

Enabling digital growth through continuous education of project managers: a framework for collaborative, complementary, sustained, and simultaneous learning in software engineering organizations

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Abstract:

Introduction/purpose: This paper introduces a novel PMO EDUCT framework that encompasses Collaborative, Complementary, Sustained, and Simultaneous learning explicitly tailored for the dynamic landscape of software engineering.

This paper contributes to the ongoing discourse on education and professional development in the digital era by illuminating the challenges faced, the framework developed, and the measurable outcomes achieved. The presented framework underscores the need for agility, adaptability, and a relentless pursuit of knowledge as fundamental tenets for success in an ever-evolving landscape.

Methods: Focusing on a large software engineering organization, this study explores the multifaceted aspects of project management education, methodology enhancement, and team optimization. The proposed methodology combines qualitative and quantitative approaches to explore the educational process area in a global organization and generate a flexible and measurable framework to improve corporate knowledge growth. The framework aims to provide learners the most flexibility about learning paths, schedules, collaboration, and best practice exchange while guaranteeing proper alignment with frequent market changes and emerging PM skills.

Results: Findings indicate that personalised, continuous learning, facilitated through collaborative environments and custom-tailored content, yields significant benefits. Through analysis of key performance indicators (KPIs), this study showcases improved project onboarding, enhanced team collaboration, and the cultivation of a culture of innovation.

Conclusion: This paper presents the PMO EDUCT framework that organizations can use to create a learning culture and empower their employees to succeed in the constantly evolving field of software development. By adopting collaborative, complementary, sustained, and simultaneous learning principles, organizations can develop a workforce with the essential skills of critical thinking, collaboration, and adaptability necessary for success in the digital era.

Key words: software engineering, learning framework, digital transformation, project management, knowledge competences, agile methodology, learning strategy, competency building.

Introduction

The rapid and transformative wave of digitalization has ushered in an era of unprecedented change, challenging traditional business models and reshaping industries across the globe. Organizations are faced with the imperative to adapt, innovate, and continuously evolve to remain competitive in this dynamic landscape. For software engineering companies, the impact of this digital transformation is particularly profound, as their core revolves around technology and innovation (Atanasijevic, 2016). The digital age has disrupted business models and redefined the skills and competencies required of professionals in the software engineering domain.

Organizations must rethink their growth, development, and education strategies in response to these transformative shifts. The traditional learning and skill acquisition paradigms no longer suffice in a landscape characterized by rapid technological advancements, frequent market changes, and evolving customer expectations. Within this context, we

introduce a comprehensive framework for continuous education and knowledge growth tailored to the intricacies of the software engineering industry. This framework embodies the principles of Collaborative, Complementary, Sustained, and Simultaneous learning, designed to empower professionals to thrive in the digital era.

In this paper, we delve into the nuances of this framework and its application within a large software engineering organization. We explore the multifaceted realm of project management education, methodology enhancement, and team optimization – critical pillars in pursuing digital growth. Leveraging qualitative and quantitative methodologies, we present a holistic approach that equips professionals with the requisite skills and fosters a culture of collaboration, innovation, and continuous improvement.

The subsequent sections of this paper detail the foundation of our framework, the context within which it operates, and the methodology employed to assess its effectiveness. We highlight the significance of tailored and personalized learning, the benefits of collaborative environments, and the measurement of outcomes through a carefully defined set of key performance indicators (KPIs). Through this study, we aim to provide insights and a blueprint for software engineering organizations seeking to embrace the digital age and harness the power of continuous education to drive growth, innovation, and lasting success.

This paper contributes to the ongoing discourse on education and professional development in the digital era by illuminating the challenges faced, the framework developed, and the measurable outcomes achieved. The presented framework underscores the need for agility, adaptability, and a relentless pursuit of knowledge as fundamental tenets for success in an ever-evolving landscape.

Enabling knowledge growth was a massive demand for the large software engineering organization like Comtrade Project Management Organization (PMO), which engages over 200 experts located in 10 locations on over 400 active projects with different roles in project management: Project Managers, Scrum Masters, Program Managers, and Engagement Managers.

To master and understand the change, our people and organization had to consider learning and development a never-ending cycle of continuous improvement. A college degree is no longer sufficient to develop the skills needed to respond to rapidly changing business processes and technologies that change multiple times a year.

Collaborative: We need to change how we teach and what we teach to engage learners. Teacher-student relationships shift from expert-disciple towards peer-based collaborative learning.

Complementary: A development program should target complementary skills in the sense that technical, functional, and behavioural skills work together. These skills are interdependent. They should be learned and acquired simultaneously.

Sustained: If a training program is intended to sustainably bridge this digital skills gap, learning cannot be a one-time affair. The new paradigm for learning and development in the 21st century differs significantly from past models because organizations must address what people learn and how they learn. We can achieve fundamental digital transformation by designing sound strategies integrating changing content and delivery needs.

Simultaneous: digital skillsets should be addressed concurrently, all infused into core content as both process and outcome.

Background and related work

Project Management favourably impacts the software engineering business outcomes. It is defined as "*applying knowledge, skills, tools, and techniques to project activities to meet the project requirements. Project management enables organizations to execute projects effectively and efficiently.*" In the age of globalization, software engineering companies have to define the range of skills and knowledge needed for successful project management to remain competitive.

By studying scientific literature, it was discovered that a vast amount of literature explores the education topic for PMs. However, *not many articles focus on the learning design framework and the conceptual model for development, especially project management education monitoring. This paper aims to contribute to this study and emphasize the importance of project management education in large software engineering companies, presenting a framework for its custom development and measurement.*

Many studies prove that project management relevant technical and soft skills are not appropriately taught in undergraduate and master's degree programs.

Research (Fioravanti & Barbosa, 2019) investigates how project management education is taught in undergraduate degree programs of higher education in computing and its disassociation between theory and practice. A survey that is conducted with software PM educators indicates that there is a particular gap between academic and software industry expectations. As a result, there is a need to improve the project management curriculum, courses, and even student evaluation. However,

the challenge of keeping pace with a rapidly changing business environment and technological advances remains since it requires constant adjustment of academic PM education with software industry trends. Therefore, a well-established corporate education process that will provide continuous PM professional development and customized and complementary competence growth is fundamental in every software engineering company.

Existing research in project management explores how digital innovation changes project management professional development.

In (Bierwolf et al, 2017), the authors present how digital transformation impacts project management performance and whether the current PM curricula match the market's needs. This research explores how PM professional bodies such as IPMA and PMI embrace PM competence development and propose several PM education actions as lifelong learning. The authors suggested organizing and adopting these ongoing PM learnings by PM in practice.

The paper (Braun et al, 2020) identified that Project Management is vital in driving and implementing digital transformation, reflecting changes in their career path, qualification, and certification programs.

In this paper, the authors point out that one of the pillars of the organization's adaptability to market failures is introducing systematic education. Systematic education and sharing experiences from past projects are imperative for the organization's success.

In a series of papers, the authors try to answer how effective and efficient digital education channels are through case studies and analysis based on the target group's research. The authors investigate the eLearning platform's effectiveness in preparing candidates for software engineering companies (Atanasijević et al, 2013). After five years of application, they conclude that it has fully justified its place as a tool in harmonizing knowledge acquired at universities and the experience needed to work effectively on fundamental problems in modern engineering practice. In (Atanasijević et al, 2019a), the authors describe a complex education and knowledge exchange solution in a software engineering company. The authors present the essential requirements that the portal solution should enable: acquiring knowledge, sharing good and bad practices through exchanging experience, and unifying software engineering processes and procedures. In the paper (Stevanović et al, 2020), the authors conclude that educational training for employee development within an IT company should efficiently increase professional knowledge. In this paper, the authors share their experiences and explain how to leverage that knowledge through project-based learning, active and

collaborative learning, delivered as face-to-face, self-paced learning, and online training courses under the mentorship of experienced business analysts.

According to research published in this domain, authors affirmed the importance of custom-tailored, lifelong PM education in software engineering companies, which has to be aligned with frequent market changes and measured through the metric system's framework on the corporate level.

The literature review revealed that academic and professional education provides extensive coverage of planning and teaching methodologies for both universities and colleges.

The current literature on planning employee education to improve engineering knowledge and skills is lacking in-depth analysis and research.

The general opinion is that in software companies, after academic education, continuing education for the profession is just beginning.

Project goals

The existing studies presented in the literature review do not sufficiently explain how companies needing intensive education can implement Collaborative, Complementary, Sustained, and Simultaneous learning and monitor the effects of such an education process. No one has measured the effectiveness and efficiency and, based on that, made conclusions on improving the process further.

Digital transformation unlocked organizations' opportunities to increase performance and efficiency, which was unachievable a few years ago before new digital solutions.

Hypothesis 1 – Disruptive digital business

To ideate, create, and manage disruptive digital businesses, people and organizations need to be immediately and strategically prepared for a set of skills that will be continually changing and evolving.

Hypothesis 2 – Rapid changes in technologies

New technologies positively impact companies' performance, giving them a competitive edge to innovations and distinguishing between them. Efficient software engineering organizations always need a laser focus on emerging technologies to deliver a sustainable and competitive supply of new products, services, and processes which impact our client's business and market structures.

Hypothesis 3 – "Follow the sun" business model

Large software engineering companies are part of a globally distributed software engineering workflow and simultaneously work in several time zones. Consequently, PMO needs to resolve geographical and time spread along all projects to design specific steps that we can take to be more successful in project management and, consequently, on the market.

Hypothesis 4 – Survey findings

In data sources (Atanasijevic et al, 2016b), the 2016 PM Insights Survey diagnostic showed that the main pain points were Education & Knowledge, Methodology, and Teams. The organization needs to establish a few new or improved processes to increase efficiency and effective project execution support effectiveness with an active role in the project environment success.

Expected results / outcomes

We live in a world where software is everything; 'Software is eating the world,' Marc Andreessen said ten years ago. Successful software engineering organizations have adjusted their Agile-SCRUM development cycles to a rhythm of two to three weeks. After each cycle, the existing software platform will have new or improved functionalities. This starkly contrasts the former software development paradigm, which involved months of analysis, planning, and design until the final delivery of software products to customers.

A widely accepted agile approach is based on moving fast, releasing often, and reacting to our users' real needs. In the Agile project management world, the main goal of PMO is to ensure improvements in the following aspects:

- Enable rapid deployment of solutions,
- Minimize waste by minimizing resources,
- Enhance flexibility and adaptability to change,
- Reduce turnaround cycles,
- Contribute to the optimization of delivery processes,
- Optimize project control,
- Increase focus on specific customer needs, and
- Improve collaboration and feedback.

As emerging priorities, based on new market demands and survey results mentioned in the previous paragraph, we recognized three main project goals or areas with expected outcomes:

Education and Knowledge

- Support creating and tracking education plans;
- Promote internal events;
- Raise awareness of certification; and
- Simplify learning, bring closer education.

Methodology

- Standardization and KPIs;
- Formal PM processes improvement; and
- Best practice sharing.

Teams

- Business growth (more people in projects);
- Team optimization for an agile approach; and
- PM and TM education.

Methodology

The research intended to apply research that combines qualitative and quantitative approaches. The aim is an exploratory study to explore the educational process area in a global organization without offering final and conclusive answers to research questions. Desirable solutions to the research question are obtained by following the steps below (Atanasijević et al, 2023):

1. We applied a quantitative research approach to gather the state of education in the company. It includes setting up the survey, summarising the results, and drawing inferences from the data. The survey also provided a sorted list of wanted educational content.
2. We used qualitative methods to recognize the most utilized communicational channels to enable the sharing of educational content. PM community provides several communication channels (existing company portals, newsletter, skype, slack, emails, audio conferences, video conferences, and live meetings). We selected those channels with the highest utilization rate to include in PMO Education Roadmap.
3. Generating a graphical and collaborative roadmap that supports strategic alignment and dialogue between Software Company departments and stakeholders should provide a transparent stakeholder relationship matrix.
4. Assessment of process/framework effects on corporate efficiency.
5. Repeating the above steps enables a flexible framework approach to corporate knowledge growth deeply rooted in learners' needs. The primary objective is to provide them with the most flexibility about the

learning paths, schedules, collaboration, and best practice exchange possible.

- The targeted framework has to provide measurable outcomes that guarantee proper alignment with frequent market changes causing emerging PM skills.

Problem-solving framework

With an active role in the project success, in 2016, Comtrade Project Management Office designed and conducted the PM Insights Survey (Atanasijevic et al, 2016a) about various aspects of project management practice and needs in their company. The survey aimed to get the project management state and, through analytics, gap analysis to identify improvement priorities.

The project managers who participated in the research provided valuable information that we will use in this paper. With their willingness to share their opinions on important matters in the project management profession and attitudes towards PM practice in Comtrade, we identified gaps, recognized key improvement factors, and defined a Roadmap for executing specific action plans.

The radar diagram and the gap bars are presented in Figure 1. Figure 2 shows the survey results across seven primary categories compared to desired values. The most significant gap emerged in the "Education and Knowledge" category, followed by the "Methodology" and "Team" categories.

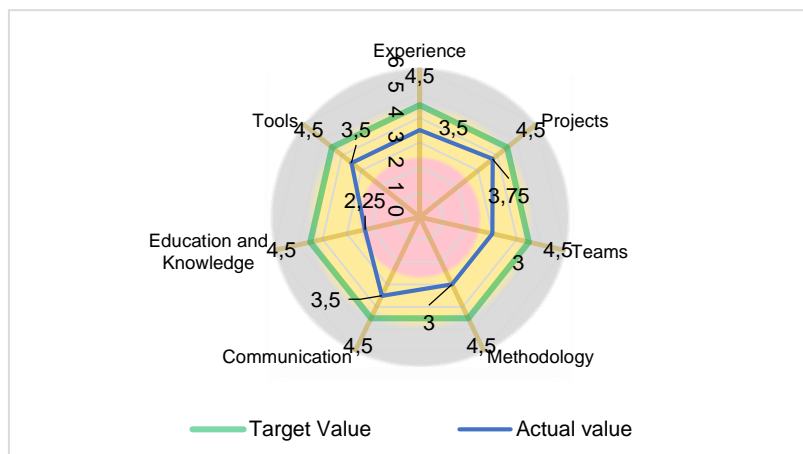


Figure 1 – PM Insights Survey results - Radar diagram
 Рус. 1 – Результаты опроса PM Insights — радарная диаграмма
 Слика 1 – ПМ резултати истраживања – радарски дијаграм

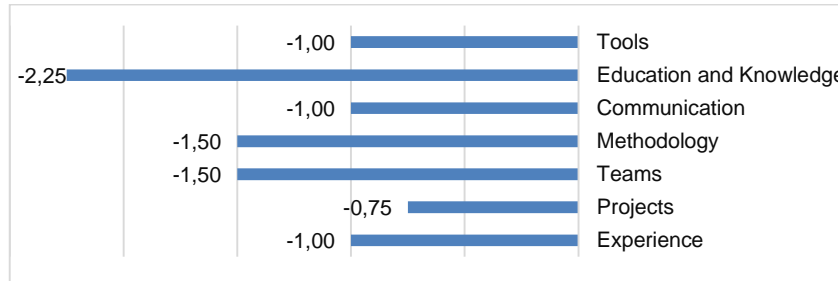


Figure 2 – PM Insights Survey results – GAP Analysis
 Рус. 2 – Результаты опроса PM Insights – GAP-анализ
 Слика 2 – ПМ резултати истраживања – ГАП анализа

Solution

The shift to a digital, knowledge-based economy imposed the solution for establishing an effective learning and growth process as the PM Framework for scaling the educational process at the enterprise level, presented in Figure 3.

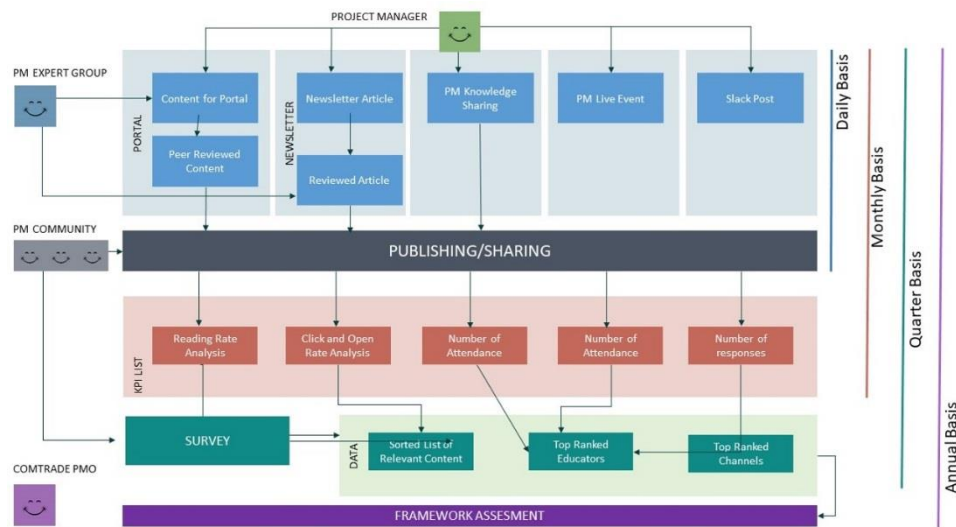


Figure 3 – Graphical representation of the established process – PM framework
 Рус. 3 – Графическое изображение установленного процесса – PM Framework
 Слика 3 – Графички приказ успостављеног процеса – ПМ оквир

The framework supports vital business priorities by developing and joining people on ongoing challenges. Persistent uncertainty, a multi-geographical workforce, and shorter shelf life for knowledge have placed

precedence on reskilling and upskilling. These are very narrow niches of education that companies cannot buy on the market as ready-to-use training programs but are forced to develop their own and then change them as practices evolve.

Multiple PM, Digital communication channels, are available within the framework. Their effectiveness and benefits for learning, collaboration, and teamwork rely on communication and stakeholders' engagement.

Such an established framework provides a relational database containing data from all stakeholders in the process, all sources, and all channels across all project life cycle phases. A combination of that data provides plenty of metrics and lists of KPIs that unambiguously show whether a process is effective.

The Comtrade PMO EDUCT portal (Janković et al, 2020) is a landing page, core for corporate knowledge sharing, collaboration, project resource libraries, aggregator of all initiatives, and a portal around which all additional PM Digital communication channels are developed, as shown in Figure 4. Our approach facilitates unlimited reach, is cost-effective, and addresses the needs of varied and globally widespread learners, keeping us on track to achieve business and project goals.

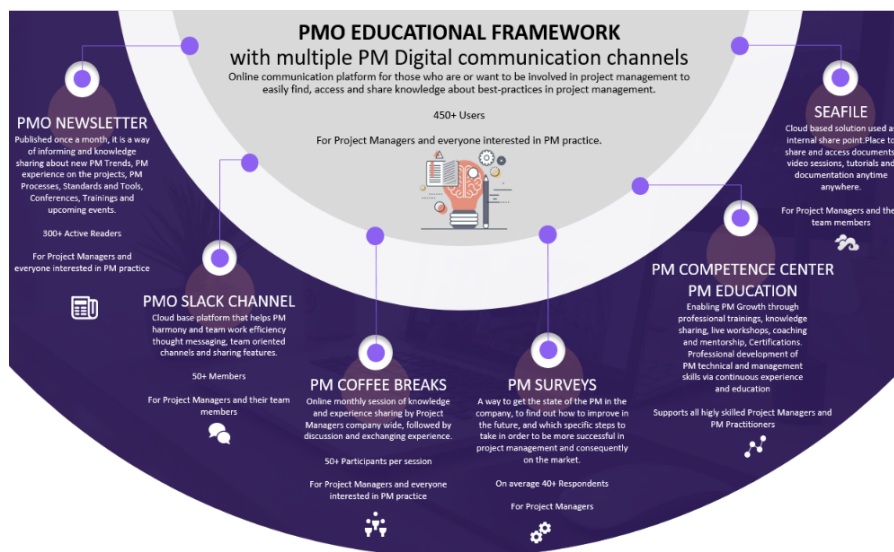


Figure 4 – PM Educational framework with digital channels of communication and knowledge sharing

Рис. 4 – Образовательная система PM с цифровыми каналами общения и обмена знаниями

Слика 4 – ПМ образовни оквир са дигиталним каналима комуникације и размене знања

The PMO EDU portal is structured in the following way:

- **Courses** focus on highly specialized training and tutorials for PMs, Scrum Masters, BAs, and project teams, as custom corporate eLearning content. Each activity includes lessons part and, in the end, knowledge validation through test exams and certification. Tutorials help learners master a chosen process and tools.
- To ensure effective project onboarding, **Coaching Corners** are for everyone interested in Scrum Master and BA, with mentorship program plans, shared personal experience, solutions for everyday Scrum and BA problems, best practices, and tool recommendations.
- **Knowledge database vocabulary** – short educational content:
- **WHAT IS:** basic concepts of project management terms, tools, or techniques. The subject is explained to help PM practitioners easily understand and apply new knowledge.
- **HOW TO:** provides step-by-step information about some specific concept. These materials are tutorials that lead the user through the key features, functions, or stages that progress through a logical sequence to understand the user's elements.
- **Certificates database:** The place where our colleagues' certificates are transparent and continuously updated– our hall of fame. The base contains Scrum Master, Product Owner, and PMO EDU certificates. We are always up to date with the knowledge and competencies of our employees.
- **PM Brochures:** Corner, where our project managers generously shares their knowledge and experience with others, is about global PM practices or internal expertise and skills.
- **PMO Forum:** Place for discussion and sharing knowledge peer to peer.
- **Support:** Place with frequently asked questions, contacts, and calls to action to contribute by sharing content and ideas.

Other Multiple PM Digital communication channels available within the framework are:

- To gather community feedback - **Comtrade PM surveys:** Survey questions and results lead us to find out the best improvements for the future, so as the concrete next steps that we can take to be more successful in project management and consequently on the market.
- **The PM Knowledge Sharing initiative** is realized through PM Coffee Breaks and BA Coffee Breaks, held once a month as a delight for the whole PM community. Topics from the best PM/BA practices and

knowledge are discussed and shared within the community. Video and audio recordings from every session are always available here.

- To promote team culture - **PMO Newsletter**: As part of the monthly updating community with upcoming trends in the industry, news, internal and external events, conferences, trainings, or achievements in a for-on newsletter are uploaded into the archive, so no information is left out.
- To foster collaboration - **PM Slack channel**: Helps PM harmony and teamwork efficiency throughout messaging and team-oriented channels.
- To encourage community exchange - **Seafile**: PM internal share point for all documents, video sessions, tutorials, and templates.

Results

We monitor the results we have accomplished through the benefits we have achieved in our daily work and measure them through the metric system we have established.

Outcomes and Benefits

Tailoring for Custom Needs

Corporate education requires highly specialized content, usually related to the latest methodologies or technologies. Very often, there are still no courses for such topics in the market by educational providers, or they are too basic, i.e., they do not have enough content for quick starting of implementation.

As custom corporate eLearning content is built on demand, it is tailored for specific requirements and corresponds to certain corporate practices (Dimic et al, 2019).

The PMO EDUCT platform provides tailored learning content, design, and delivery to suit learners, companies, and personal goals. Once the company had experienced the benefits of using content tailored to learners' needs, they never went back to pre-made courses but chose to shift to blended learning (Ashleigh et al, 2012) by:

- Engaging external professors/experts or pre-made systems whenever necessary and
- Continuing with internal education to build skills and verify readiness for project onboarding.

Turning Knowledge into Practice

Training has a lasting impact on achieving learning and development goals. Once training is complete, trainees will be challenged to test their newly acquired knowledge and workplace skills.

Testing in the real world could be hazardous for project tasks and frustrating for employees not confident enough to take responsibility for outcomes and delivery in a new role (Predić et al, 2018).

To succeed in competence building, PMO usually establishes labs and sandboxes for exercise and assignments like actual project tasks to practice their workplace skills.

Competency Building

When the external consultant completes the training, he leaves, and the PMO staff cannot verify knowledge and continue to support the implementation of new skills in practice. To prevent this shortcoming, the PMO has designed a mentoring program for fast onboarding on a project, including tasks similar to those that probationers will face on an actual project.

Effectiveness in Project Onboarding

They designed and developed PMO training to ensure that project teams understand projects thoroughly and have the information and skills to successfully deliver products and services (Zahar et al, 2020).

- The main benefit of agile delivery is that approach is rapid. It is possible to create courses and provide project training to project teams as soon as a project is launched or during the presales process.
- It delivers all the relevant project knowledge that will bring project managers up to speed on new methodologies, skills, or technologies and help them score over competitors.
- It enables simultaneous education of our globally widespread employees at the same time.
- It provides knowledge refreshing and follow-up inquiry since employees can retrieve and review learning materials whenever they want.

Efficiency in Competence Growing

- PMO EDUCT proved the best results in support of more efficient operations and enhanced productivity:
- Trains employees for new roles and speedy deployment of new systems and processes.

- Provides narrowly targeted training to help employees adapt and respond to new challenges.
- Significantly reduces costs with self-paced learning that optimizes the degree of employee time utilization.

Personalized and Targeted

Corporate-related training courses are developed considering the company goals, strategy, and career paths so they align with the business and employee's personal goals altogether (Stevanović et al, 2019).

- We control their learning pace by allowing employees to follow interactive multimedia lessons.
- Participants can access bite-sized learning chunks, illustrations, short videos, and mobile phones. The Microlearning concept allows them to learn what they need when needed, just in time.
- PMs, BAs, and developers spend countless hours in neophytes training, introducing new procedures and mandatory training sessions during the year required to meet project or personal goals.

Encouraging Collaboration

Practical corporate training should provide the mission-critical skills and knowledge necessary for everyday work and should be interconnected with employees via shared project tasks.

Employees often learn more through interactions with their peers in an agile environment than by reading a book.

Collaboration on the training strengthens team connectivity and reinforces communication and openness, especially because excellent communication and collaboration tools are in place (wikis, forums, discussions, chats, etc.)

Community Exchange and Ideation

Our corporate learning is not designed to be an individual's journey but rather a driver for enhancing employee cooperation and trust.

- Bringing employees together often leads to debates and discussions that lead to innovation, too.
- The emerging community provides a playground for social exercise in the internal environment before a customer faces circumstances.

Fostering Engagement

Collaborative learning and community further raise new benefits in better immersing and motivating employees preoccupied with daily

challenges. Employees have live exchange and immediate access to others in the learning community through features like discussion forums and web conferences. Engagement with other employees fosters collaboration and team culture, which has benefits beyond the training environment.

Monitoring KPIs

We monitored the framework usefulness and effectiveness as part of our performance monitoring within the Balanced Scorecard methodology under the Learning and Growth perspective.

The PMO Framework Radar Diagram in Figure 5 represents the effectiveness expressed through the KPI results and improvements achieved in the monitoring period. The results comparison between the years 2017 and 2019 is shown in Table 1.

To ensure the ecosystem sustainability and further improvements, we monitor achievements through the following KPIs in Table 2.

The KPIs that reflect outcomes of education are derived from the PMO EDU portal KPIs (Atanasijević et al, 2019b), and they are:

- Knowledge validation rate,
- Follow up support, and
- Geographical coverage.

The readiness for a project as a measure of employability is expressed with the following KPIs that we obtain from the dataset recorded in the Project Dashboard tool for project management:

- Onboarding cycle,
- PM readiness, and
- SM readiness.

For a review of the improvements related to the values-based, innovative, and collaborative culture, we use a targeted survey representing a measuring system for the following KPIs:

- Ideation & innovation initiatives and
- Attrition behavioural change.

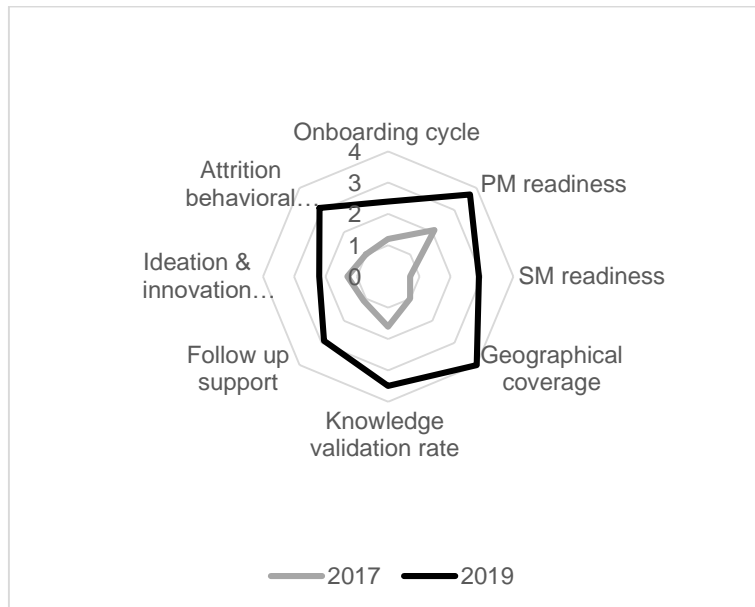


Figure 5 – PMO EDU platform Radar Diagram of the KPI results from 2017 and 2019
 Рис. 5 – PMO EDU Радарна диаграма резултатов КПИ за 2017 и 2019 годы
 Слика 5 – PMO EDU платформа Радарски дијаграм КПИ резултата из 2017. и 2019. године

Table 1 – PMO EDU platform KPI results in 2017 and 2019
 Таблица 1 – Резултати КПИ платформе PMO EDU в 2017 и 2019 годах
 Табела 1 – PMO EDU платформа КПИ, резултати у 2017. и 2019. години

KPIs/Results	2017	2019
Onboarding cycle	1.2	2.4
PM readiness	2.1	3.7
SM readiness	0.7	2.9
Geographical coverage	1.0	4.0
Knowledge validation rate	1.6	3.5
Follow up support	1.1	2.9
Ideation & innovation initiatives	1.3	2.2
Attrition behavioural change	1.0	3.1

Table 2 – PMO EDU platform KPI metrics
 Таблица 2 – Показатели KPI платформы PMO EDU
 Табела 2 – KPI метрике ПМО ЕДУ платформе

KPI metrics			
1	2	3	4
Onboarding cycle			
over a month	half a month to a month	up to half a month	within a week
PM readiness <i>Project and agile knowledge</i>			
over a month	half a month to a month	up to half a month	within a week
SM readiness <i>Agile and technology knowledge</i>			
over a month	half a month to a month	up to half a month	within a week
Geographical coverage cycle <i>Time for educational cycle per all locations</i>			
over a month	half a month to a month	up to half a month	within a week
Knowledge validation rate			
exam on training	practical assignment	grade from project	candidature for promotion
Follow up support			
no materials	learning materials from the training	additional materials for reading continuously on an online repository	consultancy from specialists through the platform
Ideation & innovation initiatives			
1-2 per year	3-5 per year	6-10 per year	over 10 per year
Attrition behavioural change <i>Self-initiated and voluntary actions for improvement</i>			
1-2 per year	3-5 per year	6-10 per year	over 10 per year

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Conclusion

In the digital age, where change is constant and innovation is imperative, organizations must proactively embrace learning and development as core strategies for growth and resilience. This paper has presented a comprehensive framework for continuous education and knowledge growth, tailored explicitly to the intricate demands of software engineering organizations. Collaborative, Complementary, Sustained, and Simultaneous learning principles have been dissected and applied within project management education, methodology enhancement, and team optimization.

Through a combined qualitative and quantitative approach, this study has demonstrated the efficacy of the framework in fostering personalized learning, team collaboration and cultivating a culture of innovation. Applying key performance indicators (KPIs) has yielded tangible outcomes, showcasing improved project onboarding, enhanced skills readiness, and increased engagement. As a result, software engineering organizations are better equipped to navigate the challenges of digital disruption and leverage education as a strategic tool for success.

The literature review found good coverage for academic education and professional training provided by various educational institutions or companies for vocational education, with plenty of practices and methodologies for effectiveness and speeding.

However, the literature does not sufficiently explain how companies needing intensive education, especially software companies, can implement Collaborative, Complementary, Sustained, and Simultaneous learning and growth and monitor the effects of such practices.

This paper contributes to applying such a solution in practice and has an original contribution as an authentic approach.

This framework allows us to pivot and adjust KPIs anytime, respond to business priorities, or adapt to any company's situation.

A company achieved digital growth goals in all key PMO areas by:

- Standardizing processes, unifying project management tools, and onboarding and training new PMs.
- Creating a common language for all stakeholders, sharing knowledge and experience, and providing continuous professional development for PMs, Scrum Masters, and project teams.
- Accelerating professional training while balancing discipline with agility, promoting personal competences, and assessing PM capabilities.

In other words, the company:

- Created a consistent and standardized approach to project management, making it easier for everyone to collaborate and share information.
- Invested in its people, providing them with the training and support they need to be successful.
- Promoted a culture of continuous learning and improvement.
- Created a more transparent and equitable environment for PMs to develop and grow their careers.

The following survey and the framework assessment will show the directions for further development.

The digital growth journey is ongoing, marked by evolution, adaptation, and continuous improvement. The framework presented in this paper offers a blueprint for organizations to instil a learning-centric culture where professionals are empowered to stay ahead of technological shifts, seize opportunities, and drive innovation. By embracing this approach, organizations can transcend traditional boundaries, bridge the gap between academia and industry, and cultivate a workforce adept at utilizing the latest tools and equipped with the critical thinking, collaboration, and adaptability skills essential for success.

This paper aims to encourage organizations to create their own and adopt a framework exposed to its realistic priorities and needs in SW development that depend on: the dynamics and requirements of their clients, the capabilities and performance of their employees, and government expectations and investments.

In conclusion, the digital era demands a paradigm shift in how organizations approach education and growth. The framework proposed in this paper serves as a guiding light, illuminating a path where education is not a one-time endeavour but an ongoing journey of exploration, collaboration, and transformation. As software engineering organizations evolve, continuous education will remain pivotal in shaping their destiny, propelling them towards a future characterized by innovation, resilience, and enduring excellence.

References

Ashleigh, M., Ojiako, U., Chipulu, M. & Wang, J. K. 2012. Critical learning themes in project management education: Implications for blended learning. *International Journal of Project Management*, 30(2), pp.153-161. Available at: <https://doi.org/10.1016/j.ijproman.2011.05.002>.

Atanasijevic, S. 2016. Inovativni modeli digitalne transformacije poslovanja-iskustva lidera. In: *Naučna konferencija INFORMATIKA 2016: Novi trendovi u razvoju informacionih sistema*, Belgrade, Serbia, pp.28-33, May 17 (in Serbian) [online]. Available at:

https://www.researchgate.net/publication/326208718_Inovativni_modeli_digitaln_e_transformacije_poslovanja_-_iskustva_lidera [Accessed: 5 June 2023].

Atanasijević, S., Atanasijević, T., Janković, V. & Zahar, M. 2019a. Application of e-Learning technology in corporate education - Case Study of Comtrade's PMO EDUCT portal. In: *The 10th International Conference on e-Learning (eLearning-2019)*, Metropolitan University, Belgrade, Serbia, pp.74-80, September 26-27 [online]. Available at: https://www.metropolitan.ac.rs/files/2020/03/eConference-2019-Zbornik_FINAL.pdf [Accessed: 5 June 2023].

Atanasijević, S., Atanasijević, T. & Zahar, M. 2019b. PMO Approach in Choosing the Optimal Project Governance Framework for Contracted Engagement Model. In: *3rd International Scientific Conference on Recent Advances in Information Technology, Tourism, Economics, Management and Agriculture – ITEMA*, Bratislava, Slovakia, pp.171-177, October 24. Available at: <https://doi.org/10.31410/ITEMA.2019.171>.

Atanasijević, S., Perić, T. & Bošković, I. 2013. Usage of moodle e-learning portal in the recruitment process for new comers comtrade group case study. In: *The Fourth International Conference on e-Learning (eLearning-2013)*, Metropolitan University, Belgrade, Serbia, pp.109-113, September 26-27 [online]. Available at: <https://elearning.metropolitan.ac.rs/files/pdf/2013/14-srdjan-atanasijevic-tanja-peric-ivana-boskovic-usage-of-moodle-e-learning-portal-in-the-recruitment-process-for-newcomers-comtrade-group-case-study.pdf> [Accessed: 5 June 2023].

Atanasijevic, S., Zahar, M., Janković, V., Fimic-Rakovic, M., Zubac Numić, A. & Sabljic, S. 2016a. PM Insights Survey 2016 Radar Diagram Framework with Survey Responses. *ResearchGate*, June. Available at: <https://doi.org/10.13140/RG.2.2.10684.26243>.

Atanasijevic, S., Zahar, M., Janković, V., Zubac Numić, A., Sabljic, S. & Fimic-Rakovic, M. 2016b. PM Insights Survey Analysis 2016. *ResearchGate*, July. Available at: <https://doi.org/10.13140/RG.2.2.26203.18725>.

Atanasijević, S., Zahar, M., Rančić, D., Atanasijević, T. & Đorđević, M. 2023. Creating an Educational Framework for Project Managers at a Software Company: A Sample Approach. In: *Sinteza 2023 - International Scientific Conference on Information Technology and Data Related Research*, Singidunum University, Belgrade, Serbia, pp.199-205, May 27. Available at: <https://doi.org/10.15308/sinteza-2023-199-205>.

Bierwolf, R., Romero, D., Pelk, H. & Stettina, C.J. 2017. On the future of project management innovation: A call for discussion towards project management 2030 In: *2017 International Conference on Engineering, Technology and Innovation (ICE/ITMC)*, Madeira, Portugal, pp.689-698, June 27-28. Available at: <https://doi.org/10.1109/ice.2017.8279952>.

Braun, T., Ekstedt, E., Lundin, R.A., & Sydow, J. 2020. Digital Transformations of Traditional PBOs and Modern PNWs: Changing Management Practices in Project Society (Final Report). *PMI Sponsored Research* [online]. Available at: <https://www.pmi.org/learning/library/digital-transformation-pbo-pnw-11997> [Accessed: 5 June 2023].

Dimic, G., Rancic, D., Macek, N., Spalevic, P. & Drasute, V. 2019. Improving the prediction accuracy in blended learning environment using synthetic minority oversampling technique. *Information Discovery and Delivery*, 47(2), pp.76-83. Available at: <https://doi.org/10.1108/idd-08-2018-0036>.

Fioravanti, M.L. & Barbosa, E.F. 2019. Outlining Software Project Management Education by Surveying Educators. In: *2019 IEEE Frontiers in Education Conference (FIE)*, Covington, KY, USA, pp.1-8, October 16-19. Available at: <https://doi.org/10.1109/fie43999.2019.9028366>.

Janković, V., Atanasijević, S., Atanasijević, T., & Zahar, M. 2020. How to Establish a Project Management Education Process in a Software Company: From Defining a Roadmap to Effective Implementation. In: *10th International Conference on Information Society and Technology (ICIST 2020)*, Kopaonik, Serbia, pp.60-63, March 8-11 [online]. Available at: <https://www.eventiotic.com/eventiotic/library/paper/585> [Accessed: 5 June 2023].

Predić, B., Dimić, G., Rančić, D., Štrbac, P., Maček, N. & Spalević, P. 2018. Improving final grade prediction accuracy in blended learning environment using voting ensembles. *Computer Applications in Engineering Education*, 26(6), pp.2294-2306. Available at: <https://doi.org/10.1002/cae.22042>.

Stevanović, J., Atanasijević, S., Atanasijević, T. & Zahar, M. 2020. Expanding the level of engineer knowledge for software modeling within corporate education by active and collaborative learning. In: *2020 IEEE Global Engineering Education Conference (EDUCON)*, Porto, Portugal, pp. 1807-1814, April 27-30. Available at: <https://doi.org/10.1109/educon45650.2020.9125250>.

Stevanović, J., Atanasijević, S., Atanasijević, T. & Zahar, M. 2019. Raising the Skills of Business Analysts – The Benefits of eLearning Technologies in Corporate Education. In: *The 10th International Conference on e-Learning (eLearning-2019)*, Metropolitan University, Belgrade, Serbia, pp.25-30, September 26-27 [online]. Available at: https://www.metropolitan.ac.rs/files/2020/03/eConference-2019-Zbornik_FINAL.pdf [Accessed: 5 June 2023].

Zahar, M., Atanasijevic S. & Vasilijevic, M. 2020. How To Leverage Corporate eLearning Platform, For Making Tool Used In Creating Candidates' Profile, Which Turns Business Opportunities Into Prospective Clients. *ResearchGate*, September. Available at: <https://doi.org/10.13140/RG.2.2.10727.68005>.

Обеспечение цифрового роста посредством непрерывного образования менеджеров проектов: основа для совместного, дополнительного, устойчивого и одновременного обучения в организациях, занимающихся разработкой программного обеспечения

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РУБРИКА ГРНТИ: 14.01.85 Автоматизация и автоматизированные системы в образовании,
14.37.09 Методика обучения взрослых,
20.15.13 Информационные службы на предприятиях и в учреждениях,
28.29.59 Программированное обучение,
50.49.37 Автоматизированные системы управления предприятиями и организациями,
82.05.09 Основы теории и принципы организации и управления,
06.81.25 Научно-технический прогресс на предприятии

ВИД СТАТЬИ: обзорная статья

Резюме:

Введение/цель: В данной статье представлена новая структура РМО EDUCT, которая включает в себя совместное, дополнительное, устойчивое и одновременное обучение. Эта структура специально приспособлена к динамичной среде разработки программного обеспечения. Данная статья вносит вклад в актуальную дискуссию об образовании и профессиональном развитии в цифровую эпоху, освещая стоящие перед ним проблемы, представляет разработанную структуру и измеримые достигнутые результаты. Представленная концепция подчеркивает необходимость гибкости, адаптируемости и неустанного стремления к знаниям как фундаментальных принципов успеха в постоянно меняющейся среде.

Методы: В данном исследовании, посвященном крупным организациям, занимающимся разработкой программного обеспечения, рассматриваются многогранные аспекты образования в области управления проектами, совершенствования методологии и оптимизации команды. Предлагаемая методология сочетает в себе качественные и количественные подходы для изучения области

образовательного процесса в глобальной организации и создания гибкой и измеримой структуры для улучшения развития корпоративных знаний. Такая структура нацелена на предоставление учащимся максимальной гибкости в плане обучения, планирования, сотрудничества и обмена опытом, гарантируя при этом соответствующую адаптируемость к частым изменениям рынка и новым навыкам управления проектами.

Результаты: Результаты показывают, что персонализированное непрерывное обучение, которому способствует совместная рабочая среда и специально подобранный контент, дает значительные преимущества. На основании анализа ключевых показателей эффективности (KPI) данное исследование показывает: улучшение адаптации на проектах, улучшение взаимодействия сотрудников и развитие культуры инновационной деятельности.

Выводы: В данной статье представлена структура РМО EDUCT, которую организации могут использовать для создания культуры обучения и расширения возможностей своих сотрудников с целью достижения успеха в постоянно развивающейся области разработки программного обеспечения. Приняв принципы совместного, взаимодополняющего, устойчивого и одновременного обучения, организации могут развивать компетенции сотрудников и необходимые навыки критического мышления, их направленность на сотрудничество и адаптивность, которые необходимы для успеха в цифровую эпоху.

Ключевые слова: разработка программного обеспечения, структура обучения, цифровая трансформация, управление проектами, компетенция, гибкая методология, стратегия обучения, формирование компетенций.

Омогућавање дигиталног раста кроз континуирану едукацију менаџера пројеката: оквир за колаборативно, комплементарно, одрживо и истовремено учење у организацијама за софтверско инжењерство

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Сажетак:

Увод/циљ: Овај рад представља ПМО ЕДУКТ оквир који обухвата колаборативно, комплементарно, одрживо и симултано учење креирано за динамичко окружење софтверског инжењеринга. Доприноси текућој дискусији о образовању и професионалном развоју у дигиталној ери осветљавањем изазова са којима се суочава, представља развијен оквир и постиже мерљиве резултате. Представљени оквир наглашава потребу за агилношћу, прилагодљивошћу и потрагом за знањем, као основним принципима успеха у окружењу које се стално развија.

Метод: Фокусирајући се на велику организацију софтверског инжењеринга, ова студија истражује вишеструке аспекте образовања за управљање пројектима, побољшање методологије и оптимизацију тима. Предложена методологија комбинује квалитативне и квантитативне приступе за истраживање образовног процеса у глобалној организацији и генерисање флексибилног и мерљивог оквира за побољшање раста корпоративног знања. Оквир има за циљ да пружи ученицима највећу флексибилност у погледу учења, распореда, сарадње и размене најбоље праксе, а гарантује и правилно усклађивање са честим променама на тржишту и новим вештинама ПМ-а.

Резултати: Налази показују да персонализовано, континуирано учење, олакшано кроз колаборативно окружење и прилагођени садржај, доноси значајне предности. Кроз анализу кључних индикатора учинка (КПИ), представљена је побољшана имплементација пројекта, бољатимска сарадња и неговане културе иновација.

Закључак: Овај рад представља оквир ПМО ЕДУКТ који организације могу да користе за стварање културе учења и оснаживање својих запослених да успеју у области развоја софтвера која се стално развија. Усвајањем принципа колаборативног, комплементарног, одрживог и истовременог учења, оне могу развити радну снагу са основним вештинама критичког мишљења, сарадње и прилагодљивости неопходних за успех у дигиталној ери.

Кључне речи: софтверски инжењеринг, оквир учења, дигитална трансформација, управљање пројектима, компетенције знања, агилна методологија, стратегија учења, изградња компетенција.

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