document sustained growth in the adoption of agile methodologies in software development teams [Digital.ai 2021]. It also confirms what national studies have noted regarding the widespread presence of these approaches in companies dedicated to software development and digital services [Aymerich et al. 2018; Díaz-Oreiro et al. 2019]. The widespread adoption of agile methodologies among the participating organizations suggests that many students completed their PPS in environments where these practices form part of everyday work.

The implementation of agile methodologies differs by type of organization. As shown in Fig. 3, multinational companies show the highest level of implementation (94%), followed by national companies (73%). In contrast, the public sector shows an even distribution between agile and traditional methodologies (50% each). These results are consistent with research indicating greater challenges to incorporating agile approaches in public organizations, due to their more rigid structures, more formal processes, and greater resistance to change [Arzuaga Mejía 2025; Mantovani Fontana and Marczak 2020; Utami et al. 2024]. As a result, students' PPS experiences take place with varying levels of maturity in the implementation of agile methodologies.

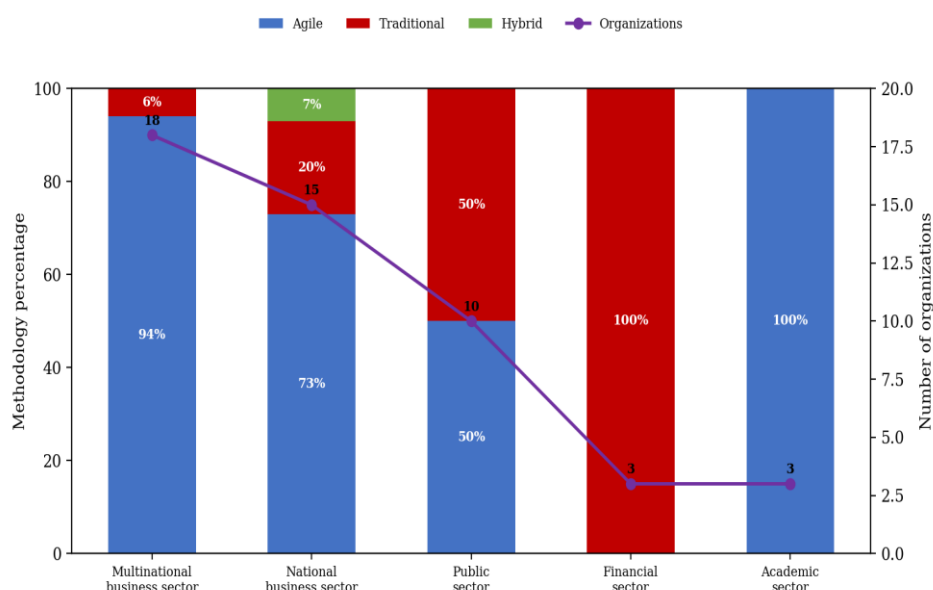


Figure 3. Project management methodologies by organization type

These findings indicate that the PPS offers learning opportunities linked to participation in organizational practices characteristic of agile methodologies. In this context, students engage in organizational practices characterized by continuous communication, collaborative work, self-organization, and adaptation to change, aspects that Fonseca Santos et al. (2024) and Wlodarski et al. (2022) highlight among the main contributions of these approaches to professional preparation. These experiences are also consistent with the tenets of experiential learning [Kolb 2015] and situated learning [Lave and Wenger 1991], as they foster student participation in authentic practice contexts, where academic knowledge is integrated with the practices, routines, and expectations of professional teams.

From an educational perspective, these results show that the widespread adoption of agile methodologies among the participating organizations provides many students with opportunities to undertake their PPS in authentic professional environments where these practices are part of everyday work. At the same time, the coexistence of agile and traditional methodologies, particularly in public organizations, highlights the need to prepare professionals capable of working across different organizational settings and adapting to diverse project management approaches.

4.3. Technological Outlook and Challenges for University Education

PPS supervisors answered two open-ended questions: the first aimed at identifying the emerging technologies that, based on their experience, are most relevant to the ICT market at present and in the short term; and the second focused on those they consider necessary to incorporate into or strengthen within the university curriculum. Since both questions addressed complementary dimensions, the responses were integrated and analyzed through an inductive thematic classification process. First, the responses were read in full, equivalent terms were standardized, and they were subsequently grouped into eight categories defined according to their conceptual affinity and correspondence with recognized areas of the discipline. Finally, the frequency of each category was calculated using each supervisor as the unit of analysis, recording a single mention per

category even when it had been referred to multiple times by the same participant. Table 1 presents the resulting categories and examples of the grouped terms. The thematic classification showed that the categories of artificial intelligence (n=42), cloud computing (n=23), and cybersecurity (n=14) accounted for the largest number of mentions and therefore constitute the focus of the analysis presented below.

Table 1. Thematic classification of open-ended responses

Thematic category	Representative terms
Artificial intelligence	AI, generative AI, LLM, intelligent agents, Machine Learning, Copilot
Cloud computing	Cloud, cloud computing, AWS, Azure, Google Storage, hybrid cloud, cloud infrastructure
Cybersecurity	Cybersecurity, information security
Git/DevOps	Git, GitHub, Azure DevOps, continuous integration, continuous delivery, containers, Docker, Jira
Automation	Automation, test automation, API automation, RPA, Power Automate, bots, macros
Data science and analytics	Data science, big data, data analytics, business intelligence
Front-end technologies	React, Angular, IONIC, Laravel, CSS, JavaScript, web development, web design, full stack
Mobile development	React Native, mobile applications, mobile apps, cross-platform, mobile devices

AI was the most frequently mentioned technology, both in relation to market needs and to curriculum update processes. The responses referred to technologies ranging from generative AI and large language models to machine learning applications, intelligent agents for process automation, and development support tools such as Copilot. Some supervisors noted that professionals must “evolve to use it in order to be more efficient” and understand how to “create prompts to produce more accurate code.” These observations reflect changes in the professional profile that align with what Gurgul et al. (2026) and Relyea and Harrysson (2026) have noted, highlighting the growing integration of AI into software development processes and the emergence of new competencies associated with overseeing and using intelligent tools.

Cloud computing was the second most frequently mentioned topic. Supervisors referred to platforms such as AWS, Azure, and Google Cloud, and highlighted knowledge related to infrastructure, scalability, and cloud services. This result is consistent with CINDE's finding [2026b] that cloud infrastructure is one of the competencies most in demand among multinational companies established in Costa Rica.

Cybersecurity ranked third among the technologies identified. Its relevance reflects the increase in threats and risks that organizations face in increasingly complex digital environments, as well as to the need to incorporate security practices at different stages of software development. Along with artificial intelligence, it was one of only two categories in which curriculum-related mentions outnumbered market-related mentions, suggesting that supervisors consider it a core component of professional preparation for Information Systems Engineering students.

Taken together, these findings reinforce the idea that the PPS is not only a space for applying knowledge and working methodologies in real settings, but also a mechanism for identifying technological trends and emerging needs in the productive sector. The convergence observed between market demands and supervisors' recommendations, particularly regarding artificial intelligence, cloud computing, and cybersecurity, provides valuable evidence to inform curriculum enhancement and continuous program improvement.

5. Conclusions and Recommendations

In line with the study objective, the findings make it possible to analyze the implementation of agile methodologies in the PPS and identify the opportunities and challenges these approaches represent for Information Systems Engineering education. The results show that agile methodologies are the predominant approach in the organizations where professional practice takes place, confirming their widespread presence in environments linked to software development and digital services.

The results show that, when the PPS is carried out in organizations that implement agile methodologies, students have greater opportunities to engage in work practices based on collaboration, continuous communication, adaptation to change, and iterative development, practices widely used in the software industry. These experiences favor the application of the knowledge acquired during the degree program in real settings and broaden the learning opportunities associated with professional practice.

However, the implementation of agile methodologies is not homogeneous across organizations. While multinational companies show high levels of use of these approaches, in other contexts, particularly in the public sector, agile and traditional methodologies coexist. This diversity highlights the need to prepare students to work within different project management models and to adapt to various organizational realities.

Likewise, supervisors identify artificial intelligence, cloud computing, and cybersecurity as strategic areas for the future of software development. These findings highlight new opportunities for curriculum enhancement, while also underscoring the need to continuously update course content and learning experiences in response to ongoing technological change.

Overall, the findings show that the PPS functions as a bridge between university education and professional practice by enabling students to apply industry practices while developing competencies aligned with current labor market needs. Beyond supporting learning in authentic professional settings, the PPS also provides valuable evidence for strengthening the relationship between the university and the productive sector and for informing continuous curriculum improvement.

Based on these findings, universities should continue to strengthen the integration of projects and practical experiences related to artificial intelligence, cybersecurity, and cloud computing, as these areas are strategic components particularly in the newly proposed Bachelor's Degree in Computer Engineering, which will begin in 2027. The findings support this curriculum update, as supervisors identify these technologies as priorities for professional practice and for the evolution of the software industry.

In addition, the information obtained through a course such as PPS should be used systematically to inform curriculum development, since it makes it possible to identify changes in working methodologies, competencies required by organizations, and emerging technological trends, thereby strengthening the connection between the university and the professional environment.

Finally, it is necessary to strengthen the integration of agile methodologies and the use of artificial-intelligence-based tools in educational processes and professional practice experiences. Given the widespread adoption of agile approaches among the participating organizations and the growing role of artificial intelligence in the sector, learning experiences should be designed to incorporate these tools into activities related to project management, requirements definition, documentation, testing, and software development. These initiatives should be accompanied by opportunities for critical reflection on the scope, limitations, and ethical implications of these technologies, promoting their responsible and informed use.

References

- Abdelrahman, O. E. (2020). Introducing script as a software design tool for agile software development methodology. *2020 International Conference on Computing and Information Technology (ICCIT-1441)*. <https://doi.org/10.1109/ICCIT-144147971.2020.9213766>
- Adamantiadou, D. S., and Tsironis, L. (2025). Leveraging artificial intelligence in project management: A systematic review of applications, challenges, and future directions. *Computers*, 14(2), 66. <https://doi.org/10.3390/computers14020066>
- Afshari, M., and Gandomani, T. J. (2021). A typical practical team structure and setup in agile software development. *7th International Conference on Electrical, Electronics and Information Engineering (ICEEIE)*. <https://doi.org/10.1109/ICEEIE52663.2021.9616743>
- Al-Saqqa, S., Sawalha, S., and AbdelNabi, H. (2020). Agile software development: Methodologies and trends. *International Journal of Interactive Mobile Technologies*, 14(11). <https://core.ac.uk/download/pdf/482969304.pdf>
- Arcos-Medina, G., and Mauricio, D. (2020). Identifying factors influencing on agile practices for software development. *Journal of Information and Organizational Sciences*, 44(1), 1-31. <https://doi.org/10.31341/jios.44.1.1>
- Armijos, L. M., Vélez, C. A., and Lojan, E. L. (2024). Estudio de la adopción de las metodologías ágiles en proyectos de desarrollo de software en la región 7 del Ecuador. *Revista Espacios*, 45(4), 73. <https://doi.org/10.48082/espacios-a24v45n04p06>
- Arzuaga Mejía, R. G. (2025). Metodologías ágiles como herramienta para la transformación y competitividad empresarial en entornos dinámicos. *European Public & Social Innovation Review*, 11, 01-17. <https://doi.org/10.31637/epsir-2026-2241>
- Assalaarachchi, L. I., Masood, Z., Hoda, R., and Grundy, J. (2026). Generative AI for software project management: Insights from a review of software practitioner literature. *IEEE Software*, 43(3), 62-69. <https://doi.org/10.1109/MS.2025.3619936>

- Aymerich, B., Díaz-Oreiro, I., Guzman, J. C., López, G., and Garbanzo, D. (2018). Software development practices in Costa Rica: A survey. *Advances in Artificial Intelligence, Software and Systems Engineering*, AHFE 2018, *Advances in Intelligent Systems and Computing*, 787, 122-132. Springer. https://doi.org/10.1007/978-3-319-94229-2_13
- Bambauer-Sachse, S., and Helbling, T. (2021). Customer satisfaction with business services: Is agile better? *Journal of Business & Industrial Marketing*, 36(8), 1389-1402. <https://doi.org/10.1108/JBIM-04-2020-0221>
- Beck, K., Beedle, M., van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M., Grenning, J., Highsmith, J., Hunt, A., Jeffries, R., Kern, J., Marick, B., Martin, R. C., Mellor, S., Schwaber, K., Sutherland, J., and Thomas, D. (2001). *Manifesto for Agile Software Development*. <https://agilemanifesto.org/>
- Caeiro-Rodríguez, M., Manso-Vázquez, M., Mikic-Fonte, F. A., Llamas-Nistal, M., Fernández-Iglesias, M. J., Tsalapatas, H., Heidmann, O., DeCarvalho, C. V., Jesmin, T., Terasmaa, J., and Sorensen, L. T. (2021). Teaching soft skills in engineering education: An European perspective. *IEEE Access*, 9, 29222-29242. <https://doi.org/10.1109/ACCESS.2021.3059516>
- Carballo, L. A. (2019). Gestión de proyectos con metodologías ágiles en Costa Rica, Scrum: Un caso de estudio. [Tesis de maestría, Universidad Nacional de Costa Rica]. Repositorio UNA. <https://repositorio.una.ac.cr/server/api/core/bitstreams/bbcb77db-f6ac-47b0-ae1c-4e0497c6a0e3/content>
- Chaudhari, A. R., and Joshi, S. D. (2021). Study of effect of agile software development methodology on software development process. *2021 Second International Conference on Electronics and Sustainable Communication Systems (ICESC)*, 1-4. <https://doi.org/10.1109/ICESC51422.2021.9532842>
- Cico, O., Jaccheri, L., Nguyen-Duc, A., and Zhang, H. (2021). Exploring the intersection between software industry and software engineering education - a systematic mapping of software engineering trends. *The Journal of Systems & Software*, 172, 110736. <https://doi.org/10.1016/j.jss.2020.110736>
- Coalición Costarricense de Iniciativas de Desarrollo (CINDE). (8 de enero de 2026a). *Multinacionales consolidan la presencialidad flexible y maduran sus modelos de trabajo en Costa Rica*. <https://www.cinde.org/es/noticias/multinacionales-consolidan-la-presencialidad-flexible-y-maduran-sus-modelos-de-trabajo-en-costa-rica>
- Coalición Costarricense de Iniciativas de Desarrollo (CINDE). (14 de mayo de 2026b). *CINDE revela las carreras, certificaciones y habilidades que el mercado multinacional busca en Costa Rica*. <https://www.cinde.org/es/noticias/cinde-revela-las-carreras-certificaciones-y-habilidades-que-el-mercado-multinacional-busca-en-costa-rica>
- Díaz-Oreiro, I., Chaves, D., Aymerich, B., Guzmán, J. C., López, G., Genero, M., and Vizcaíno, A. (2019). Software development practices and frameworks used in Spain and Costa Rica: A survey and comparative analysis. En X. Franch, T. Männistö, y S. Martínez-Fernández (Eds.), *Product-Focused Software Process Improvement: 20th*

- International Conference, PROFES 2019, Lecture Notes in Computer Science*, 11915, 112-119. Springer. https://doi.org/10.1007/978-3-030-35333-9_8
- Digital.ai. (2021). *15th State of Agile Report*. <https://info.digital.ai/rs/981-LQX-968/images/SOA15.pdf>
- Digital.ai. (2025). *18th State of Agile Report*. <https://digital.ai/resource-center/analyst-reports/18th-state-of-agile-report/>
- Downie, A., and Finio, M. (7 de octubre de 2024). *La IA en el desarrollo de software*. IBM Think. <https://www.ibm.com/mx-es/think/topics/ai-in-software-development>
- Fonseca Santos, M., Filipe, R. A., and Cunha, J. C. (2024). From traditional to agile methodologies in software project management education: A case study. *16th International Conference on Education Technology and Computers (ICETC 2024)*, 491-497. <https://doi.org/10.1145/3702163.3702460>
- Fuentes, A. (2023). *Propuesta de prácticas ágiles para mejorar la eficiencia en la fase de preinversión en AyA* [Tesis de maestría, Universidad Estatal a Distancia]. Repositorio UNED. <https://repositoriotec.tec.ac.cr/handle/2238/14623>
- Gartner. (22 de abril de 2026). *Gartner forecasts worldwide IT spending to grow 13.5% in 2026 totaling \$6.31 trillion*. <https://www.gartner.com/en/newsroom/press-releases/2026-04-22-gartner-forecasts-worldwide-it-spending-to-grow-13-point-5-percent-in-2026-totaling-6-point-31-trillion-dollars>
- Gemino, A., Horner, B., and Serrador, P. M. (2020). Agile, traditional, and hybrid approaches to project success: Is hybrid a poor second choice? *Project Management Journal*, 52(2), 161–175. <https://doi.org/10.1177/8756972820973082>
- Gröpler, R., Klepke, S., Johns, J., Dreschinski, A., Schmid, K., Dornauer, B., Tüzün, E., Noppen, J., Mousavi, M. R., Tang, Y., Viehmann, J., Aslangül, S. Ş., Lee, B. S., Ziolkowski, A., and Zie, E. (2025). The future of generative AI in software engineering: A vision from industry and academia in the European GENIUS Project. *2nd IEEE/ACM International Conference on AI-powered Software (Alware 2025)*. <https://doi.org/10.1109/AIware69974.2025.00026>
- Gurgul, V., Gubela, R., and Lessmann, S. (2026). The state of generative AI in software development: Insights from literature and a developer survey [Preprint]. <https://doi.org/10.48550/arXiv.2603.16975>
- Guzmán, S. (2022). *Propuesta de implementación de metodología híbrida Scrumban dirigido en una empresa constructora* [Tesis de licenciatura, Universidad para la Cooperación Internacional]. <https://omeka.campusuci2.com/biblioteca/files/original/a06ef0532db84fed7098effa2cd25926.pdf>
- Hernández, M. (2021). *Análisis de la implementación de metodologías ágiles en industrias costarricenses* [Tesis de licenciatura, Universidad Latinoamericana de Ciencia y Tecnología]. Repositorio ULACIT. <https://repositorio.ulacit.ac.cr/bitstream/handle/20.500.14230/10635/REF-1632601416-1.pdf>
- Imran, R., and Soomro, T. R. (2022). Mapping of agile processes into project management knowledge areas and processes. *2022 International Conference on*

Business Analytics for Technology and Security (ICBATS).
<https://doi.org/10.1109/ICBATS54253.2022.9759013>

Insuasti Vidal, M. de J. (2021). Estándares tradicionales y metodologías ágiles en la dirección de proyectos. *Ciencia y Educación*, 2(5), 16-23.
<https://cienciayeducacion.com/index.php/journal/article/view/65>

Khabbali, H., Zaoui Seghroucheni, Y., and Ziti, S. (2023). Agile pedagogy: Using Scrum and project-based learning for enhanced educational experiences. *7th IEEE Congress on Information Science and Technology (CiSt)*, 445-449.
<https://doi.org/10.1109/CiSt56084.2023.10410018>

Kokol, P. (2024). The use of AI in software engineering: A synthetic knowledge synthesis of the recent research literature. *Information*, 15(6), 354.
<https://doi.org/10.3390/info15060354>

Kolb, D.A. (2015). “Experiential Learning: Experience as the Source of Learning and Development”, 2nd edn. Pearson Education, Upper Saddle River (2015).

Lave, J. and Wenger, E. (1991). “Situated Learning: Legitimate Peripheral Participation”. Cambridge University Press, Cambridge

Mantovani Fontana, R. M., and Marczak, S. (2020). Characteristics and challenges of agile software development adoption in Brazilian government. *Journal of Technology Management & Innovation*, 15(2), 3-10. <https://doi.org/10.4067/S0718-27242020000200003>

Martínez, P., Vergara, J. A., Pino, J., and Ibañez, I. A. (2023). El proceso de prácticas profesionales en empresas de software en Coatzacoalcos, Veracruz, México. *Tecnología Educativa Revista CONAIC*, 10(1), 10-16. <https://terc.mx/index.php/terc/article/view/284>

Merchán-Narváez, N., Palma-Peralta, E., and Poma-Japón, D. (2024). Comparación de metodologías ágiles para el desarrollo de software. *Journal Scientific MQRInvestigar*, 8 (1), 5052-5074.
<https://doi.org/10.56048/MQR20225.8.1.2024.5052-5074>

Mohammad, A., and Chirchir, B. (2024). Challenges of integrating artificial intelligence in software project planning: A systematic literature review. *Digital*, 4, 555–571.
<https://doi.org/10.3390/digital4030028>

Neumann, M., and Baumann, L. (2021). Agile methods in higher education: Adapting and using eduScrum with real world projects. *2021 IEEE Frontiers in Education Conference (FIE)*. <https://doi.org/10.1109/FIE49875.2021.9637344>

Pow-Sang, J. A., and Zapata, C. (2025). La IA generativa en el proceso del desarrollo de software: Un enfoque práctico. 2025 14th International Conference on Software Process Improvement (CIMPS).
<https://doi.org/10.1109/CIMPS69356.2025.11419691>

Promotora del Comercio Exterior de Costa Rica (Procomer) y Cámara de Tecnologías de Información y Comunicación (CAMTIC). (2019). “Mapeo de Tecnologías Digitales 2019: Caracterización del sector de tecnologías de información y comunicación (TIC) en Costa Rica”. <https://www.camtic.org/wp-content/uploads/2019/09/Caracterizaci%C3%B3n-del-sector-de->

[tecnolog%C3%ADas-de-informaci%C3%B3n-y-comunicaci%C3%B3n-TICs-en-Costa-Rica-2019.pdf](#)

- Rambo, A., Kuna, H. D., Sueldo, R., Urquijo, R., and Piotroski, F. (2018). Análisis de factores de éxito para gestión de proyectos académicos unipersonales de práctica profesional supervisada en carreras de Informática. *XIII Congreso de Tecnología en Educación y Educación en Tecnología*. <http://sedici.unlp.edu.ar/handle/10915/68745>
- Reaiche, C., and Papavasiliou, S. (2022). *Management methods for complex projects*. James Cook University. <https://jcu.pressbooks.pub/pmmethods>
- Relyea, C., and Harrysson, M. (1 de abril de 2026). *The AI revolution in software development*. McKinsey & Company. <https://www.mckinsey.com/capabilities/tech-and-ai/our-insights/the-ai-revolution-in-software-development>
- Sauvola, J., Tarkoma, S., Klemettinen, M., Riekk, J., and Doermann, D. (2024). Future of software development with generative AI. *Automated Software Engineering*, 31, 26. <https://doi.org/10.1007/s10515-024-00426-z>
- Tenhunen, S., Männistö, T., Luukkainen, M., and Ihantola, P. (2023). A systematic literature review of capstone courses in software engineering. *Information and Software Technology*, 159, 107191. <https://doi.org/10.1016/j.infsof.2023.107191>
- Universidad Nacional (UNA). (2026). *Programa del curso EIF-408: Proyecto y sus aplicaciones en la organización* [Programa de curso no publicado]. Escuela de Informática.
- Utami, A. T., Raharjo, T., Mustaqim, I. Z., and Trisnawaty, N. W. (2024). Barriers of agile requirements engineering in the public sector: A systematic literature review. *Interdisciplinary Journal of Information, Knowledge, and Management*, 19(6). <https://doi.org/10.28945/5262>
- Vargas, D. (2018). “Integración de prácticas ágiles en la gestión de proyectos del Área de Desarrollo de Sistemas del Centro de Informática de la Universidad de Costa Rica” [Tesis de grado, Instituto Tecnológico de Costa Rica]. Repositorio TEC. https://repositoriotec.tec.ac.cr/bitstream/handle/2238/10017/integracion_practicas_agiles_metodologia_para_gestion_proyectos_area_desarrollo.pdf?sequence=1&isAllowed=y
- Welsch, D., Burk, L., Mötefindt, D., and Neumann, M. (2024). Navigating cultural diversity: Barriers and benefits in multicultural agile software development teams. *Proceedings of the 39th ACM/SIGAPP Symposium on Applied Computing*, 818-825. <https://doi.org/10.1145/3605098.3635988>
- Wlodarski, R., Poniszewska-Marańda, A., and Falleri, J. R. (2022). Impact of software development processes on the outcomes of student computing projects: A tale of two universities. *Information and Software Technology*, 144, 106787. <https://doi.org/10.1016/j.infsof.2021.106787>