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Sarah Reynolds
reynos23@my.erau.edu

Omar Ochoa
ochoao@erau.edu

Massood Towhidnejad
towhid@erau.edu

James J. Pembridge
pembridj@erau.edu

Radu Babiceanu
babicear@erau.edu

Learning About Faculty Service Through Scrum: A Ph.D. Students' Perspective

Sarah Reynolds
Department of Electrical Engineering and Computer Science
Embry-Riddle Aeronautical University
Daytona Beach, U.S.A.
reynos23@my.erau.edu

Omar Ochoa
Department of Electrical Engineering and Computer Science
Embry-Riddle Aeronautical University
Daytona Beach, U.S.A.
ochoao@erau.edu

Massood Towhidnejad
Department of Electrical Engineering and Computer Science
Embry-Riddle Aeronautical University
Daytona Beach, U.S.A.
towhid@erau.edu

James J. Pembridge
Engineering Fundamentals
Embry-Riddle Aeronautical University
Daytona Beach, U.S.A.
pembridj@erau.edu

Radu Babiceanu
Department of Electrical Engineering and Computer Science
Embry-Riddle Aeronautical University
Daytona Beach, U.S.A.
babicear@erau.edu

***Abstract*— This innovative practice full paper describes the integration of Ph.D. students into departmental operations using Agile approaches, i.e., Scrum. Scrum is an agile framework originally developed for managing software development projects, but in recent years has been adapted into a framework used in classroom experiences and a management technique for non-engineering project-based work. In this work, Scrum was adapted at the department operations level to enhance the efficacy of department projects and processes. A Ph.D. student acted as the Scrum Master for one of the teams. This provided the Ph.D. student with a unique experiential learning opportunity to apply theoretical knowledge in a practical setting, significantly enhancing their learning experience. The benefits for the Ph.D. student included the development of soft skills that made them a more well-rounded Ph.D. student and the creation of meaningful relationships with the faculty members on their team which increased their sense of belonging within the department. Additionally, the Ph.D. student gained insight into the intricacies of university operations, which is valuable training for a student who seeks a career in academia. This paper aligns with a desire to improve the experience of engineering and computing education of graduate students outside of the typical classroom and research domains.**

Keywords: Graduate Education, Professional skills, Ph.D. students, Scrum

I. Introduction

In many ways, graduate education is in need of a refresh. Ph.D. students leave their program lacking desired skills, suffer from the degradation of their mental health, and frequently abandon their goals of remaining in academia [1, 2, 3]. This work aims to improve the experience for graduate students and avoid losing high value candidates to other industries and domains.

This innovative practice paper proposes a method of integrating a Ph.D. student into department operations using Scrum. This integration encourages a symbiotic relationship between the Ph.D. student and the department: the Ph.D. student benefits by (1) gaining experience and soft-skills to make them a more well-rounded student and (2) developing an increased sense of belonging in the department and the department benefits because the Ph.D. student is creating a product of value.

In this experiential pilot study, a Ph.D. student was integrated into departmental operations over one academic year by having them serve as the Scrum Master of a service committee. This project had dual benefits. First, the innate qualities of Scrum allowed for this student to develop a wide range of soft skills that are not typically a focus of Ph.D. programs. The Ph.D. student became more integrated into the department through the relationships they were able to develop with faculty as co-workers, increasing the student's sense of belonging. Secondly, the Ph.D. student was able to use their expertise in Scrum in order to improve the functioning and increase the output of the department's marketing service committee.

Through the implementation of this program, the department discovered a solution for improving the quality of education for the Ph.D. student, improving the competence of the individual and their confidence, which can be a potential mitigation to the mental health crisis in graduate education [2].

This paper discusses the implementation of the program as well as the wide range of benefits found. Section II discusses the relevant literature surrounding the implementation of Scrum and the relevant issues within graduate education. Section III gives a detailed overview of the implementation of the Scrum team. Section IV describes the observations throughout the implementation of this project. Section V summarizes and discusses the effects of this program. Section VI provides implementation advice for adapting this program to other scenarios. Section VII concludes this paper.

II. Background and Related Work

This work fits into two bodies of literature. First, the work addresses well-known issues within the training of Ph.D. students. This work also relies upon the body of literature on the Scrum process, which is the framework that allowed this work to successfully improve the experience for Ph.D. students.

A. Ph.D. Program Enhancement

There are two issues within Ph.D. programs that are addressed by this research. The first is the need to improve the quality of well-rounded education provided to students. The second is the mental health crisis prominent for many students in graduate programs.

First, there is a need within Engineering Education to place more focus on developing well-rounded Ph.D. students. Many students who seek a future role in academia must first pursue a postdoc position to develop the necessary skills to seek a research position later [4, 5]. Though the expectations of postdoctoral roles in Ph.D. development varies across fields, there is a clear gap in Ph.D. training that prevents them from transferring to their ideal role straight after school. To some extent, this gap in knowledge has been shown to be directly related to their experiences as a student. Students who work as research assistants receive more thorough research training and students who work as teaching assistants have stronger teaching skills [3]. A student who desires a tenure track position must be proficient in both areas. This work allows students to improve their abilities in Service, a third pillar of what it means to be a tenured faculty member.

Beyond their individual skill level, students in Ph.D. programs leave academia due to a variety of reasonings such as a lack of confidence in their abilities or through becoming burnt out [2]. It is no secret that tenure-track positions in academia are limited, which can be a significant stressor to Ph.D. students who desire an academic career [1].

There are a wide range of factors that need to be addressed to improve the experience of Ph.D. students. This work focuses on an experiential learning practice that, through improving student competence and encouraging greater department involvement, may both make Ph.D. students into better candidates for academia while also improving their perception of the situation and therefore their mental health.

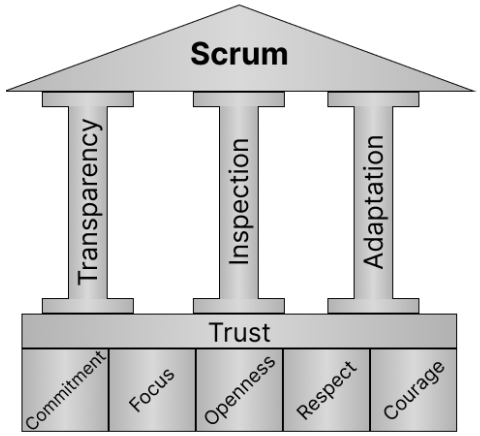

Fig. 1. The pillars of Scrum

Experiential learning has been shown to be impactful towards creating a positive experience for students and their future careers, particularly underrepresented and minority students [6, 7]. Based on the history of experiential learning, this work addresses a method of experiential learning through integrating Ph.D. students into department service projects.

B. Scrum

Scrum is first and foremost a framework for completing work [8]. First developed in the 1990s, Scrum has become incredibly popular in Software Engineering disciplines, and has expanded through other Engineering disciplines as a project management technique.

The work in Scrum is based on 3 pillars: Transparency, Inspection, and Adaptation. The process and work products

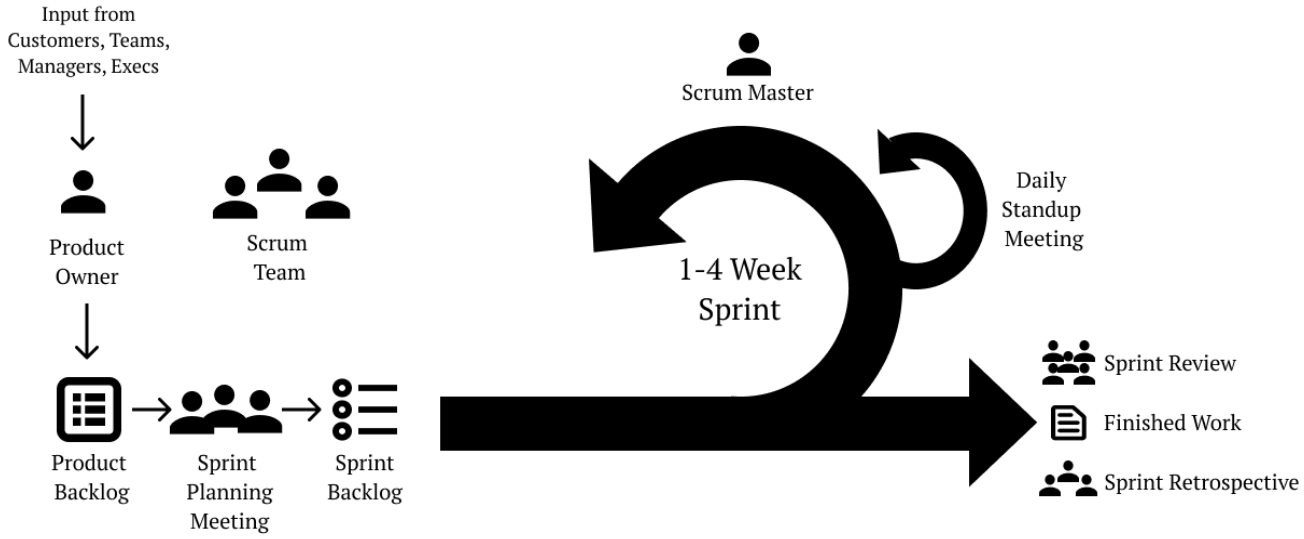

Fig. 2. An overview of the Scrum process

must be **transparent** to all involved, so that they can be **inspected** frequently to monitor for issues, and the process or product can be **adapted** as necessary.

As shown in Fig. 1, Scrum relies on a foundation of trust, which is supported through values of commitment, focus, openness, respect, and courage. Within the Scrum process, it is these values that make a team effective.

The process of Scrum is relatively simple and is depicted in Fig. 2. A Scrum Team is made up of a Product Owner, a Scrum Master, and Developers. The Product Owner has the final say on the features that are necessary for a product. In their role, they help streamline communication between external stakeholders in the project and the Scrum Team. The Scrum Master is the steward of the Scrum practice. They ensure that the Scrum process is being followed in an optimal manner by the team. Developers is meant as a broad term to encompass all people on the team who are involved with creating any element of the backlog within a Sprint. In total, a Scrum Team is a small team, with 3-10 team members.

There are two main documents involved in Scrum, the Product Backlog and the Sprint Backlog. The Product Backlog is a list of all tasks related to the product. It acts like a wish list, in that items on the backlog are prioritized with the understanding that not everything is guaranteed to be accomplished.

At the beginning of each Sprint, which is a period of 1-4 weeks, the Scrum Team meets and moves items from the Product Backlog to the Sprint Backlog. The concept of self-determination is very important at this stage, as each developer is ultimately responsible for what they work on and how much they can accomplish during a sprint. Thus, the Sprint Backlog defines the work that will be completed during the Sprint. The Sprint Backlog is developed at the beginning of the Sprint and does not change throughout the Sprint. Progress is noted through a daily 'Stand Up' meeting. In the Stand Up each developer clearly communicates their progress on their assigned tasks and any roadblocks. The Scrum Master and the Scrum Team work together to try to alleviate any roadblocks.

At the end of the Sprint, the goal is that all of the items on the Sprint Backlog have been completed. The work done is reviewed, in a process known as the Sprint Review. The team also participates in a Sprint Retrospective, in which the team discusses how well the Scrum process itself is working and any ways in which it can be improved.

The cycle of Sprints continues until the Product is finished.

1) *Scrum and Educational Institutions*

The popularity of Scrum in Engineering industries has earned it a place in the Engineering classroom [9]. In a variety of ways, Scrum has been used to manage project-based courses and introduce students to the Scrum approach to make them better candidates for industry.

As faculty bought into the benefits of Scrum, they expanded the potential usage of Scrum. This led to the adoption of Scrum not only in non-project-based courses, but also as a method for managing teaching, research, and service within a University department [9, 10].

This work specifically focuses on the utilization of Scrum at the department level to manage service tasks. This paper builds upon the previous discussion of Scrum for managing departmental service by introducing a Scrum team in which a Ph.D. student fulfilled the role of Scrum Master. Other students were also integrated with this team.

Despite concerns by the creators of Scrum that adaptation of Scrum will bring focus away from the original goals and values of the Scrum process, this work contributes to a body of work in which small changes are made to allow Scrum to be applicable to new domains, while still prioritizing the values and pillars of the Scrum theory [8, 11].

III. Approach

In this section, the structure and operation of the Scrum team within the department is described. A depiction of this process is provided in Fig. 3. This includes the general Scrum team structure employed within the department and the specifics of the Scrum team referenced in this study.

A. Scrum Service Teams

Within the department, faculty service projects are done through Scrum teams. These teams are formed at the beginning of each academic year. The goals of the team come from a variety of sources. Some are implemented due to need (such as the faculty search committee), some are requested by the Department Chair, and faculty are invited to suggest projects based on their passions and interests for the department. Teams are then organized based on the expertise and interest of the members. The Scrum Team discussed in this work had the goal of improving the department's marketing and communications and was known as the Marketing Team.

B. Team Roles

The roles of Scrum Master, Product Owner, and Developer/Team Member are maintained in this structure, with a few minor differences. The Scrum Master is in charge of running the meetings within the Scrum Team. Choosing a good Scrum Master with a strong background in Scrum helps maintain the team's fidelity to the process. The Product Owner is a faculty member on the team who has a particular interest in the outcome of the project or is otherwise able to take responsibility for the outcome. Rather than utilizing the term Developer, this work moves away from the Software Engineering terminology and refers to everyone else as Team Members. The Team Members are other members of the faculty and, in this case, students who are participating to complete the project.

One major difference in this implementation of Scrum is the role of Customer. Requests for appropriate tasks related to the project can come from brainstorming within the team or external entities, such as the Department Chair or the Dean. While traditionally, the role of Product Owner means that they

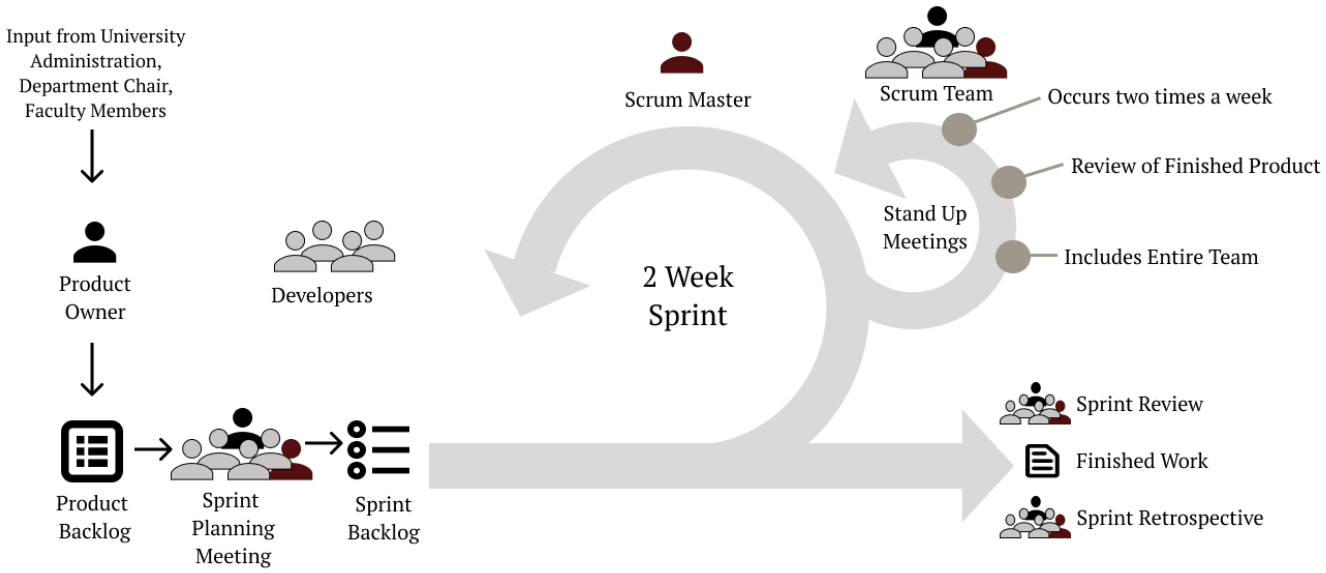

Fig. 3. The Department's Scrum Process

have the final say on what features are implemented in the Product, the integration of a Scrum Team into a traditional University hierarchy limits the ability of the Product Owner to choose features when they are desired by upper administration. Therefore, the Product Owner must always be aware of the current workload and balance of the team. In addition, support of the institution is helpful in ensuring that the Scrum process can be followed. For project features that are suggested by the team, the values of Scrum are incredibly important in ensuring that the ideas of the team members are respected and handled appropriately.

1) Faculty Participation

The level of faculty plays a role in the effectiveness of the Scrum team. Generally, more experienced faculty have a greater knowledge of university functions and important contacts than newer faculty. A team with a variety of experience levels is important for the functionality of the team and allows for newer faculty to benefit from knowledge transfer.

Service is an important role fulfilled by faculty members, but the completion of service tasks is more difficult to define than other requirements, such as research or teaching. By defining this work within a Scrum framework, the team is able to make consistent progress towards their goal throughout the year, with a low weekly time commitment.

2) The role of students

The Marketing Team discussed in this work is unique in that students (undergraduate, Masters, and Ph.D.) were included as members of the service team. This work primarily discusses the effect and benefits of the Ph.D. student, who acted as the team's Scrum Master and reported observations to this work. However, future work will further explore the role and effects of this process for other students.

C. Meetings and Goals (Sprints)

Sprints are generally a 2-week period throughout the semester. Adjustments are made for holidays and work-heavy periods of the semester. Since service tasks are only a portion of faculty responsibility, the number of Stand Up meetings was reduced from daily to twice weekly. Meetings were scheduled for a 30-minute block, though the goal was for most meetings to be held within 15 minutes, but to have the time reserved for longer meetings to handle content-heavy periods such as Sprint Planning and Reviews/Retrospectives.

The goal is to have each Sprint be self-contained. Ideally, in Scrum no changes are made to the Sprint, particularly changes that endanger the Sprint Goal [8]. However, one of the challenges in liaisons with external stakeholders (other departments not using Scrum, urgent projects, and requests from administration) is that certain tasks may come up that cannot wait until the next Sprint. Therefore, the Scrum Master must either leave a buffer for extra tasks to be added or allow for certain tasks to be left incomplete at the end of the Sprint.

The meeting is run by the Scrum Master. The Scrum Master must ensure that the process is being followed to the best of the team's ability. Through the quality of the Scrum Master's stewardship, the team will either succeed or fail in meeting the Project's goals.

IV. Observations

The evaluations of this project were made through observations and a series of unstructured interviews with the Ph.D. student. The progression of tasks was recorded through the online Scrum process management tool, Scrumwise [12]. Together, this paints a wholistic description of the team's functioning over the year.

A. Product Backlog

In AY '23-'24, the Scrum Marketing Team was composed of 3 faculty members and 3 students (1 Ph.D., 1 Masters, and 1 undergraduate). Table 1 shows the Product Goals, a selection of associated backlog items, the hours of effort spent by the team, the primary team members who worked towards the goal, any external teams that were evolved, and the status of the goal at the end of the year.

The team completed an estimated 188 hours of work, successfully fulfilling all Product Goals, except for one that was postponed externally. The velocity of the team, or how much effort was spent for each of the 11 sprints, is depicted in Fig. 4 to ebb and flow. Despite this, the velocity remained on a positive trajectory throughout the year, showing that the team was becoming more effective and able to handle more work. All team members were able to contribute to tasks according to their experience and received feedback and aid from other team members.

The success of the project was noted by the department. From being able to display over 20 posters of student and faculty research to increasing the engagement on LinkedIn, some of these results are instantly measurable. Other results have suggested impacts, but the results are not yet available or cannot be solely contributed to the efforts of the marketing team. For example, the team was in charge of the creation of promotional material to better market the department and to improve program rankings. In the Fall, the department saw an increase in rankings for the department's graduate programs. Similar results will hopefully occur during the Summer when undergraduate program rankings are released. Positive feedback from the Department Chair and other administrators reinforces the idea that this team was successful in its goals.

B. Skill Development and Knowledge Transfer

A variety of skills were gained by members of the team. This primarily occurred via knowledge transfer, in which someone with the appropriate expertise was able to guide and aid those without the necessary expertise in completing tasks. Much of the knowledge transfer flowed from experienced faculty to new faculty members and students. For example, the following knowledge was transferred from faculty to students:

- Working with department forms and service requests
- An understanding of department goals and priorities
- Communicating with other faculty members
- Knowledge and the function of program rankings
- The role and goals of an Industrial Advisory Board

Those with less department experience were also able to share skills and ideas that allowed knowledge transfer to occur in the opposite direction. Some of these ideas are listed below:

- Visual design techniques for marketing materials
- Increasing online interaction through hyperlinks and QR Codes.

1) Overcoming Challenges

TABLE I. MAJOR GOALS COMPLETED BY THE SCRUM MARKETING TEAM

Project Goal	Sample Backlog Items	Total Hours	Team Members Involved	External Connections	Final Status
Increasing Visibility of Department Research Posters	• Order poster hangers for the hallway. • Improve the printing pipeline for faculty and students.	40	Master's student, Faculty	Facilities	Complete
Create promotional videos featuring students for social media	• Contact eligible students to gauge interest. • Schedule available sessions with marketing.	30	Undergraduate student, Faculty input	Marketing Department	Complete
Update program brochures	• Make a list of changes to the degree program.	15	Ph.D. student, marketing team	Marketing Department	Complete
Create marketing material for program rankings	• Contact Student Employment for a list of internships offered.	20	Ph.D. student, faculty	Dean's Office, Student Employment	Complete
Organize a virtual expert summit	• Work with marketing to finalize a date.	5	Faculty	Marketing Department	External Hold: Postponed
Create marketing material for LinkedIn and other dissemination platforms	• Develop an online form for capturing research announcements.	65	Faculty	Individuals to be Interviewed	Complete
Get polos for faculty and students presenting at conferences	• Create an online form to track who is in need of a polo.	5	Faculty	External Companies	Complete
Update faculty information in department entryway	• Get a list of new faculty members in the department.	3	Undergraduates	N/A	Complete
Update faculty headshots	• Contact the Digital Media Office and schedule a time.	5	Faculty	Digital Media Office	Complete

The Ph.D. student reported that one of the challenges was stepping outside the Scrum Team to gather information from other faculty within the department. Specifically, ones they did not know. When faculty were too busy to reply, the interactions became uncomfortable for the student, who did not want to come off as a nuisance. Therefore, an important skill that they practiced was effective communication and the ability to get a hold of individuals using different methods.

The second major struggle reported is that most communication with other departments comes in the form of emails. Ensuring that all necessary tasks were handled, communication occurred clearly, and everyone knew what to do with incoming emails was essential. The Ph.D. student reported that their email communication style changed greatly towards being clearer and more concise.

2) Career impact

When asked about how this experience affected the student's desires to be a tenure track professor in the future the student reports that they still have the same aspirations. However, they would feel more comfortable now than at the beginning of a year coming in and interacting with a faculty department.

In addition, the student reported that they really enjoyed the way the team worked together, making the load light for everyone. This gave them insight into what they would want in a department and environment when they are job hunting.

C. Relationships and Culture

Overall, the participation in the Scrum team fostered relationships between individuals on the team and created a positive and welcoming culture.

1) Reduced Academic Hierarchy

One of the interesting developments is the evidence of reduced hierarchy within the Scrum team. This is a quality of Scrum that contradicts the existing structure within departments. Requests for task completion were reported to go equally from members to other team members regardless of their academic hierarchy. Everyone was treated with an equal voice and say in the team.

2) Relationship Development

The emphasis on equality between Team Members within the Scrum framework aided the forming of relationships between the Ph.D. student and the faculty members present. However, by including the Ph.D. student in the role of Scrum Master in which they were able to immediately demonstrate expertise, the faculty involved were able to respect the Ph.D. student more.

The student reported that the team became very comfortable with each other. Meetings were productive, but lighthearted, and always an enjoyable part of the day. Whereas the Ph.D. student already had a positive relationship with their advisor, the student felt as though they could go to anyone on the team for support.

The end result of this was a close-knit team that was meeting all of the Scrum values. That not only allows for trust to be built

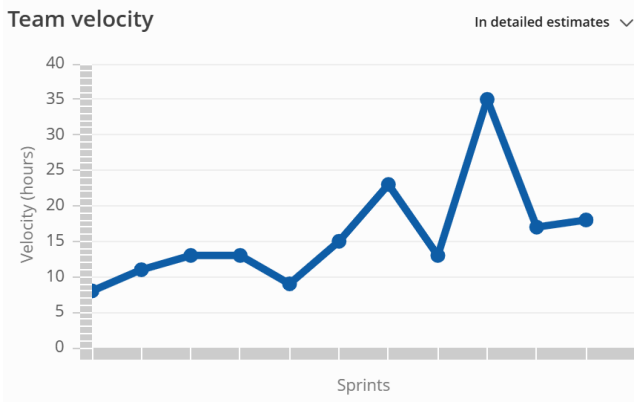

Fig. 4. Marketing Team velocity chart from Scrumwise [12].

and to run a successful project, but it fosters a sense of community within the department. Outside the project, the Ph.D. student reports feeling more integrated in the department. This connection is an important part of increasing the support a student feels and reducing potential feelings of isolation.

The Ph.D. student felt supported by faculty, more so when the faculty nominated the student for an award at the end of the year to honor the student's contributions to department service. The student felt as though they were seen as competent by members of the team, which enabled them to feel confident taking on more unfamiliar tasks from the backlog.

D. Adherence to Scrum

Overall, the team adhered very closely to the department Scrum process. Meetings were held twice a week for 15 minutes. To accommodate changing schedules, individuals who could not attend due to travel or other obligations were allowed to join the meetings remotely. In addition, the Scrum Master summarized the meeting contents and distributed the information to the team for reference.

At times, the team had to add tasks in the middle of a Sprint due to the timeline of the external stakeholders. Team members were exceptionally flexible at taking on the extra tasks when their schedule allowed, which allowed this burden to be shared equally among teammates. On the flip side, at times tasks could not be completed because they were waiting on an external action.

The other major change was altering the sprint retrospective and reviews to be less formal. Rather than dedicating time to them at the end of the Sprint explicitly, the Scrum Master worked to subtly integrate them throughout the Sprint. For example, once a physical item for review was completed, it would be demonstrated at the meeting. This worked in the situation because the light workload the Scrum team was managing allowed for a natural staggering of the reviews. As for retrospectives, they occurred more frequently in the beginning but fell off as the team began making solid progressions and feeling more comfortable with the Scrum process.

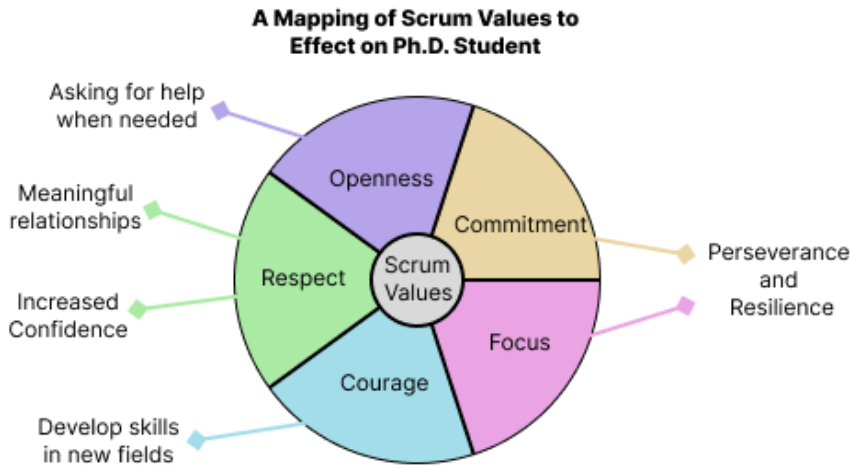

Fig. 5. A mapping of Scrum Values to Ph.D. soft skills

V. Evaluation

This section discusses the success of the project itself and describes how the adherence to Scrum values had an overall positive effect on the Ph.D. student, as shown in Fig. 5.

A. Scrum Succss

The success of these projects is attributed to the formation of the Scrum team. The individuals of the team were motivated and remained engaged in the project throughout the academic year. An issue noted throughout the department is that service teams have a tendency to fall off throughout the year as they stop following the Scrum process. Therefore, this team's success is attributed to not only the individual performance, but the effectiveness of the Scrum Master and their ability to maintain fidelity to the Scrum process throughout the school year.

B. Perseverence and Resilience

Perseverance and resilience were qualities that were developed for the Ph.D. student participating in the process. The Scrum values of commitment and focus led to them taking on new tasks and developing new skills.

C. Increased Confidence

The student reported that they developed new skills throughout the process of participating in the Scrum team. This was reflected in an increased confidence in their ability to believe in their own capabilities.

D. Skill Development

In this process, the student was able to develop skills specific to the expectations of the marketing team, but they were also able to develop soft skills that will transfer to a number of future experiences and careers.

E. Asking for help when needed

One important soft skill that was nurtured by the Scrum process is the ability to ask for help when needed. This can be seen through knowledge transfer, that individuals were able to ask for advice when their expertise was lacking for a specific task. The sense of openness needed to have this dialogue is something that is extensively fostered by the Scrum experience and is a necessary skill to have when trying to develop skills in new domains and situations. This skill is a positive skill for graduate students to work on, whether they are going into academia or the workforce.

F. Sense of Belonging

Throughout the process, the Ph.D. student was able to develop meaningful relationships, with faculty on the team and with other members of the department. This had a positive impact on the inclusion the student felt and the overall sense of belonging.

This is very important to the mental health and success of graduate students within a program and is one of the most important outcomes of the program. The respect that a student receives from their team clearly can impact the way they feel about themselves and their position within a department.

G. Limitations

The main limitation of this work is that is a case study of a single implementation of a departmental Scrum team. The success of the team is attributed in part to the Ph.D. student effectively managing the team as Scrum Master. In addition, the Ph.D. student in question reports positive benefits in association to the Scrum team, such as feeling supported and respected by the department as a whole. Despite this, there is not enough evidence to claim that Scrum is the only factor behind these changes. However, the trial period of this process is seen as a success by the department and further work will be done to study the implications and mutual benefits of combining faculty and students to work on department projects using Scrum.

VI. Adaptation Guidance

This paper discusses a singular Scrum team's functioning. However, each Scrum team will look slightly different. The

goal of this section is to provide advice for adapting the structure of projects using Scrum and Ph.D. students to any department activities.

Team Organization: Scrum teams are always small, no more than 10 people should be on a team. Ideally, the number of students should be fewer or equal to the number of faculty to encourage knowledge transfer.

Department Support: Scrum teams can be implemented on a variety of scales. Though this work discusses a department-wide change, Scrum can be located to a singular team, with the understanding that there will be external stakeholders that do not align with the boundaries of Sprints.

Appropriate Projects: There are a few projects that may seem inappropriate or too advanced for Ph.D. students to be involved in. For example, even a faculty search committee, where a Ph.D. student would lack the appropriate knowledge to contribute significantly, they can still aid in handling smaller more administrative tasks while absorbing knowledge and skills that will help them in the future.

Knowledge of and Adherence to Scrum: This work shows how a strict adherence to Scrum isn't necessary and it can be adapted to fit the needs of the group. However, two things are very important. (1) The values and goals of Scrum must be kept in mind and any changes must prioritize them. (2) The method chosen must be followed with belief in the process.

Time Requirements: A common concern when it comes to faculty and service projects is that they are a waste of time and take away from other important ventures, such as research. The same concern can be applied to taking time away from the demands of Ph.D. work. Service is a pillar of the responsibilities of faculty. This work aligns with the perspective that community and the development of soft skills are an important part of academia that should be fostered. Additionally, the lightweight framework of Scrum supports a minimal time invasion (2 15-minute meetings a week) and the ability for individuals to determine how much time they have to dedicate to tasks within a Sprint.

VII. Conclusion

This pilot study demonstrates how Scrum can be an effective way for managing department service projects. Specifically, this work focuses on how the integration of a Ph.D. student well versed in the Scrum process as Scrum Master can help the team function effectively and help the team meet and exceed service expectations in an academic school year. In addition, the students involved in the Scrum team were able to benefit from the values of Scrum, improving their relationships with faculty, increasing their confidence, and increasing their competence in a variety of soft skills that are important to creating a well-rounded student for any career path.

In this study, isolation was not a prior concern for any of the students involved. However, the benefits of connection within the department were large enough to see how regularly implementing programs such as this one could be beneficial and reduce the threat of Ph.D. students feeling isolated.

This initial study supports both the use of Scrum as a department management technique and the integration of students, particularly Ph.D. students in these teams. This work will continue to be developed and evaluated by the research team. Other universities and departments are encouraged to adopt and adapt these methods for their own use, for the purpose of creating better Ph.D. students and a better culture for them to thrive in.

ACKNOWLEDGEMENTS

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