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Initial Faculty Perceptions of Scrum for Departmental Change

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Abstract

This RESEARCH paper examines faculty perceptions regarding the use of Scrum for departmental operations. Scrum is an agile methodology that applies processes and procedures that encourage transparency, inspection, and adaptation in the creation of a product. Across the literature for engineering education change, there has been a focus on identifying the barriers and affordances to cultural change in engineering departments. The objective of this paper is to examine the driving factors and barriers to implementing Scrum for departmental operations. The paper will specifically address how a group of faculty, about to adopt Scrum, perceive the impact of that adoption and its potential changes to departmental operations and culture. Findings indicate concerns with the traditional barriers of time and workload. However, they also indicate that there is some expectation for Scrum to decrease elements of the faculty workload and reduce time to complete tasks. These findings also build on the understanding of how faculty collaboration is perceived as both a barrier and affordance to departmental change. This paper is preferred to be presented in a lightning talk, round table discussion, or poster.

Introduction

Engineering departments operate based on institutional policy and procedures as well as norms established through the lifetime of the department [1], [2]. When approaches an institutional change effort there are several factors that affect decision making. These factors are associated with external entities, the institutional itself, department, and the individuals who are part of the change (Table 1).

Table 1. Factors that affect decision making in academic institutions (Adapted from [3], [4])

External	Institutional	Departmental	Individual
Markets	College mission	Faculty	Personal experiences
Governments	Resources	Discipline	Educational background
Accreditation	Governance	Student characteristics	Career stage
	Institution type	Culture	Professional development
	<u>Institution culture</u>		

These factors establish norms that lead to an expectation of how tasks will be completed and clear definition of each faculty role in their department [1], [5], [6]. For the most part, faculty in a traditional engineering department are responsible for teaching, research, and service [6], [7]. Depending on the institution, the relative weighting of these responsibilities can vary. A large university with a Carnegie classification of R1 will be more focused on research, whereas a small primarily undergraduate university may have a higher emphasis on teaching. Inherent to each of these classifications is the vision of the institution and how those goals align with the departmental goals and the eventual prioritization of faculty work.

Significant changes within higher education can lead to shifts in culture and philosophical approaches to curriculum and instruction. The changes are often impeded by barriers related to structural and systemic features within the academic system [4], [8]. From an organizational perspective, individual barriers are commonly associated with misunderstandings and lack of communication, lack of trust and threats to job status and security [9], [10]. Particularly concerning to faculty are changes that affect resources and time [10–12]. Lozano [9] notes that barriers are also present at the group and organizational level [10]. The change can be impeded by the groups culture and norms, intergroup dynamics and group conflicts. At the organizational level, barriers to change can include a lack of strategy, institutional bureaucracy, and a lack of commitment to change by top level management.

Therefore, when a department undergoes a significant change, those changes need to align with the current culture of the institution [7], [14], [16]. In order to better understand the potential success of the change, a department must first evaluate their current position in an effort to see how effective the current approach to change will be received and its likely success [7], [16], [17]. In supporting the call for more empirical studies that demonstrate how organizational culture interacts with change initiatives, this paper examines these initial perspectives for an engineering department that is beginning the process toward changing their overall operations with the intent that these changes will have impacts on improving the culture of the department and the educational experience for students. This department is planning on using Scrum as their primary mechanism for departmental operations.

Scrum

Scrum is an agile methodology that encourages the collaboration among members of a Scrum Team in the incremental development of a product [18]. The development emphasized achieving a minimal viable product. This product is developed over a series of Sprints (timeboxes). Sprints can last one to four weeks long. During a Sprint the Scrum Teams works on items from a product backlog that lead to the release of the product. The product backlog is generated by product owner. Each backlog item is prioritized for its value and estimates of work are used to determine what can be accomplished during a Sprint. This process ensures that the team is focused on the overall value of the product.

The Scrum Team consists of a Product Owner, Scrum Master, and development team members [18]. The Product Owner works with the customer and stakeholders to better understand what are the required elements of the product. The Product Owner works with the development team to make sure that the product increment has the highest value possible to customer/stakeholder or organization. The Scrum Master advocates for the Scrum process, guiding the development team and Product Owner through the process. The Scrum Team works collaboratively to complete the backlog items during the Sprint.

Each Sprint includes several key meetings. These meetings begin with a Sprint Planning session, where the development team chooses items from the product backlog and places them in the Sprint Backlog. Throughout the Sprint the Scrum Team meet daily to discuss what has been

done, what needs to be done, and what is impeding that work. This meeting is intended to only last 15 minutes. At the conclusion of the Sprint, there is a Sprint Review, where the completed backlog items are presented to the product owner and any stakeholders. The Sprint is closed with a Sprint Retrospective, where the Scrum master leads a discussion with the development team about what can be improved in the process for future Sprints.

Departmental Adoption of Scrum

The department presented in this work has chosen to adopt Scrum at an operational level. The intent is that Scrum Teams will be formed within the department that will be focused on developing products that can enhance the quality of the student experience, quality of education, and the success of the faculty. Some of these products can include changes to the curriculum, modifications to instruction, and recruitment, and professional development.

A prevalent change strategy in STEM education [19], identifies the use of dissemination, reflection, policy, and shared vision tactics to support a balanced approach to institutional change [19]. Each of the key features of Scrum promote align with these tactics [20]. Scrum can promote dissemination through the transparent approach which can include artifacts and dissemination of knowledge needed to be successful ion Scrum Teams. Sprint Review, and Sprint Retrospectives, and Sprint Planning encourages reflection that examines respectively the extent that the Sprint was successful, what can make it better, and what are the next most important elements than need to be completed. The adoption of Scrum is a process that will require a modification to policy about how work is done and when multiple teams of Scrum are working there is the intent of establishing a Shared Vision for the approach.

Utilizing Scrum as a change process has the potential to promote lasting change as it can overcome several of the barriers that prevent institutional change. Lozano [9] identified the integration of groups in the change process and focusing on collaboration to help adjust the group values as a technique to overcome the inherent barriers in the organizational structure. Within academia, effective change models should focus on structural changes that require faculty as partners in the process [4], [19]. The use of Scrum as departmental operation accomplishes both of those goals. Faculty, who are members of the Scrum Team are actively involved in the change process and have the autonomy to prioritize the highest value tasks that can lead to the development of the product they are working on.

Despite these benefits, the department exists within a normative higher educational institution and governing structures affected by the factors identified in Table 1. In order to better understand the alignment between the organizational culture and the intended use of Scrum, this study addresses the following research questions:

RQ1. How do faculty perceive that the use of Scrum will impact departmental operations?

RQ2. How do faculty perceive that the use of Scrum will impact the departmental culture?

Methods

The larger study, examining culture change within an engineering academic department, utilizes interviews, classroom observations, department meeting observations, student surveys and focus groups to describe the changes in the department across the implementation period. The data presented in this paper include interviews with faculty collected within the first six months of the change initiative and were focused on establishing a baseline for the department.

Participants

The participants in this study included sixteen full-time faculty in the engineering department. The engineering department is part of a larger College of Engineering in a medium-size private institution. The faculty included a range of academic ranks and tenure status (Table 2).

Table 2. Academic rank and tenure status of participants

Academic Rank – Tenure Status	#
Full Professor – Tenured	6
Associate Professor - Tenured	4
Assistant Professor – Tenure Track	4
Non-Tenure	2

Due to low representation in the department, demographic data associated with sex and race are not reported to protect participant confidentiality. Additional faculty who did not participate included adjuncts and graduate teaching assistants.

Data Collection

Faculty were recruited to participate in semi-structured interviews during the Spring 2020 academic term, with interviews being conducted virtually through Zoom due to the shift to remote work associated with COVID-19. The interviews included five main sections: approaches to instruction, instructional response to COVID-19, perspectives on inclusivity, current departmental operations, and intended use of Scrum in the department.

On average, interviews lasted 60 minutes. The video and audio were recorded during these sessions, and all audio was transcribed. Transcripts of the interview were member checked for intention in the responses to the interview prompts. All participants were provided gender neutral pseudonyms to ensure the confidentiality of the participants.

Data Analysis and Quality

The transcribed interviews were analyzed using open and axial coding. A codebook was generated for use by two different coders and was validated through an iterative process of discussion of code definitions and revisions of those codes. After reviewing each of the interviews, a set codes were identified based on themes across the interviews. From these codes

an initial set of definitions and uses of the codes were created. Using that initial codebook, two coders individually coded three transcripts. Intercoder reliability tests were conducted through MAXQDA Software to identify discrepancies in the application of the codes. The two coders then discussed in detail the first coded document and clarified any differences, updating the codebook along the way and codes applied to each interview were updated. This process continued across the 16 interviews.

Findings

Themes identified across the interviews addressed how faculty perceived that Scrum could both positively and negatively impact department culture operations. Critical to this interpretation is the fact that about half the faculty had previous familiarity with Scrum and leading up to the interviews, there had been several meetings discussing the potential to use Scrum and its impacts. The identified codes are represented with their definitions for perceived impacts of Scrum on departmental culture (Table 3) and operations (Table 4).

Table 3. Perceptions of impacts on departmental culture

Code	Definition
(+) Enhance cohesion	Describes how Scrum is a means to incorporate, collaborate, and include all members of the department in initiating change.
(+) Drive innovation	Provides insight on how Scrum will benefit the implementation of new processes, innovative ways to teach, approach to solving problems.
(-) Inability to compromise	Expressions of how faculty in the department have strong opinions and will not deviate from what they believe is the norm and correct way.
(-) Difficult to get faculty engaged in change process	Identifies a concern that Scrum may be difficult to implement because the professional backgrounds of faculty make it difficult to get everyone on board to the process.
(-) Reduce ownership and autonomy	Expresses concern with how Scrum may take away uniqueness from the faculty and may remove ownership, especially concerning course materials and instruction.
(-) Difficulty defining roles	Discusses how the implementation of Scrum is difficult because of academic structure and not having an outside perspective.

Table 4. Perceptions of impacts on departmental operations

Code	Definition
(+) Increase time availability	Discusses how they believe that Scrum will help with time management by easily facilitating tasks.
(+) Enhance pace of change	Discusses how they believe that Scrum will help make the steps towards change easily manageable, process will be able to be completed faster because of the nature of Scrum.
(-) Time consuming	Describes how they believe that some aspects of Scrum are too time consuming, particularly the daily meetings; transition to the Scrum process will also take time.
(-) Additional faculty workload	Describes how the transition to agile methodologies has caused an increase amount of work for faculty on top of everything they have to do for it already.
(-) Limited ability to accomplish goals	Describes how they are concerned about the transition due to the potential that the end goal may not be accomplished; describes that they will focus too much on the process not the outcome.
(-) Task suitability for Scrum	Describes how there are some activities that are not suited for Scrum because of the nature of how they are completed.

Impacts on Departmental Culture

Scrum is focused on enhancing collaboration and driving innovation that is focused on the release of a product rather than processes and documentation. Initial impressions of Scrum directly related to these precepts. Overall, faculty identified a collegial culture where opinions and insights were able to be expressed in open when working toward a task or making departmental decisions. As a tool, faculty perceived that Scrum could increase the departmental cohesiveness, encouraging broader collaboration toward a common goal:

“I think facilitating the Scrum process and getting better at it would, they'll improve at being inclusive. Because the Scrum process with its nature, brings, how can I say, makes the voices heard; because you have meetings almost every day or whatever your period is and everybody has to talk and you get opinions, you decide on what is important. So, if we managed to get this Scrum process rolling, I would say, it is going to improve inclusivity.” - Garo

This collaboration, in consideration of the process and previous familiarity with the Scrum process, led faculty to see it as an opportunity to drive innovation. This innovation would be a result of enhancing focus toward a specific goal, where the process directed its completion in smaller accomplishable tasks where all team members were working toward the common goal. Implementations of these innovations were predicted to directly affect curriculum and

instruction, assessment, and recruiting. Several also addressed how this could be achieved through focused incremental change and “short term actions”:

“But the initial thoughts on that is that because there is a product and a team working on a product and process which encourages you to push forward a little bit every week or every sprint” - Kham

Negative perceptions on the impact to the departmental culture were closely related to the culture norms at a department level and academia. As previously mentioned, the department was recognized as being collegial, but a part of that collegiality also was a focus on ensuring consensus before decisions were made and changes made. Some faculty acknowledged how dissenting faculty could limit the effectiveness of Scrum. The expression was not focused on how faculty would intentionally restrict progress, but that there were strong feelings associated with how things have always been done. In addition to this perspective, it was noted that it may be difficult to get faculty to fully commit to the process:

“...they don't feel this is really a good idea. And then we kind of postpone and come back again and again, like that.” - Kenth

“we go through all those runs and nothing gets accomplished. Because it needs a decision process. And then it gets turned down.” - Crix

Another element that reflects the impact of the current culture was a concern based on the roles within the department and how those roles would intersect with the Scrum roles of Scrum Master, Product Owner, and team member. One participant questioned if it would create more administrative roles and how this would differentiate between traditional departmental roles of Chair, Associate Chair, and Program Chair. One of the other considerations associated with role definitions is directly associated with identifying a product owner. In a traditional department the role of Product Owner is not the same as a Scrum Team member. It was also noted that stakeholders are typically a direct customer or other stakeholder who can provide insight into the product that is to be developed [21]. However, within the academic implementations of Scrum, faculty who were on the Scrum Team could be developing a product where they could also be the stakeholder:

“Scrum typically has a customer. But if the customer is part of your own group, it becomes a very weird scenario of the customers defining things for people to work on, but who says that that's the right customer, or that they have the big picture view?” - Davals

Impacts on Departmental Operations

The adoption of Scrum, as a departmental approach to operating, may require significant changes to not only procedures but also policies that can foster and enhance the use of Scrum. The changes are sure to have a considerable impact on the way faculty work and how their work is

recognized. These changes also occur within the context of a traditional university structure with its own policies and procedures for all departments. Expressed within the interviews, faculty saw these implications directly affecting their allocation of time, overall workload, and the approach to achieving goals set by the department.

In comparison to the current prescribed departmental processes, guided by institutional norms and policies, some participants perceived that the adoption of Scrum could hasten the time to implement change or respond to a situation. This possibility was acknowledged as a result of the key elements of Scrum and the process. Specifically, the specification of a set time for the Sprint and expectation of results was acknowledged as a key factor. The deliverable to be showcased during the Sprint Review at the end of the Sprint became “Not something you can just put off”, thus creating some accountability to see work completed. Furthermore, the clear specification of responsibilities was key to increasing the speed that change could occur:

“I think the way it might positively impact the department is the speed of the way things should happen. In other words, if we do use the Scrum, then we know our responsibilities, whatever position we have in the Scrum Team or which team of the Scrum that we belong to, and we know the deadlines, we know the backlogs. It's not like we talk about it in one department meeting, and then all of a sudden, six months from that meeting, "Oh, we did think about that, didn't we?" It's not something you can just put off.
- Vinis

While it was noted by several participants that Scrum could be beneficial to a wide variety of focus within academia, products that were closely connected to university policies were of great concern. Most notably were those associated with promotion and tenure. Within the institution, promotion is a documented process with protocols that are adopted the university and campus faculty. These specified processes and timeline begin at the department level. Similarly, the institutional policies and procedures associated with curriculum and degree programs are strictly prescribed by the institutional policies and moderated by workflow used by all departments in the institution. While the department can propose changes to the curriculum, it is currently reviewed and either accepted or rejected by other members of the college and faculty on the local campus outside of the college.

In addition to the concern about the institutional procedures, others placed concern with the need to follow Scrum process for the sake of the process, rather than focusing on the goals of the department and the quality of the product developed by the Scrum Team:

“it's very easy to feel you're doing a great job on the process and not actually accomplish the goal. And get too focused on making the process work and not keeping your eye, that we're actually trying to accomplish a goal” – Davals

The need for an institutional goal is well documented within Scrum processes as they are inherent to the development of the backlog and identification of products, there were other

concerns that goal setting could become disjointed and fracture what was notable a “cohesive” department. With the department offering multiple degree programs, each program was observed to have different goals. It was expressed by one participant that the solutions and products generated by the Scrum Teams should benefit the entire department and enhance the academic programs without negatively impacting another. This perspective identifying an approach to Scrum that could reduce the cohesion in the department was further elaborated that by breaking the department into multiple teams, may inadvertently fracture the department:

“if we break it up too much, we can find ourselves in too many teams, or too many team meetings. And that's, my one worry is that I, if we don't organize things well, we're going to fracture, basically fracture ourselves too much” – Vidarr

In addition to how work was completed, faculty allocation of time in a Scrum environment were viewed as being both a potential positive and negative attribute of the adoption of Scrum. As process, Scrum is focused on making the use of time more productive toward the development of a product. At the same time, Scrum, in its literal implementation leverages a series of meetings to ensure the successful development of a product. The meetings include daily stand-up meetings, Sprint Review, Sprint Retrospective, Sprint Planning. In addition, time is needed to develop and maintain the backlog.

From one perspective, participants viewed the use of Scrum to allocate time proportionally with the current workload. As one participant noted “you will have things to do, then the time you need to finish them. If you cannot finish them in time, you know why. So that's the most valuable thing that” (Garo). The same participant saw the use of collaboration as a key element to the effective use of time and getting things done. Other participants saw the planning as a benefit because it allowed for better preparation for work to be done.

In contrast, several participants viewed the time needed to participate in all the meetings as things that would take away from their already limited time. One of the key concerns was using these meetings effectively. This led to concerns about not having a clear purpose or intent to the meetings which is further exacerbated by excessive socialization or deviating from the intent of the meeting.

"Why the hell am I in this meeting every day? For 10 minutes or 15 minutes, I've got plenty to do. We're not doing anything. We don't have a purpose. We don't have a mission. There's no reason for these teams to be together. We're just doing process for process sake." - Kham

Several participants acknowledge that there was the potential for an increase to time commitment as less experienced Scrum Team members learned the process and as the department determined how best to implement the process. One participant noted that the prescribed Scrum process may be modified in order to accommodate the faculty responsibilities and schedules. For example,

rather than have the daily stand up every day they considered it may be more feasible to meet once or twice a week.

This perception of time was directly related to the faculty workload. A majority of faculty, when discussing the departmental culture, felt that the current workload prior to the adoption of Scrum was excessive. Primary concerns were focused on how the requirements of their course, especially when there were time periods when teaching responsibilities were higher. Several Assistant Professors, working towards tenure, were concerned how their participation in the Scrum Teams would count towards their tenure review. Most notably, participation in the Scrum Teams was viewed as a service responsibility, that only accounts for 10% of the evaluation, reflected by the following participant:

“The concern is obviously the service load. It seems that to adopt this paradigm, there are a lot of new things we need to do. Those workloads are being distributed to the faculty members and we already have a predefined service load for a lot of people, so when we start this new initiative there are definitely new things and additional workload we have to take. I think it's very important that Scrum latest service is counted in the faculty members workload. That is very important.” - Tarsi

This focus on individual workload was also expressed as an area where Scrum may be detrimental when considering tasks that require perceived individual effort. Participants specifically acknowledge research and delivery of instruction. The use of Scrum as an operation to change instruction or deliver instruction was specifically identified as an approach that could increase workload:

“Every day modifying the class and everything else, because of the single point of entry, to say that a student is complaining about this. Let's change the curriculum. We need a pattern to see if it is possibly an issue or not, so knee-jerk reaction, if Scrum results to knee jerk reaction, then that would be a very bad activity.” - Kodo

It is important to note that within current institutional policies, both research and teaching are evaluated for individual effort in those areas.

Conclusion

Like other studies on institutional change [10-12], time and resources were identified by interview participants as key barriers to the adoption of Scrum as a departmental approach to operations. Additional barriers alluded to a lack of cooperation by all faculty that could reduce the effectiveness of the implementation. For each of these barriers, there were directly alternative perspectives relating to how Scrum can increase time availability and increase departmental cohesion that can overcome identified barriers.

The identified perceptions shared by the participants show that there is both optimism and concern for the pending change. Participants view the introduction as an opportunity to introduce more innovation and higher collaboration amongst faculty in the department. However, the current norms and requirements of the faculty lead to concern about how those current responsibilities and processes will change. While participants noted more negative than positive outcomes of the change to Scrum, they were not asked about relative weighting of those perceptions.

This paper serves to reinforce the need to better understand the current culture and determine how the change will be perceived before proceeding. As seen in other studies, the allocation of faculty time remains a key consideration in their perceptions of the change. As academic departments make changes, there needs to be conscious effort of how faculty time will be re-allocated and how those efforts will be recognized by the institution. Overall, there will need to be an understanding among faculty and those involved in the change process about what is valued and how those goals align with that change.

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References

- [1] Peterson, Marvin W., and Melinda G. Spencer. "Understanding academic culture and climate." *New directions for institutional research* 1990.68, 3–18, 1990.
- [2] Bogler, Ronit, and Lya Kremer-Hayon. "The socialization of faculty members to university culture and norms." *Journal of further and Higher Education* 23.1 (1999): 31–40, 1999.
- [3] Lattuca, Lisa R., and Joan S. Stark. *Shaping the college curriculum: Academic plans in context*. John Wiley & Sons, 2011.
- [4] Besterfield-Sacre, Mary, Monica F. Cox, Maura Borrego, Kacey Beddoes, and Jiabin Zhu. "Changing engineering education: Views of US faculty, chairs, and deans." *Journal of Engineering Education* 103, no. 2 (2014): 193-219.
- [5] Lynton, Ernest A. "Making the Case for Professional Service. Forum on Faculty Roles & Rewards.", 1995.
- [6] Gehrke, Sean, and Adrianna Kezar. "Unbundling the faculty role in higher education: Utilizing historical, theoretical, and empirical frameworks to inform future research." In *Higher education: Handbook of theory and research*, pp. 93–150. Springer, Cham, Switzerland, 2015.
- [7] Berger, Edward J., Chuhao Wu, Elizabeth K. Briody, Elizabeth Wirtz, and Fredy Rodríguez-Mejía. "Faculty subcultures in engineering and their implications for organizational change." *Journal of Engineering Education*, 2020.

- [8] Borrego, Maura, Jeffrey E. Froyd, and T. Simin Hall. "Diffusion of engineering education innovations: A survey of awareness and adoption rates in US engineering departments." *Journal of Engineering Education* 99, no. 3 (2010): 185-207.
- [9] Lozano, Rodrigo. *Orchestrating organisational change for corporate sustainability: Strategies to overcome resistance to change and to facilitate institutionalization*. Cardiff University, 2009.
- [10] Blanco-Portela, Norka, et al. "Towards the integration of sustainability in Higher Education Institutions: A review of drivers of and barriers to organisational change and their comparison against those found of companies." *Journal of Cleaner Production* 166 (2017): 563-578.
- [11] Sunal, Dennis W., et al. "Teaching science in higher education: Faculty professional development and barriers to change." *School Science and mathematics* 101.5 (2001): 246-257.
- [12] Sunal, D., and J. Hodges. "Summary of national reports of innovative changes in college science teaching." *Presentation at the NOVA Leadership Forum annual national conference, College Park, MD*. 1997.
- [13] Cuban, Larry. "Reforming again, again, and again." *Educational researcher* 19.1 (1990): 3-13.
- [14] Harris, Stanley G., and Kevin W. Mossholder. "The affective implications of perceived congruence with culture dimensions during organizational transformation." *Journal of management* 22, no. 4, 527-547, 1996.
- [15] Kezar, A. J., & Eckel, P. D. "The effect of institutional culture on change strategies in higher education: Universal principles or culturally responsive concepts?" *The Journal of Higher Education*, 73(4), 435-460, 2002.
- [16] Merton, P., Froyd, J.E., Clark, M.C. et al. "A Case Study of Relationships between Organizational Culture and Curricular Change in Engineering Education." *Innovations in Higher Education* 34, 219-233, 2009.
- [17] Baba, Marietta L., and Diane Pawlowski. "Creating culture change: An ethnographic approach to the transformation of engineering education." In *International Conference on Engineering Education*. Retrieved January, vol. 15, p. 2009, 2001.
- [18] Schwaber, Ken, and Jeff Sutherland. "The scrum guide. 2017.", 6-17, 2017.

- [19] Borrego, Maura, and Charles Henderson. "Increasing the use of evidence-based teaching in STEM higher education: A comparison of eight change strategies." *Journal of Engineering Education* 103, no. 2 (2014): 220-252.
- [20] Timothy A. Wilson, James J. Pembridge, Massood Towhidnejad, Erin Elizabeth Bowen, and Carlos Alberto Castro. "Scrum as a Change Strategy". 2020 ASEE Virtual Annual Conference Content Access, Virtual Online, 2020, June. ASEE Conferences, 2020. <https://strategy.asee.org/35181>
- [21] Adnan, Muhammad, and Muhammad Afzal. "Ontology based multiagent effort estimation system for scrum agile method." *IEEE Access* 5, 2017.