COMP8790 - Software Engineering Project

Exploring the Use of SCRUM for Administrative Practice Improvement

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Abstract

Better workforce practices are beneficial for any organization. While a significant effort is usually spent on performance measurement, it is equally important to think how to improve performance management. This study looked at a methodology in Software Engineering that is successful with its deliverable outcomes and that focuses on team communication and collaboration. Among Agile development methods, we found that SCRUM could be adapted and used in an environment different to the software development environment and still be successful. We therefore explored the possibility of adapting SCRUM for the purpose of improving administrative practices, in particular team performance and the quality of its work. This work was important to check whether using SCRUM would not only improve team performance but also increase its productivity in an environment where team collaboration was limited. A one-month study in an administrative organization was run to identify more appropriate performance and effectiveness measures. Data from this SCRUM period were compared to 3 other Non-SCRUM periods (where normal procedures of the organization were used). The results of the study showed a significant improvement in team performance during SCRUM period measured by number of processing days of applications. This was largely attributed to the use of adapted SCRUM. These results open the door for further research on application of the approach used in the study to various levels of organizational management.
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Chapter 1 – Introduction

In this study, we explored the possibility of adapting SCRUM [1] for the purpose of improving administrative practices, in particular team performance and the quality of its work. There were two research questions:

- Can the use of SCRUM improve the performance of administrative teams?
- Can the use of SCRUM help identify more appropriate performance and effectiveness measures in administrative teams?

This study was conducted inside an administrative organisation within a real environment and with real problems. A particular group in one of the organisation’s department has earned its reputation as cohesive and cooperative group for its professionalism and high standard outcomes. After suffering from continuous mishaps for two consecutive years, the group felt that their excessive efforts to restore the group functionalities were not rewarded; therefore, they lost their motivation. Despite the factors that influenced the members’ productivity, they were underperforming from the department management’s perspective. To improve the performance in the entire department, the management introduced new work practices (i.e. call centre to reduce interruptions, Semi-automated templates to increase the productivity, daily group performance reports to encourage group competency). This didn’t help the group to improve its performance; after implementing these practices the management was still complaining about low performance. In Software Engineering, there has been worked to improve the workforce practices. An example is PCMM [2] - People Capability and Maturity Model. I have personal experience in SE from my previous work. My interest in SE was reinforced during my current Master degree. Therefore I started searching for a methodology/process in Software Engineering that can address the team performance problem. Agile development methods are powerful options as they address the lack of people motivation, low productivity and other software project’s problems (schedule delays, high costs, etc...); they rely on people and their creativity rather than on processes [3]. Many research studies found strong evidence about the correlation between the use of SCRUM (a framework for Agile software development process) and productivity [4]. It is a framework within which various processes and techniques could be employed [1] and is thus adaptable, and could be applied in the administrative context described above. Five members of the above mentioned group participated in this study during work hours. They formed one focus team that applied an adapted SCRUM methodology to complete their daily applications (work related) for a period of one month.

Quantitative and qualitative data had been collected from the participants’ daily work (online applications) during four periods (one month long each); one SCRUM period (when the adapted SCRUM methodology was applied) and three other different periods (Non-SCRUM periods) of the same year (2014). The aim was to analyse and discuss the results and outcomes of this data and how they would answer our research questions.

In this report, we started by a description about the organisation where the study was conducted, its structures and procedures and how this project evolved. Then we went
through similar literature. Description of the methodology and steps followed in this study was mandatory starting by SCRUM framework with its artefacts, events and roles, the adapted SCRUM to the data collection. This was followed by results analysis and discussions, then conclusion with our findings and future works.
Chapter 2 – Background

Description of the organisation
The organisation where the study was conducted is a foreign non-profit organisation. Its main role is to monitor students sent, under a scholarship program, to study in Australian universities in both undergraduate and postgraduate level. These scholarships are provided by various government and non-government sponsors of this foreign country, whose name kept anonymous for privacy purposes.

Structure of the work environment
The organisation is divided into different departments. The department where the study was held (Academic department), is composed of 5 groups having each a group manager who reports directly to the head of the department, and a different number of group members. Each group is responsible for a number of Australian academic institutions. The sponsored students studying in these institutions are allocated to group members with the same role (academic advisor). The assigned group members monitor students’ academic progress and receive their applications online via the organisation’s portal, assess them and take the appropriate actions –i.e. processing the application to the next level, accepting or rejecting it (make a decision), or returning it back to students for more information or documents. The types of applications’ flow is described separately in this chapter. Moreover that group members have to deal with students’ phone calls and emails, as well as any communication from their institutions. Group members are also responsible for solving any academic problems that might arise.

There are 34 types of online applications. Once the student submits an application, it appears directly as a “new application” in the allocated employee’s account (“Incoming” folder). According to the organisation’s rules, an application should be processed within 5 days of its submission. If not, it will be moved automatically from the “Incoming” folder to the “Overdue” folder. Weekends and public holidays are included in the count.

Although, the group members deal with the same types of applications (34 types), the number of applications received on a daily basis and their type vary from one member to another. The group manager usually assigns approximately the same number of students to each member irrespective of the possible variation in the number applications.

I noted through observation that a fair distribution of students among members should be based on: the number of applications expected to be submitted, the complexity of these applications which is relevant to academic level of the institutions, their cooperation and professionalism, the maturity and responsibility of students and the quality of previous work.
Flow of Applications
There are 4 types of applications’ flow

- **Type 1**: The final decision (rejecting or approving the application) is at the employee’s level. If the application is incomplete, the employee can return the application back to the student’s account for more clarification and to add extra documents (if required).

- **Type 2**: The final decision (rejecting or approving the application) is at the level of group manager. If the application is incomplete, the employee can return the application back to the student’s account. The manager can return the application back to the employee’s account for more clarification or investigation.

- **Type 3**: The final decision (rejecting or approving the application) is at the level of head of the department. If the application is incomplete, the employee can return the application back to the student’s account. The manager can return the application back to the employee’s account. And the head of the department can return the application back to the manager or directly to the employee for more clarification or investigation.

- **Type 4**: The final decision (rejecting or approving the application) is at the level of the student’s sponsor (overseas). In addition to what is described above about the possibility of returning the application at the levels of the head of department, manager, and employee to the previous level, the sponsor can return the application back to the employee’s level for more clarification (if incomplete), or make a decision (either accept it or reject it) and close the application directly or return it back to employee as kind of notification with their final decision. And the employee closes the application accordingly.
**Work Practices within the Department**

In the department’s culture, students’ phone calls and emails are high priority. Even though, it was noticed that the time spent on answering phone calls or emails as well as all the other tasks mentioned above are not taken into account by the management when evaluating the number of tasks completed daily. Instead, the main focus is on overdue applications and students’ complaints. These two are interrelated; the more the number of overdue applications, the higher complaints to deal with, which in turn leads to more overdue applications and so on.

![Diagram](attachment:image.png)

**Figure 2-1 – Reinforcing loop [6] showing the impact of overdue applications**

*Fixes that Fail*

In their quest to reduce the number of complaints, the management created a “Call Centre”-a unit that receives phone calls diverted from employees’ phones if unanswered for any reason. Unfortunately, because employees working in this centre were not trained well for this job, they constantly interrupted the employees by sending emails and follow-up emails during the day. This had the effect of increasing the number of uncompleted tasks, and consequently the employee’s workload, resulting in more unanswered phone calls on the employee’s side, more complaints and more overdue applications.

Appropriate training for the workers in the call centre could be a good intervention strategy to make the balancing loop [5] [6] the dominant one. In other words, the call centre’s workers should be trained to answer phone calls and provide information without interrupting the employees.
Quality of Applications
There is a strong correlation between low quality applications and the increase in employee’s workload.

Too many applications in the employees’ account lead to overdue applications. Under the pressure of time limitation and complaints, there is a high chance that processed applications will be of low quality (i.e. insufficient information, incomplete documents, etc…). This in turn increases the number of returned applications from management to the employees’ account for more revision.

This issue is problematic in itself; when the application is returned to the employee’s account, its creation date (submission date) is overridden by the returning date. The date counter of the system gets reset to zero, which gives the employee an extra 5 days to do the revision. That unintentionally sorted out the problem of time limitation and overdue applications in the system but didn’t sort out complaints; to students, submission dates remained the same.

To reduce the time spent on applications and to improve the quality of processed applications, the management created in 2013 semi-automated templates for each type of application. The intention was to reduce the number of returned applications, but this didn’t lead to a significant improvement in the performance. In 2014, the management was still complaining about overdue applications.
The impact of the semi-automated templates on the quality of processing applications, and whether they contain enough information to help the management take decisions concerning these applications (i.e. how efficient these templates are) are out of scope of this study. But it is noticed that no official quality measurement procedures are used in the organisation. It all depends on the observation of the manager or the head of the department - when they receive the applications. The next paragraph reveals how the management assesses performance.

The Department’s Performance Measurement

The management used to send, early in the morning, a daily report to the whole department stating the following:

- Number of current applications in each group’s account (sum of all the applications in the account of each member of the group)
- Number of current overdue applications in each group’s account (sum of all the overdue applications in the account of each member of the group)
- Percentage of overdue applications of a group in all overdue applications of the department for the day on which the report was generated.

Based on the daily report, if a group member is not performing well, the performance of the whole group will be affected despite the fact that its members are working separately and group collaboration is limited.

It is important to note again that if the application is returned (from manager, head of the department or sponsor), the returning date will override the submission date. This simply means that returned applications and new applications are measured equally!

The number of daily received applications as well as processed applications vary from one group to another. But it doesn’t mean that the group that processed 80 applications per day is performing less than the group that processed 100 applications per day. The dual load (combination of complexity and priority) of any application and its quality should be

Figure 2- 3 – Reinforcing loop showing the impact of low quality application on workload
considered; after all what is the point of processing 100 applications if 20 of them will be returned due to poor quality (lack of information or missing documents or wrong data, etc...)? Unfortunately, no official quality measurement procedures were used in the organisation to give credit to a group processing high quality applications.

From the perspective of the five group members that later participated in this study (this group is referred to as group A in the report), their group was performing at high capacity given the fact that they had to cope with the loss of two members who were moved to different role in the organisation (management decision) and the resignation of another two. No quick actions were taken by the management to fill their place in the group. The remaining members had to adapt to these changes quickly and restore the group’s functionality by covering the universities previously handled by their former colleagues themselves, even when the resulting number of students per group member exceeded the average number allocated to members of other groups. In addition to this difference in students’ number, the remaining members of this group had to get acquainted with new students, which in some critical cases slowed application processing; they had to study the new students’ files in depth and do additional work before processing their applications. This was not the case in other groups where members continued to deal with almost the same universities and same students at least for the last two years. Management didn’t consider all these factors while assessing the performance of group A. The group members felt their efforts were wasted, and consequently lost motivation.

As part of group A, I was really frustrated about what seemed to me an unreasonable comparison of groups. We can’t think of a team as a unit in isolation of all the factors mentioned above.

The following figure gives a clearer idea about the factors that influence the performance of a team.

![Figure 2-4 - Causes and Effects Diagram Influencing Team Performance](image-url)
Evolution of the Project

When I was enrolled in COMP6353 (Systems engineering for software engineers), Dr. Shayne Flint talked about cross-disciplinary research and the possibility of importing successful methodologies in Software Engineering (SE) to other disciplines and vice-versa. That’s how I started looking in this direction searching for process or methodology in SE that can help defining new metrics to measure the performance of a team.

Further readings in the topic discouraged me from proceeding in the area of performance appraisal. W.E. Deming identified performance appraisal as one of the seven deadly diseases of management [7]. The survey of 200 human resource professionals referred to by Pfeffer and Sutton stressed on low productivity, negative effects on employee engagement, and reduced collaboration as results of performance appraisal.

On the other hand, I thought that the outcome of this process or methodology, if used, will not be seen on the short term. Time will be needed to do more training to improve quality. Also more planning for students’ redistribution among the group members based on the correct estimation of the applications loads would be mandatory. This requires a change in the management’s perception; they won’t adopt any process unless its effectiveness on a very short term is proven. Added to that, the organisation is unlikely to apply it as the department where this study was held is the only one that works in groups. Therefore, there is no point of working on a process or methodology that is really good and contains all the metrics that identify the performance of the team, if the management is not going to use it. It might be used in other organisations but as the team performance problem with all its dimensions and influencing factors aroused in this organisation, I was really keen to find a methodology that could be adopted there first.

Many studies demonstrated that better workforce practices are beneficial [8] [9] [10]. Rather than continuing in performance measurement why don’t we work on performance management? Therefore, we started looking for a methodology in Software Engineering that is successful with its deliverable outcomes and focuses on team communication and collaboration as well. That narrowed the search to Agile development methods.
Chapter 3 - Literature Review

There wasn’t a lot in the literature about adapting SCRUM in environments other than software development.

“FloraHolland” is a flower auction company that used SCRUM and “agile elements” to change the working way of their several business units, as described by “InfoQ” [11]. They extended the Job Demands – Resources model[12] with SCRUM to be flexible in responding to market changes. Unfortunately, neither their slides presented at the XP Days Benelux 2013 conference [13] nor the answers of the company’s representatives published on “InfoQ” website gave a clear idea about how SCRUM was adapted to be used in FloraHolland. But they separated the daily business (i.e. their usual daily work) from what they called the “improvement activities” which happen once a week when all involved teams work on these improvements on the same day. SCRUM was used to manage these “improvement activities”. There might be more details that could clarify how this process is related to SCRUM, but from the information published and presented, it seems that what they did was only to select some artefacts of SCRUM and use them separately.

SCRUM in essence is a framework. It’s a whole unit where all pillars (artefacts, roles, meetings) are interrelated to make SCRUM an efficient and productive methodology. We can’t take parts of it and say we applied SCRUM. I believe that FloraHolland just improved the implementation process of “improvement activities” by transforming their vision to points, put them as items in one list, prioritise these items, take the first one and make all the involved teams dedicate one day a week to implement its sub items.

Figure 3-1 –SCRUM and Job Demands - Resources Model as presented by FloraHolland at the XP Days Benelux 2013 conference

In the article “Performance Management Using Scrum” (published on SCRUM alliance [14]), the author wrote his thoughts about using SCRUM as a framework for performance appraisal. He defined three pillars to his framework “People SCRUM”: 
Roles:
- Appraisee
- Appraises
- Reviewer

Artefacts:
- Goal list,
- Appraisee’s Daily Performance Chart
- Appraiser’s Daily Performance

Events:
- Goal-setting meeting
- Updating the Appraisee’s Daily Performance Chart
- Updating the Appraiser’s Daily Performance Chart
- People Sprint review meeting
- Goal retrospective meeting

What was described in the article is an imitation/replication of SCRUM framework. While it’s true it has same pillars as SCRUM, such as roles, artefacts and events (meetings), it nevertheless has extremely different context and spirit. It might achieve its target and get a performance appraisal report, but as mentioned above, it will have a negative impact on team performance and collaboration. While SCRUM works on improving motivation, productivity and autonomy, People SCRUM will have a counter-effect. It will emphasize the individual and diminish the group; everyone will be focusing on meeting their daily goals rather than the team’s goals. On the other hand, if members are going to be assessed during daily meetings, would they mention any impediments they are facing or might face to the same person whose is assessing them? In addition to that, the author suggested SCRUM Master to play the appraiser role which totally contradicts what the role of SCRUM Master is, which is to have no managerial authority over SCRUM team.

There were also literature about applying SCRUM principles to SPM (Software Product Management) [15] and using SCRUM to guide the execution of SPI (Software Process Improvement) [16], but we still in the discipline of Software Engineering.

What was interesting to read, is a study about introducing SCRUM as an agile pedagogy in Higher Education [17] where learning outcomes are the product backlog and the knowledge objects are SCRUM deliverables. Professors, Teachers and Students play SCRUM roles. In similar context, a study was published [18] exploring the possibility of adapting SCRUM methodology in the classroom to encourage collaborative learning between students. The study was conducted at Elon University - North Carolina during the 2009-2010 academic year when the author decided to design her PWR (Professional Writing and Rhetoric) courses – each consisting of full semester client projects – to encourage collaborative learning. Lack of trust between group members, lack of interest in the subject and disorganisation made the collaborative learning not enjoyable from the students’ perspective. The author used a new metric to measure the students’ success: Students development as collaborators. She used SCRUM methodology as a framework for her courses’ projects. At the beginning of the semester, Product goals (as Product Backlog) were given to the students to accomplish; the
SCRUM deliverables are the accomplished goals. As the course structure required to divide the work into three types: “Preliminary work and research”, “Client proposals” and “Production” therefore, three sprints were done. The students did the “Daily SCRUM Meeting” in every class and the typical SCRUM questions were asked; a discussion of reading materials related to the students’ project were added to these meetings; the author played the role of SCRUM Master. The study noted that students changed their manner of handling group project from “divide and conquer” to collaborative, trustful and credible one over the semester.

I would say that defining new metric for students’ evaluation as the author did in her study was the first step that redirected students minds from individual learning to collaborative learning, which SCRUM obviously elaborated over the semester period.
Chapter 4 – Methods

Why SCRUM?
SCRUM is a framework for Agile software development process widely known in software engineering due to its efficiency and productivity. It focuses on management practices. A systematic literature review done by Cardozo et al. [4] found strong evidence of the correlation between SCRUM and productivity in software projects. It has shown success characteristics in team motivation, quality and client satisfaction

SCRUM at A Glance

SCRUM Artefacts
The artefacts of SCRUM are:

- **Product Backlog**: a prioritized complete list of everything the team has to produce.
- **Sprint Backlog**: a prioritised list of tasks that the team needs to work on during a sprint.
- **Sprints**: series of iterations which last from two to four weeks. In each iteration, the team works on the tasks specified in the Sprint Backlog to produce a useful increase in the final product.
- **Deliverable or Increment Product**: the product backlog items completed during a sprint.

![The SCRUM Process](image)

*Figure 4 - 1 – The SCRUM Process [23]*
SCRUM Meetings
In SCRUM, there are 3 types of meetings:

- **Sprint Planning Meetings**: held at the beginning of each sprint to discuss the tasks that will be given highest priority to work on during the coming sprint.
- **Daily SCRUM Meetings**: held at the same time and in the same location within a timeframe of 15 minutes at most. The aim of these meetings is to discuss the team’s achievements of the previous day, set the coming day’s tasks and discuss any impediments that hindered or might hinder the team’s goals.
- **Sprint Review and Retrospective Meetings**: held at the end of each sprint to demonstrate a potentially shippable product increment and to discuss any impediments that influenced the team’s achievements.

SCRUM Roles
There are three fundamental roles in SCRUM:

- **Product Owner**: prioritises and re-prioritises the product backlog, accepts and rejects the product increment.
- **SCRUM Master**: helps removing impediments the team might face and making sure the meetings are restricted to the specified timeframe. SCRUM Master also serves as facilitator for the Product Owner and SCRUM Team, but he/she doesn’t have managerial authority over the team.
- **SCRUM Team**: a self-organising and self-managing entity that is strongly collaborative and has internal and external autonomy. Its perfect size is 7 plus/minus 2.

Adapted SCRUM
As SCRUM has to be used for administrative practices - i.e. in an environment different from a software development environment, it has to be adapted. In this study, the product is the continuous / non-stop unprocessed applications received around the year.

The refined SCRUM artefacts are:

- **Product Backlog**: continuous lot/set of unprocessed applications
- **Sprint Backlog**: list of daily applications to be processed during the sprint
- **Sprint**: iteration in which the team worked on the assigned applications. The sprint cycle is one week, as the applications must be processed within a specified timeframe; Five days from the application’s submission day as per the organisation’s rules.
- **Deliverable**: set of applications processed during the week
The Add-in Process

After defining SCRUM as the framework of this study and retuning its artefacts, the workload disparity had to be solved. It is unreasonable to expect the same level of achievements from participants having different number of applications. A process that can assure an even distribution of applications among participants during sprint was needed. The “Applications Distribution Process” emerged to the surface. It is a simple process that Group A came up with in 2012 to reduce the workload of a member in lieu of a colleague on leave. This process proved to be better than the normal procedure used in the department, where only one member will be in charge of all the tasks of the colleague on leave, in addition to his/her tasks.

This Application Distribution Process consists of three steps:

1- Check the applications to be distributed.
2- Check the account of the members to assess their current load. This step doesn’t violate the employee’s privacy as per the organisation’s rules and the employees are aware of that.
3- Assign applications to group members taking into consideration their current workload and the load of transferred applications.

At that time, the “load” of work carried by a group member was not really taken into consideration. Instead, it was roughly estimated by the group member who was charged with the distribution of applications.

The distribution process needed some improvement before being adopted and used in conjunction with the adapted SCRUM in this study; a reasonable distribution was required. Using the improved distribution process without SCRUM as framework wouldn’t achieve the required efficiency; meetings, review, feedback, team communication, and the improved distribution process were interrelated as components of the adapted SCRUM.

To assure the reasonable distribution, a new metric was defined to measure application load. This metric is called “Weight”; it has two parameters: Complexity and Priority, where “Complexity” measures how complex the application is, whereas “Priority” defines the importance of the application from the participant’s perspective. Their level/degree varies from Low, Medium to High.

Let’s take as example the “Leave” application. As per policy, Students are entitled to go back home either during breaks, or when they have a gap of a maximum of 3 months between the completion date of their English studies and the starting date of their academic studies (Diploma, Bachelor, Master, etc...). They must however submit a leave application and secure its approval before leaving Australia. As per the organisation’s rules, the approval of this application is compulsory before the student is allowed to leave the country. The total duration of the leave within a year should not exceed 3 months for the students at a university degree level and 1 month for students studying English language courses. A problem arises when student has a gap of more than 3 months, which is the case with universities having trimesters, and with no availability of courses in the third trimester. In such a case, the “Leave” application needs extra work. Specifically, the employee has to do the following: (1)
double – check with the university the courses availability, (2) send notification to the student to apply for a deferral (another application) for the period after 3 month period taken as leave and (3) suspend the scholarship (another application) during the gap period falling out the approved leave. The participant having similar cases assigned “High” as “Complexity” level and “Low” as “Priority” level. Therefore, the “Weight” of “Leave” application for this participant is 4 (3 for High and 1 for Low).

The factors that influenced the degree of Complexity from the participants’ perspective are:

- Academic level of the students (undergraduate or postgraduate)
- Institute response and cooperation
- Current study of the students (English or academic degree)
- Academic level of the institute
- Institute’s study periods (semester or trimester)

Complexity didn’t change according to individual cases, but was rather applied to all students under the supervision of the participant. That means if the participant faced a special and critical case, he/she didn’t change the complexity level of this application. Complexity remained constant for this type of applications during the whole sprint.

Approval of ANU Human Research Ethics Committee
As this study involved humans, an approval from ANU Human Research Ethics Committee was needed. Therefore, I attended the ARIES training session on Tuesday 2 September from 12.30pm to 2:00pm in the Ross Hohnen room, Chancellery Building 10 – ANU. The human ethics protocol number 2014/577 - type “Expedited Ethical Review E1” was submitted on 17/09/2014. Further clarifications were required. The protocol was approved on 12/10/2014.

Selection of Participants
Due to the structure of the department, and because each group in the department has its own internal procedures and mindset, it was preferable to choose participants in this study from same group. The focus was on Group A.

At the time of this study, Group A was composed of 10 members. As the size of SCRUM team is 7 plus minus 2, invitation was sent to 4 members of the group asking if they were interested in participating in the study. I was the fifth participant. A copy of the “Participant Information Sheet” and “Consent Form” were attached (See Appendices). The five (including myself) agreed to participate.

The Training
It was important that the participants do a basic SCRUM training to make sure that they all have a clear idea about SCRUM and understand what they are doing, what their role during the study will be and how they are going to run it. The trainees were ready, but finding a trainer was a difficult job; he/she had to be a certified SCRUM Master. It took about three weeks to find a volunteering trainer. The training session was held on 21 Oct 2014 at Ian Ross building – ANU - 2nd floor (Conference Room) from 5:00 to 7:00 pm. During the session, the trainees were introduced to Agile methods in general, SCRUM methodology in particular, its
artefacts, and the benefits of using SCRUM in software development. The focus was on SCRUM meetings and roles. After that, Adapted SCRUM and Add-in Process were explained.

During this training session, the participants showed high interest in the topic and were really excited. It was their first training in the last three years and they were enthusiastic to try something different, and this opportunity to break their work routine provided them with more motivation to participate in the study.

The Study
On Monday 27 Oct 2014, the participants were asked to fill the “Complexity – Priority” sheets to help assign weight to student applications prior to distribution. Each participant had to define the complexity and priority level for the 34 application types from his/her perspective according to his/her students.

After all the following components had been ticked, we were ready to start the study.

- Framework of study chosen
- Add-in Process defined
- Participants selected
- Training completed
- Complexity – Priority Sheet filled

Let’s SCRUM
The study started on Tuesday 28 October 2014 and ended on Friday 21 November 2014; during this period, 4 sprints were done:

- Sprint1: Tue 28/10/2014 to Fri 31/10/2014
- Sprint2: Mon 03/11/2014 to Fri 07/11/2014
- Sprint3: Mon 10/11/2014 to Fri 14/11/2014
- Sprint4: Mon 17/11/2014 to Fri 21/11/2014

Daily Preparation
At each night before each sprint day, I used to check the participants’ accounts and prepare a daily Excel sheet named “Daily Applications Sheet” listed the following:

- Application Number: a number assigned automatically to the task when created
- Creation Date: Submission date of the task
- Application Type: the type of the application (1 out of 34 types)
- Application Owner: the original owner of the Application, i.e. the employee who should originally work on it.
- Assigned to: the participant who should work on it after the distribution
- Actual Weight: the weight of each application in the participant’s account before distribution
- After-Distribution Weight: the weight of each application in the participant’s account after distribution (if this application is assigned to another participant the “After-Distribution Weight” will be 0)
• **Achieved Weight**: the weight of each achieved application in the participant’s account at the end of the day, where “Achieved” means that the participant took an action on this application - i.e. processed it to the group manager, returned it back to student, or closed it (approved it or rejected it).

• **Status**: the action taken on the application if any (Returned, Processed, Closed)

• **Processing Date**: the date when the participant took an action on the application.

Before starting the study, the participants had to agree on two things:

• **Definition of Done (DoD)**: in order to measure or assess the daily and weekly performance, two variables for DoD were set:
  - Daily DoD: when “Total Achieved Weight” is greater than or equal to “Total After-Distribution Weight”.
  - Sprint DoD: when all applications created or submitted before five, four or three days from date of end Sprint (Fridays) should be processed.

• **Max Target Weight**: is the maximum total weight expected from the participants to achieve daily when distributing the tasks. Its value was set on 45 in the first Sprint Planning Meeting and didn’t change during the study. As discussed in the Sprint Planning Meeting, 11 is the typical average number of processed applications per group member when applications are of medium complexity and priority (i.e. a weight of 4 per application, for a total of 44, which can be roughly rounded to 45).

**SCRUM Meetings**

The management was a bit cautious about the meetings conducted for the purpose of this study (referred to as SCRUM period in this report). For this reason, the participants decided to keep those meetings within the minimum possible timeframe. Consequently on Mondays, we had to merge the Sprint Planning meeting with the Daily SCRUM meeting (a maximum of half an hour). Specifically, on Fridays, the Sprint Review meeting was also merged with the Daily SCRUM meeting (another half an hour). We made sure the time spent on SCRUM meetings did not exceed 15 minutes. This wasn’t problematic at all as the Sprint was only one week long (5 working days) and the participants were working on similar tasks in every Sprint.

• **Sprint Planning Meetings**: held on the first day of each sprint around 9:45 am (Tuesday for the first sprint and Mondays for the other sprints), directly after the daily meeting. In those meetings, the participants planned for the coming Sprint, discussed any possible changes to the value of Max Target Weight and advised of any modifications in their Complexity – Priority sheet. The participants agreed that no modifications to this sheet should be made during the current Sprint. However they had a license to amend it before the next Sprint started.

• **Daily SCRUM Meetings**: held daily at 9:30 am for about 10 to 15 minutes in the meeting room at the organisation. One of the other four participants played the role of SCRUM Master. In these meetings, the participants go over all the tasks in “Daily Applications Sheet” and distribute them. The following 3 questions were at the base of these meetings: What did they do yesterday? What are they going to do today? Any impediments they faced?
• **Sprint Review Meetings**: held on the last day of each Sprint (Fridays), directly after the daily meeting to discuss the participants’ achievements, concerns, and any new entry to the “Feedback Pool” which is a kind of information, practice, or method that helped in solving a problem in certain applications. For example, a participant noticed that there was a bug in the system that extends the students’ study plan automatically if their application for extension were approved, even when the study plan is already correct and reflects the expected completion date of the student. Three new entries were added to “Feedback Pool”.

**Applications’ Distribution**

As mentioned in “Daily Preparation”, a list of all the participants’ applications was prepared (by myself) beforehand. This preparation included the calculation of “Actual Weight” for each type of applications for all participants as well as their “Total Actual Weight”. During the daily meetings, the participants revised the “Daily Applications Sheet” and distributed the applications among them as evenly as possible. After the daily SCRUM meeting, I used to send a soft copy of “Daily Applications Sheet” to the participants to start working on their assigned applications. After distribution, there was a need to transfer the applications from their owners to the other participants based on the “Daily Applications Sheet”. A transfer request was sent daily around 10:00 am usually followed by a prompt response from the person in charge of applications transfer during Sprint1.

The following tables represent part of “Daily Application Sheet” dated on 18/11/2014 for two Participants 1 and 2. For example, for Participant 1, the Actual Weight for application Type20 is 5 based on the value assigned for Priority (High (3)) and Complexity (Medium (2)) for this type of application in his Priority-Complexity sheet - Sprint4. The total of Actual Weight is 57 which is greater than the Max Target Weight (45). After applications’ distribution, four of Participant1 applications were assigned to Participant 2 (having Total Actual Weight 11). After-Distribution Weight and Achieved Weight for each transferred application are set to 0 for Participant 1. Now Participant 1 has a total After-Distribution Weight of 36.

Daily Applications – Participant1(A)
For Participant2, the total of Actual Weight is 11. When distributing the applications, the Weight is kept as defined by the application’s owner (See Red Boxes), since each participant
assigned a weight for each of his/her applications based on the factors mentioned at the beginning of this chapter. Participant 2 had a total “After-Distribution Weight” of 41 after applications distribution.

It is important to note that some applications are previously processed by the sponsors both before the study and during it. These applications would be returned back to the employee’s level just as a notification of the final decision (Please refer to Type4 described in Flow of Applications – Chapter2). The system, however, does not give any indication about the applications’ status, and the employee has to open the application to know the decision. For this reason, although most of these applications were given their specified actual weight in the Daily Applications Sheet, the participants amended their Actual Weight, After-Distribution Weight and Achieved Weight to 0 in the Updated Daily Applications Sheet.

The organisation’s system’s day counter for each application resets to 0 if the application is transferred from one account to another regardless of its creation date; the transfer date overrides the creation date. To avoid this reset during the study, and because the participants were working as one team and trying to improve its performance, the creation date was maintained in “Daily Applications Sheet” (See Purple Boxes). The rationale was, the participant who received the application should be aware of it, so he could process the application as soon as possible (See Red Boxes).

As the information in “Daily Applications Sheet” was collected once nightly of the day before, all applications submitted during the working hours of the day, and processed on the same day wouldn’t appear in the participants’ next day account as they would be already processed. For that, the participants were asked to add these applications to “Updated Daily Applications Sheet” (Applications in Orange in the figures above). They were also asked to update the status of their applications (after distribution) before sending it back to me to be able to calculate their “Total Achieved Weight” and to store the data for later analysis.

The participants were really committed and very cooperative during the study. They sent updated daily applications sheet every day before 4:00pm. Their accuracy in filling this sheet with the required information was remarkable.

Data Collection
The department’s management used to send via email a daily report (Excel sheet) on all the applications to the employees with the following information: application number, application type, name of the student who had submitted the application, student ID, application owner (name of the employee whose account was assigned the application), the employee’s group and “Submission date” which is the date of the latest action taken on the application. That means if the application is a new one and submitted on 19/09/2014, “Submission date” will be 19/09/2014. If the application was processed to the group manager and returned back to the employee’s account on 22/09/2014 for clarification, “Submission date” will be 22/09/2014.

The reader should note that in this project we looked at the processing date of the application from the participants’ accounts only.
As advised by the Statistical Consultant Unit at ANU, we opted to compare the participants’ performance during SCRUN period with their performance during Non-SCRUN period where:

- **SCRUN period**: refers to the one month period when Adapted SCRUN methodology was applied (i.e. during the study)
- **Non-SCRUN periods**: refers to all periods when the normal procedures and processes of the organisation were applied (i.e. the other 11 months of the year).

To select the appropriate Non-SCRUN period, three parameters were considered:

- All five participants were not on leave (annual leave) during the entire month Non – SCRUN period. A check with the participants was done to exclude the months when one or more participants were on leave. As a result of this, the number of possible Non-SCRUN periods went down from 11 to 5 periods.
- Working hours during SCRUN period and each Non-SCRUN period were similar. That reduced the number of possible Non-SCRUN periods from 5 to 4 periods, excluding a particular one-month-period where the working hours were reduced.
- The initial historical data was available. That reduced the number of possible Non-SCRUN periods from 4 to 3 periods as the department’s management ceased to send the daily reports by mid-September 2014.

The three remaining Non-SCRUN periods were:

- From 17/02/2014 to 14/03/2014.
- From 31/03/2014 to 24/04/2014.
- From 25/08/2014 to 19/09/2014.

The collected data consisted of online applications only, without any of the other tasks that are parts of the employees’ job. The reason behind this is the unavailability of historical data of all other tasks, in addition to the fact that the organisation measures the employees’ performance based on their productivity in processing the applications regardless of any other tasks.

**Non-SCRUN Period**

We are looking at the processing days of the applications. For that reason, we had to know the submission date and the processing date of the application. But as the application could be processed backward (returned to student) or returned from the group manager to the employee’s account as many times as required to get a complete application, the submission dates should be considered and the processing days after each action taken within the specified non-scrum period should be recorded in the final data. Unfortunately, the system (software) used in the organisation doesn’t generate a report stating the actions taken during the processing procedure of an application or if this application is a new one or returned back from the manager to the employee’s account. According to the procedures used in the department, the returned applications are counted as new applications in the performance measurement reports mentioned earlier in Chapter 2.
For example, if an application was submitted on 18/02/2014 and processed to the manager on 20/02/2014; the processing days equal 3. If the application was returned from the manager on 21/02/2014, reprocessed again by the employee on 24/02/2014, the processing days now equal 5. All these processing actions and dates had to be recorded in our final data.

In order to get all this information, the following steps were required:

- **Step1:** Get the data of all the applications listed in the daily reports that the department’s management used to send. After getting the 20 reports (5 days x 4 weeks), information relevant to the 5 participants’ applications was filtered. A date field “Date” was added in each report to show when it was prepared or sent. Then all the 20 reports were merged together in one list. The following example is taken from this merged list and it shows that the application 8835400 appeared 3 times in the 3 daily reports dated on 15/09/2014, 16/09/2014 and 17/09/2014.

<table>
<thead>
<tr>
<th>Date</th>
<th>Application Number</th>
<th>Submission date</th>
<th>Application Type</th>
<th>Participant Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>15/09/2014</td>
<td>8835400</td>
<td>12-09-2014 17:05</td>
<td>Type 14</td>
<td>P#</td>
</tr>
<tr>
<td>16/09/2014</td>
<td>8835400</td>
<td>12-09-2014 17:05</td>
<td>Type 14</td>
<td>P#</td>
</tr>
<tr>
<td>17/09/2014</td>
<td>8835400</td>
<td>12-09-2014 17:05</td>
<td>Type 14</td>
<td>P#</td>
</tr>
</tbody>
</table>

- **Step2:** Get all applications of the 5 participants from the organisation’s system (software). The aim is to collect the applications that were submitted after the preparation of the daily reports and processed at the same day, because the department’s daily reports were prepared once early in every morning and no updates on these reports were happening during the day. Unfortunately, the system generates a report for a specific period (customisable by the user), listing the applications submitted during this period for only one employee at once. Therefore there was a need to repeat this step for each participant. But another issue appeared when realising that the creation date (submission date) of the applications doesn’t appear in these generated reports. That was problematic, because as explained above, the submission date changes with the latest action taken on the application. Therefore, the extraction of whole Non-SCRUM period at once won’t be helpful given the fact that the resulting report is automatically sorted by the system according to Submission date (Oldest to Newest). And because a comparison between creation date and submission date will be an indicator of any processing action, the extraction of all the applications for each participant was done day by day. Then the resulting lists were merged together.

Let’s look at this example, when the data extraction was done for the whole Non-SCRUM period from 25/08/2014 to 19/09/2014 for participant P#; the following data appeared:

<table>
<thead>
<tr>
<th>Application Number</th>
<th>Submission date</th>
<th>Application Type</th>
<th>Participant Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>8835400</td>
<td>01-10-2014 04:13</td>
<td>Type 14</td>
<td>P#</td>
</tr>
</tbody>
</table>
The submission date is out of the range of the specified Non-SCRUM period. It means that the creation date of the application is in the specified period but the latest action was taken on 01/10/2014.

The day-by-day extraction for participant P# revealed that this application was created on 06/09/2014 i.e. within our range and actions were happening between 06/09/2014 and 01/10/2014.

<table>
<thead>
<tr>
<th>Date</th>
<th>Application Number</th>
<th>Submission date</th>
<th>Application Type</th>
<th>Participant Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/09/2014</td>
<td>8835400</td>
<td>01-10-2014 04:13</td>
<td>Type 14</td>
<td>P#</td>
</tr>
</tbody>
</table>

These two full lists (resulting from step 1 and step 2) were merged together in one list (Excel Sheet) named “Daily Applications”.

After the merge, some data were confusing. Continuing with the same example mentioned above, data in black is the data collected from the daily reports (List 1) and data in orange is the one collected from the system’s generated reports (List 2).

<table>
<thead>
<tr>
<th>Date</th>
<th>Application Number</th>
<th>Submission Date</th>
<th>Application Type</th>
<th>Participant Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/09/2014</td>
<td>8835400</td>
<td>01-10-2014 04:13</td>
<td>Type 14</td>
<td>P#</td>
</tr>
<tr>
<td>9/09/2014</td>
<td>8835400</td>
<td>08-09-2014 05:07</td>
<td>Type 14</td>
<td>P#</td>
</tr>
<tr>
<td>10/09/2014</td>
<td>8835400</td>
<td>08-09-2014 05:07</td>
<td>Type 14</td>
<td>P#</td>
</tr>
<tr>
<td>15/09/2014</td>
<td>8835400</td>
<td>12-09-2014 17:05</td>
<td>Type 14</td>
<td>P#</td>
</tr>
<tr>
<td>16/09/2014</td>
<td>8835400</td>
<td>12-09-2014 17:05</td>
<td>Type 14</td>
<td>P#</td>
</tr>
<tr>
<td>17/09/2014</td>
<td>8835400</td>
<td>12-09-2014 17:05</td>
<td>Type 14</td>
<td>P#</td>
</tr>
</tbody>
</table>

This data could be grouped in 3 categories based on the values in Submission date: (1) the first row, (2) the two second rows and (3) the last three rows.

This has two explanations:

1- Application was submitted on 06/09/2014 after the department’s daily report was prepared, and returned back to student at the same day; that’s why it didn’t appear on the next day’s daily report (07/09/2014). In this case, it should be recorded as application having processing days = 1. Then another 3 actions happened later (on 08/09/2014 (processing days = 3), 12/09/2014 (processing days = 4 (6 days minus the weekend days)), and 01/10/2014 (out of the specified period)). To note that this type of applications (Type 14) can’t be processed to the group manager (Type 1 described in Flow of Applications – Chapter 2); the final decision is at the employee’s level.

2- Application was submitted on 06/09/2014 but transferred from the owner of the application to participant P# on 08/09/2014. That’s why the Submission Date
changed to 08/09/2014. In this case the processing date should be recorded as 3 days and so on as explained above.

To get the correct information, the application itself was opened to see its actions’ record; the application was submitted on 06/09/2014 then transferred from non-participant’s account to participant P# on 08/09/2014. That wouldn’t count, as the application’s owner is not a participant in this study. P# didn’t take any action on the application neither on 09/09/2014 nor on 10/09/2014 as it was listed in the daily reports dated on these two days. P# returned the application to the student on 10/09/2014 (processing days = 3). Student resubmitted the application on 12/09/2014. The application should be counted twice. To do so, the application number was changed for the second action from 8835400 to 8835400S where S was used to indicate that the application was returned from student. The application was returned again on 17/09/2014 to the student. Resubmitted again on 01/10/2014 and accepted on 02/10/2014. That last action was outside the specified non-scrum period (25/08/2014 to 19/09/2014); therefore, it wasn’t recorded.

It was observed that when searching for a certain application (in the organisation’s system), the value that appears in “Submit Date” (submission date) represents the date of the last action taken on the application. For example the application number 8834844 (Request Number as named in the system) was submitted on 06/09/2014 to the participant’s account (or at least that was the last submission action taken). The participant processed the application to the manager on 09/09/2014. To have more indications about the processing dates, it is useful to know the submission date of the application to the manager’s account; so a third step is now required.

<table>
<thead>
<tr>
<th>Request Number</th>
<th>Student Name</th>
<th>Student Id</th>
<th>Student Id in Attachee</th>
<th>Request Type</th>
<th>Submit Date</th>
<th>Competent employee</th>
<th>Request Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>8834844</td>
<td></td>
<td></td>
<td></td>
<td>Change Major Request</td>
<td>09-09-2014 08:05</td>
<td>Director Name</td>
<td>Rejected</td>
</tr>
<tr>
<td>8834844</td>
<td></td>
<td></td>
<td></td>
<td>Change Major Request</td>
<td>06-09-2014 12:34</td>
<td>Participant Name</td>
<td>Rejected</td>
</tr>
</tbody>
</table>

- **Step 3:** Get list of all the applications (with all their information) that were processed to the manager’s account. That required extraction of the applications from three different lists for two Non-SCRUM periods and two different lists for the third Non-SCRUM period. That’s because there was a change in Group A management at the beginning of September 2014 (lists of applications processed to the first manager and list of applications processed to the
second manager) and there is only one type of applications (Type31) that should be processed to a different group manager (who processes only this type of applications). In addition to that, a fourth group manager was in charge when the original one was on leave at the end of February. After extracting these reports from the system for each manager by specifying a whole Non-SCRUM period at once, there wasn’t a need for a day-by-day processing as the applications were already recorded from the previous merged lists. Instead, what was needed from these new lists was only the submission dates from employee’s account to the manager’s account.

All these lists were appended together in one list (Excel sheet) named “Managers List”. Query was run to add the submission date from “Directors List” to “Daily Applications” list.

The results were similar to the following:

<table>
<thead>
<tr>
<th>Date</th>
<th>Application Number</th>
<th>Application Type</th>
<th>Submission Date: Participant</th>
<th>Participant Name</th>
<th>Submission Date: Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/09/2014</td>
<td>8836489</td>
<td>Type13</td>
<td>06-09-2014 21:20</td>
<td>P#</td>
<td>17-09-2014 08:23</td>
</tr>
<tr>
<td>9/09/2014</td>
<td>8836489</td>
<td>Type13</td>
<td>06-09-2014 21:20</td>
<td>P#</td>
<td>17-09-2014 08:23</td>
</tr>
<tr>
<td>16/09/2014</td>
<td>8836489</td>
<td>Type13</td>
<td>15-09-2014 04:12</td>
<td>P#</td>
<td>17-09-2014 08:23</td>
</tr>
<tr>
<td>17/09/2014</td>
<td>8836489</td>
<td>Type13</td>
<td>15-09-2014 04:12</td>
<td>P#</td>
<td>17-09-2014 08:23</td>
</tr>
</tbody>
</table>

Application 8836489 was submitted on 06/09/2014 (Saturday), processed on 09/09/2014 (didn’t appear in daily report dated 10/09/2014), submitted again on 15/09/2014 and processed on 17/09/2014 (submitted to manager’s account).

- **Step4:** Specify the correct processing dates for the applications and change the application number based on the actions if there was more than one action.

A record of the returned applications had to be kept in order to test if the quality of the applications reduced with the velocity of applications’ processing. For that reason, the application had to be opened to check if on 15/09/2014, it was resubmitted by the student or returned from the manager. This showed that the application was resubmitted by the student therefore, consequently “S” should be added to the application number (See Red Box).

<table>
<thead>
<tr>
<th>Date</th>
<th>Application Number</th>
<th>Application Type</th>
<th>Submission Date: Participant</th>
<th>Participant Name</th>
<th>Processing Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/09/2014</td>
<td>8836489</td>
<td>Type13</td>
<td>06-09-2014 21:20</td>
<td>P#</td>
<td>09/09/2014</td>
</tr>
<tr>
<td>16/09/2014</td>
<td>8836489S</td>
<td>Type13</td>
<td>15-09-2014 04:12</td>
<td>P#</td>
<td>17/09/2014</td>
</tr>
<tr>
<td>17/09/2014</td>
<td>8836489S</td>
<td>Type13</td>
<td>15-09-2014 04:12</td>
<td>P#</td>
<td>17/09/2014</td>
</tr>
</tbody>
</table>

In addition to “S” the following suffixes were used:

- “R”: Applications returned from the management to the participant’s account
- “A”: Applications returned from the sponsors as notification of approval.
- “T”: Application transferred from the application’s owner to a participant to process them.
- “ST”: Application resubmitted by the student then transferred to a participant.
- “TS”: Application that was originally transferred to a participant, returned back to the student then resubmitted by the student.
- “SS”: Application submitted for the third time from the student.
- “NPT”: Applications transferred from a non-participant’s account to a participant account.

- **Step5**: Sort the applications by the application number and “Date” (from Newest to oldest) and remove the duplicates. The results were similar to the following:

<table>
<thead>
<tr>
<th>Date</th>
<th>Application Number</th>
<th>Application Type</th>
<th>Submission Date: Participant</th>
<th>Participant Name</th>
<th>Processing Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>17/09/2014</td>
<td>8836489S</td>
<td>Type13</td>
<td>15-09-2014 04:12</td>
<td>P#</td>
<td>17/09/2014</td>
</tr>
</tbody>
</table>

Those steps mentioned above were repeated for the 3 Non-SCRUM periods. The total number of applications for the Non-SCRUM periods was 3180 applications.

- **Step6**: Add weight to all the applications in Non-SCRUM period based on the weight assigned to each application for every participant in Complexity – Priority sheet. To do this, a selection of the suitable Complexity – Priority sheet used during SCRUM period must be done.

  *It’s important* to note that this sheet was updated during SCRUM period 2 times:

  - At the end of Sprint1: as the weight concept was a new one, participants realised after trying it that some of these weights should be adjusted (less or more than the assigned value).
  - At the end of Sprint2: because at the beginning of this sprint, there was a redistribution of the academic institutions over the members of Group A. That changed the complexity and priority of some applications.

For the reasons mentioned above, Complexity – Priority sheet used in Sprint2, before the institutes’ redistribution was considered the suitable one.

- **Step7**: Merge all the data collected for SCRUM and Non-SCRUM periods.
- **Step8**: Calculate the real processing days (working days) by excluding the public holidays and the weekends if they fell in the processing period of the application. A list of all the weekends and the public holidays was created. The processing days were reduced by one for every holiday in the list that occurred between the processing date and the submission date.

- **Step9**: Remove the applications submitted before the specified periods.
SCRUM Period
Collecting data for SCRUM period wasn’t a complex task; the data had been previously collected day by day. The applications’ weight was already assigned. All the Updated Daily Applications Lists were merged together in one list. The data was sorted by application number. The suffixes described above were added in a similar way to what was explained in the previous section. Since the team was working as one unit during SCRUM period, only one record of the transferred applications was kept in the list. Otherwise, each transferred application will be counted twice with two different processing days. For example, application number 9289475 was submitted on 28/10/2014, transferred (T as suffix) to another participant on 29/10/2014. “T” was added as suffix to the first record to keep the original submission date and not the transfer date.

<table>
<thead>
<tr>
<th>Application Number</th>
<th>Submission Date</th>
<th>Processing Date</th>
<th>Processing days</th>
</tr>
</thead>
<tbody>
<tr>
<td>9289475</td>
<td>28/10/2014</td>
<td>29/10/2014</td>
<td>2</td>
</tr>
<tr>
<td>9289475T</td>
<td>29/10/2014</td>
<td>29/10/2014</td>
<td>1</td>
</tr>
</tbody>
</table>

The application was recorded in the list as:

<table>
<thead>
<tr>
<th>Period</th>
<th>Methodology</th>
<th>Application#</th>
<th>Application Submission Date</th>
<th>Application Processing Date</th>
<th>Processing Days</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>28/10/2014 to 21/11/2014</td>
<td>SCRUM</td>
<td>9289475T</td>
<td>28/10/2014</td>
<td>29/10/2014</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

All the factors that might had influence on the team performance were recorded - i.e. the management decision, delays in applications transfer, absence of participants, etc...

The total collected data for SCRUM and Non-SCRUM periods was 4093 applications. A soft copy of this data is available with Dr. Shayne Flint.
Chapter 5 – Results

After collecting the data, it had to be analysed to see the impact of SCRUM on the team performance. It’s worth noting that the data used to compare team performance between Sprints in SCRUM period contained all the applications that were in the participants’ accounts when SCRUM period started regardless of their submission date; these applications were part of the participants’ workload therefore should be added to their actual weights and their impact on the percentage of achievement should be counted.

To compare team performance during SCRUM and Non-SCRUM periods, the used data contained only the applications that were submitted during these periods (SCRUM and Non-SCRUM periods). The reason behind this is the number of applications submitted long time before Non-SCRUM periods (some exceeded 30 days) and processed during it was greater than the number of such applications in SCRUM period which could make the data unbalanced.

Two types of analysis were done to test:

- Performance comparison between Sprints in SCRUM period
- Performance comparison between SCRUM and Non – SCRUM periods

Performance Comparison between Sprints in SCRUM period

Before looking at the team performance during SCRUM, it was important to measure the effectiveness of applications distribution process. The following chart shows the total weight of the applications for each participants before and after applications distributions during SCRUM period. It clearly shows that the used process brought a certain balance to the workload.

![Figure 5-1. Total applications weight for each participants before and after distribution](image-url)
The next section will show the team performance during SCRUM given the fact that the applications had been distributed among the participants and their performance as a team is now the focal point.

A comparison had been done between “Total Weight” (the total weight of team’s applications collected before each sprint’s day started - i.e. applications listed in “Daily Applications Sheet”) and “Total Achieved Weight” which is the total weight of applications listed in “Updated Daily Applications” sheet – i.e. the processed applications from the “Daily Applications Sheet” and all applications that were submitted during the day and processed on the same day.

When Sprint 1 started, the total weight was 233 in the first day (Day1), which is the highest total weight noted during SCRUM period. The calculation of the total weight included the weight of all the applications that were in participants’ account when the “Daily Applications Sheet” was prepared. Some of these applications were submitted before the starting date of SCRUM period but they were part of the participants’ workload, therefore were counted.

![Chart 1](Image1.png)

**Figure 5-2.** The total weight of team’s applications vs the total achieved weight – Sprint 1.

Figure 5-2 shows that team performance started to improve since Day2 and reached its peak in Day3.

![Chart 2](Image2.png)
Figure 5-3. The total weight of team's applications vs the total achieved weight – Sprint 2.

Figure 5-3 shows that the team was underperforming especially in Day3. On Monday morning of Sprint 2 week, there was a redistribution of the academic institutes among the members of Group A whom our team is part of it. The team wasn’t happy about the management decisions. Another redistribution happened the next day, and the team felt even worse. Besides that, there was a delay in transferring the applications to the assigned participants. A speed recovery was noticed in Day 4.

Figure 5-4. The total weight of team's applications vs the total achieved weight – Sprint 3.

Figure 5-4 shows good performance since the beginning of the week, its peak is on Day 3. The team performance dropped on Day5.
Figure 5.5. The total weight of team’s applications vs the total achieved weight – Sprint 4.

Figure 5.5 shows again a good performance of the team since the beginning of the week and again the peak in on Day 3.

Figure 5.6 – Percentage of achievement at the end of every day in each sprint.

Figure 5.6 shows that, with the exception of Sprint2, the percentage of achievement (Total Achieved Weight /Total Weight * 100) reached its peak in Day3 in each sprint. This could be related to number of phone calls and emails that were increasing on Mondays and Tuesdays compared to other week days. To note that there wasn’t a Day 5 for Sprint1 because it started on Tuesday rather than Monday. This explains the drop in achievement percentage in Day5 – Sprint1. To note also that when “Total Achieved Weight” is higher than “Total Weight”, it doesn’t mean that all applications in “Daily Applications List” were processed. New applications might be submitted and processed on the same day; therefore their weights were counted toward the total achieved weight.
Figure 5.7 shows that Sprint’s average of “Percentage of Achievement” was better in the last two sprints but it reached its best results in Sprint4. This could be an indication that the team became more confident sprint after sprint with the whole methodology.

Performance Comparison between SCRUM and Non-SCRUM Periods
All the results above were promising about the impact of SCRUM on team performance but now all the data (SCRUM and Non-SCRUM) had to be statistically analysed. The collected data had different numbers and weights for the applications processed during SCRUM and Non-SCRUM periods. To be comparable, this data was analysed with GenStat software using ANOVA (Analysis of variance) for unbalanced data (Unbalanced ANOVA).
As some applications had Weight = “0”, Log base10 transformation had been used to calculate the number of processing days for each applications’ weight (0,2,3,4,5,6) during SCRUM and Non-SCRUM periods. The used l.s.d. (Least Significant Difference) was 5% (the vertical straight line to the left in the plot area). When the difference between two points in SCRUM and Non-SCRUM exceeds that value (0.05), it means that the difference is statistically significant. To be able to see the real values of the processing days showed in Figure 5.8 , a back transformation was used (value*10 -1) in Figure 5-9.

Figure 5.9 – Processing days during SCRUM and Non-SCRUM

Figure 5.9 shows that applications with weight “2” had relatively same number of processing days during SCRUM and Non-SCRUM periods. The most significant differences appeared in applications having weight 3, 5 and 6. It also shows that the number of processing days in SCRUM period is increasing with the weight (except for applications with weight “0”), which indicates predictability improvement.

Returned Applications during SCRUM and Non-SCRUM periods
It was important to test whether the improvement in the number of processing days had an impact on the number of returned applications. The applications that were returned from the manager to the participants for clarification during SCRUM and Non-SCRUM period were counted (applications with suffix “R”).
Figure 5.10 – Percentage of Returned Applications

Figure 5.10 shows that the percentage of returned applications during SCRUM period increased by 0.18% compared to the third Non-SCRUM period but also decreased by 0.12% and 0.47% compared to the first and the second Non-SCRUM periods (respectively).
Chapter 6 – Discussion

SCRUM was used as a framework to define the structure and the guidelines of the study, and the applications distribution process brought a more balanced workload redistribution to the team members in order to achieve a better team performance. In other words, the combination of SCRUM and the applications distribution process worked well together.

The above results showed a significant improvement in team performance during SCRUM period compared to previous Non-SCRUM periods. Except for the applications whose weight is “0”, the number of processing days during SCRUM period was increasing constantly with the application’s weight, which indicated that the weight defined for the applications reflected their actual weight for all the participants. In other words, the assigned weight for each application was correct. As for the applications with weight “0”, it was noted that some employees didn’t prioritize these applications as they consisted only of notifications. Although the performance of the same team was measured in Non-SCRUM periods, the inconsistency in number of processing days with the application’s weight was remarkable (figure 5-9), and could be used as an evidence that the applications distribution process gave balance to the team performance. To note that the chosen “Complexity-Priority Sheet” used to assign weights to the applications during Non-SCRUM periods was considered the appropriate one, as all the factors that influenced on the assigned values to complexity and priority in “Complexity –Priority Sheet” - Sprint 2 were similar to those factors in Non-SCRUM periods.

Many factors influenced the improvement in team performance. During SCRUM, The team members jointly shared the same decision authority. They set their own rules in applications processing procedures, scheduled their meetings and defined complexity and priority for their applications. The team felt self-managed and empowered, and thus became more proactive and productive [19]. The SCRUM training was their first one in the last three years and the fact that they learned something new and were going to experiment it was really motivating and appealing to them. Besides that, the team members believed in themselves and were very keen to prove their efficiency and productivity. This was also consistent with Daniel Pink’s [20] thoughts in his book (DRiVE) when he talked about Autonomy, Mastery and Purpose as the three secret elements that drive to better performance rather than financial incentives. In addition to that, the team was able to measure its achievement on daily basis and the participants were excited during the daily SCRUM meeting to know about the previous day achievement and whether the team met its target. Feedback and communications are important factors in team performance [21].

As recorded in a daily SCRUM meeting’s comments, a participant mentioned that because of those meetings, he started to feel more confident about himself. His self-esteem increased as he could see what his daily achievements (Total Achieved Weight) were. It’s worth noting that this participant was participant 1 who had the highest number of applications as shown in figure 5-1. He didn’t realise the heavy workload he was carrying on, and he was blaming himself before SCRUM for his poor performance.
The team skills and knowledge besides the years of experience also contributed to this improvement. The team members trusted each other’s decisions so they felt comfortable with the applications distributions process where a participant (other than the application’s owner) had to work on the applications. Moreover, SCRUM meetings were helpful in knowledge sharing, and provided an opportunity for better solutions to some of the problems discussed during them. They also provided a clearer idea about each participant’s workload, which led to more support and cooperation from the participants with less load. It was noticed that the team cohesion and team bonds induced during SCRUM were getting tighter over the sprints; team members coordinated effectively, which had a positive impact on team performance [22].

As recorded in the last Sprint review meeting’s comments, the participants advised that SCRUM added a new dimension to their way of thinking about teams. Although they had to do “extra/unfamiliar/unusual work” during the study (i.e. meetings, daily updates on the processed applications and new ones, weekly planning), they didn’t feel stressed about it. They even considered proceeding with SCRUM methodology after the study. They all agreed however that the organisation’s culture would be a significant barrier, especially with the daily SCRUM meetings in an environment where the meetings are rare and used mostly for announcements purposes.

Management decisions played an important factor in team performance. As we noticed during SCRUM, the percentage of achievement was the lowest in Sprint2 among the 4 sprints although the starting total weight (calculated total weight before starting Day1 of the sprint) of Sprint 2 was 169 and was the lowest total weight compared to the starting total weight for Sprint1, Sprint3 and Sprint4 (233, 204 and 205 respectively). A Review of the actions that happened during Sprint2 showed that reshuffling of the academic institutes among Group A members, whom our team is part of, was at the top. The team was upset about the new decisions as it added more workloads to participant1 (already overloaded) and participant2 and gave less workload to participant3 (already under-loaded). A lot of time was wasted in Day1 and Day2 discussing the management decisions. Furthermore, in Day3 and Day4 of this sprint (Sprint2), there was a delay of 3 hours and 5 hours respectively in transferring the applications among participants’ accounts, based on the distributions decided by the team in the daily meeting. To mitigate this issue, the team’s members exchanged their account’s numbers and each one worked on his/her assigned applications (after distribution) from the account of the applications’ owner. I would say that the trust shared among team members helped them to come up with the above mentioned solution to the applications’ transfer problem.

The improvement in processing days during SCRUM period might be an important reason for an apparent decrease in the number of phone calls as noted by the team but unfortunately, there wasn’t any available data that could be used to confirm this.
For a better redistribution of the academic institutions over group members, a similar way to what was done during SCRUM period to collect the data – i.e. the “Daily Applications List” and the “Updated Daily Applications List” would give a clearer idea about the daily workload of the employees. It could be collected from three periods over the year; peak, medium and low periods.

Technical improvement could be done on the organisation’s system (software) to help the management reach a better performance assessment and consequently take more effective performance management actions. The system should be able to create a transactions log for each application to record the processing actions, action’s owner (who did the action), action’s reason and action date. Processing days could be calculated from the action dates of two records of the transactions log and the maximum estimated processing date is 5 days starting from the last “Action Date”. For example say we had the following records in transaction log of application 1478523:

- “Processing Action” is “Submitted”, “Action Date” is 02/03/2015, “Action Owner” is student name
- “Processing Action” is “Processed”, “Action Date” is 04/03/2015, “Action Owner” is employee name

The processing days in this case are 3 days and the maximum estimated processing date is 06/03/2015 (5 days starting from 02/03/2015) as per the organisation’s rules.

Processing days counter should be modified to include only the working days and hours, given the fact that in the current process, the application could be submitted on after work hours on Friday, and by Monday the remaining processing days are only 2 days. This is similar for the applications submitted the night before or during public holidays. In such a case, the applications submitted on Friday during work hours and the applications submitted after work hours have the same max estimated processing date. I noticed during data collection that the organisation’s system records the date and time. That could be helpful in calculating accurately the processing days and the maximum estimated processing date for the applications. Two lists could be created: list of time specifying the non-working hours and list of dates specifying the weekends and the public holidays for the whole year; the system would then recalculate the processing dates and the maximum estimated processing date after checking these two lists, and consequently decrease the number of processing days and increase the maximum estimated processing date accordingly.

I suggest that the organisation’s generated report should have an extra field to show the creation date of the applications. The day by day applications’ extraction used during data collection showed that the creation date of the applications is recorded in the system but doesn’t have a field to be shown in the generated report. A feature could be added to the system to give the employees the option to sort the applications in their accounts based on the creation date for a clearer idea how they should reprioritise these applications for the day.
I also suggest that the report should highlight the applications having highest processing days. A review of the transaction logs of these applications could help the management to point out the flaws in their current procedures in regard to certain types of applications, as well as whether they are from the sponsor, students or employees; this will assist the management to improve their current procedures and processes using D.R.I.V.E. (Define, Review, Identify, Verify, Execute), which is one of the top approaches used for process improvement.
Chapter 7 – Conclusion & Future Work

We have conducted a one-month study in an administrative organisation to explore whether the use of SCRUM can improve the performance of administrative teams and help identify more appropriate performance and effectiveness measures.

4093 applications were collected from 4 one-month-long periods: one SCRUM period (where SCRUM methodology was used) and three Non-SCRUM periods (where normal procedures of the organisation were used). The statistical analysis showed a significant improvement in the team performance during SCRUM period measured by number of processing days of applications.

We found that SCRUM could be adapted and used in an environment different to the software development environment and still be successful; it improved the team performance and increased its productivity in an environment where team collaboration was limited. We also found that the lack of management’s support, the organisation’s culture, and the reduced external autonomy are important barriers for team efficiency and productivity.

It will be interesting to apply Adapted SCRUM methodology that we used in this study in the same environment but for a longer period (more than one month) to check whether it will show the same successful results. During SCRUM period, the team performance was improving sprint after sprint and reached its highest level in the last one. The aim of the future work is to check whether the team performance will continue its improvement, or whether it will drop after reaching a certain level.

Also, it will be interesting to explore the possibility of adapting SCRUM for the purpose of managing the improvement process of organisations procedures. Where the product backlog will be the prioritised list of all the processes that need improvement. The sprint log will be the process having the highest priority in product backlog. During the sprint the D.R.I.V.E. approach/methodology could be used to improve the process and the deliverable will be the improved process. This represents a potential for subsequent research, where SCRUM can be used on a broader scale in managing administrative processes as we did in this study.
References


## Appendices

### Appendix A - Sprint2 Complexity - Priority Sheet

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Participant Information Sheet

Researcher:
My name is Maha Ziade. I am doing a Master of Computing (Software Engineering) at Research School of Computer Science – ANU and undertaking a research project as the final unit.

Project Title: Exploring the Use of SCRUM for Administrative Practice Improvement

General Outline of the Project:
In this project, we will explore the possibility of adapting SCRUM, which is a successful agile methodology widely used in Software Engineering, for the purpose of improving administrative practices, in particular teams' performance and the quality of its work. We will also investigate the best practices in administrative environment and explore the possibility of importing those practices to software development. The target participants are a group of employees working in the same team. They all have the same administrative role within the team.

Before running the adapted SCRUM methodology for one month, we will record the historical performance data of the participants. This is the same data that is collected by the organization on a regular basis. At the end of the one month period, a comparative study will be done between the historical performance data and the new one to measure the impact of this methodology. We will also measure the quality of the team’s work and analyse how it changes during the experiment.

The research findings might be turned into a paper. However, any data used for reporting in this project or in a paper will be anonymized. Participants will get a briefing of the research results if they ask for that.

Participant Involvement:
Participation in this research is voluntary. The participants may withdraw from the research at any time until the preparation of the research report without providing an explanation. If the participants choose to withdraw from this research, their data will be destroyed.

The research will be conducted at the participants’ workplace and during working hours. They will form one focus team that will apply the adapted SCRUM methodology to complete their daily tasks (work related) for a period of one month. All members of the team will have the same authority. No changes will occur in their current roles or positions in their workplace.

The participants will run 2 types of meetings:
- Daily meeting (10 to 15 minutes) to prioritise the team’s tasks and distribute them in order to ensure a more balanced task weight over the team’s members.
- Weekly meeting (one hour) to discuss flow of tasks.
We will use recording to capture all the information and to avoid missing important details discussed during the meetings, if the participants consent to that.

There won’t be any kind of invasion on the participants’ privacy. No private information is required (i.e. Personal information, salary, or any information that is not related to work tasks.

The results of this project will be used for research purposes only and will not form part of the formal performance appraisal of the participants.

If participation in this research causes any kind of pressure or discomfort to the participants, they may withdraw from it at any time before the preparation of the research report without providing an explanation.

No incentives will be offered for participation.

**Confidentiality:**

- Only my project supervisors and I will have access to the “quality” data. In addition, we will use the performance data that the organisation regularly collects.
- None of the participants’ names, positions and roles will be mentioned in the research report.
- Confidentiality will be protected as far as the law allows.

**Data Storage:**

During data collection, the data will be kept on the investigator’s password protected laptop and kept for 5 years from publication. A backup secured copy will also be kept on an external hard drive (investigator)

**Queries and Concerns:**

If you have any queries, please feel free to contact myself at u4953550@anu.edu.au or my primary supervisors Dr. Shayne Flint at Shayne.Flint@anu.edu.au and Dr. Ramesh Sankaranarayana at ramesh@cs.anu.edu.au

**Ethics Committee Clearance:**

The ethical aspects of this research have been approved by the ANU Human Research Ethics Committee.

If you have any concerns or complaints about how this research has been conducted, please contact:

Ethics Manager

The ANU Human Research Ethics Committee

The Australian National University

Telephone: +61 (0) 2 6125 3427

Email: Human.Ethics.Officer@anu.edu.au

Appendix C – The Consent Form
WRITTEN CONSENT for Participants for exploring the use of SCRUM for administrative practice improvement

**Ethics protocol number: 2014/577**

I have read and understood the Information sheet you have given me about the research project, and I have had any questions and concerns about the project addressed to my satisfaction. I agree to participate in the project.

Signature:……………………………………………. Date………………………………………..

YES ☐ NO ☐ I agree to the meetings being audio taped

YES ☐ NO ☐ I give my permission to the investigator to access my performance data (historical and new)

YES ☐ NO ☐ I give my permission to the investigator to collect and use my quality data (historical and new)

I agree to be identified in the following way

YES ☐ NO ☐ A team member

YES ☐ NO ☐ Pseudonym

YES ☐ NO ☐ Complete confidentiality

Signature:……………………………………………. Date………………………………………..

The Australian National University | Canberra ACT 0200 Australia | CRICOS Provider No. 00120C

Appendix D – Human Research Ethics Application Form
HUMAN RESEARCH ETHICS COMMITTEE
Application Form

Created by: u4953550
Record number: 6913
Protocol type: Expedited Ethical Review (E1)
Protocol number: 2014/577

Date entered: 07/09/2014
Ethics program type: Postgraduate
Requested start date: 22/09/2014
Requested end date: 15/12/2014

Protocol title: Exploring the Use of SCRUM for Administrative Practice Improvement

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<th>Role</th>
<th>Department</th>
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<tr>
<td>Flint, Shayne</td>
<td>Supervisor</td>
<td>Research School of Computer Science, College of Engineering and Computer Science, ANU</td>
</tr>
<tr>
<td>Sankaranarayana, Ramesh S</td>
<td>Supervisor</td>
<td>Research School of Computer Science, College of Engineering and Computer Science, ANU</td>
</tr>
<tr>
<td>Ziade, Maha</td>
<td>Primary investigator</td>
<td>Research School of Computer Science, College of Engineering and Computer Science, ANU</td>
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</tbody>
</table>

Investigators Detailed

**Name:** Flint, Shayne    **Role:** Supervisor

**Expertise:** Dr. Flint has an extensive experience in Software Engineering, Engineering Systems Design, Engineering Design Methods, Information Systems Development Methodologies, Interdisciplinary Engineering, Distributed and Grid Systems, Simulation and Modelling. He is currently part of SISE (Software Intensive Systems Engineering) - Research School of Computer Science

**Name:** Sankaranarayana, Ramesh S    **Role:** Supervisor

**Expertise:** Dr. Sankaranarayana has an extensive research experience in Information Retrieval and Software Intensive Systems Engineering. He is currently part of SISE (Software Intensive Systems Engineering) - Research School of Computer Science

**Name:** Ziade, Maha    **Role:** Primary investigator

**Expertise:** I have completed an undergraduate degree in Applied Mathematics (Informatics) and worked as Software Engineer in Lebanon. Currently I am doing a Master of Computing (Software Engineering) here at ANU. I am also working in an administrative role in an organization in Canberra. My research interest stems from my will to combine my previous training and expertise in software engineering with my current involvement in an administrative
role. In particular, I am willing to investigate the possibility of applying agile methodologies, that have already proven to be successful in software engineering, to administrative environments.

## External Investigators

<table>
<thead>
<tr>
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<th>Role</th>
<th>Institution</th>
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## Departments

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<th>Department</th>
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<tbody>
<tr>
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<td>Research School of Computer Science</td>
<td>College of Engineering and Computer Science</td>
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## Project Questions Detailed

### Description of Project

Describe the research project in terms easily understood by a lay reader, using simple and non-technical language. SCRUM is a successful agile methodology widely used in Software Engineering. In this project, we will explore the possibility of adapting SCRUM for the purpose of improving administrative practices in particular teams’ performance management. We will also investigate about the best practices in administrative environment and explore the possibility of importing those practices to software development.

### Location of Data Collection

- **Australia**: Yes
- **Overseas**: No

Provide country / area where data collection will be conducted

- Canberra, Australia

### Aims of the Project

List the hypothesis and objectives of your research project. Hypothesis: SCRUM methodology can be extrapolated from Software Engineering and applied in administrative environment for performance management purposes.

Objectives:

Investigate the use of successful agile methodologies of Software Engineering (SE) in other disciplines to improve their practices, in particular administrative environment.

### Methodology
In language appropriate for a lay reader, explain why the methodological approach minimises the risk to participants. (For surveys, include justification of the sample size). The participation in this research is voluntary; No withdrawal penalty will apply.

The main technique of this research project consists of:
- Retrieving historical performance assessment data for the participants.
- Running a discussion group consisting of all the participants, in the form of brief daily meetings, and over a period of 30 days. The aim of these meeting is to gather the daily tasks of the group, prioritize and distribute them in order to ensure a more balanced task weight over the participants.
- At the end of the 30 days period, the performance of the participants will be assessed in order to measure the impact of this methodology. In particular, the quality of the work achieved rather than quantity will be the point of focus. The learning curve of the participants, as a result of the daily discussions, will be also recorded.

The data collected at the end of the 30 days, will be used for research purposes only and will not form part of the formal performance appraisal of the participants.

The meetings may be recorded after granting the participants' approval.

Provide the survey method, a list of the questions to be asked or an indicative sample of questions. These should give a good sense of the most intrusive/sensitive areas of questioning. N/A

What mechanisms do the researchers intend to implement to monitor the conduct and progress of the research project? For example:
How often will the researcher be in touch with the supervisor?
Is data collection going as expected? If not, what will the researcher do?
Is the recruitment process effective?
How will the researcher monitor participants willingness to continue participation in the research project, particularly when the research is ongoing? My supervisors will be updated weekly about the progress of this research project as per the current arrangement.

Performance data is collected by the organization on a regular basis

New participants from within the organization will be recruited in the event of withdrawals.

Participants

Provide details in relation to the potential participant pool, including:

Target participant group;
Identification of potential participants;
Initial contact method, and Recruitment method. The target participant group in this project are employees working in an administrative role in the same organization. Potential participants will be identified in the research project as "member" of the focus group; No names will be mentioned.
Initial contact method with the participants will be via email, outlining the purpose of the study and seeking their participation.

Proposed number of participants 7
Provide details as to why these participants have been chosen? As this research project is about team performance management in an administrative environment, the selected participants are currently part of one team in the same organization. This will enhance the communication level during the meetings.

Cultural and Social Considerations/Sensitivities

What cultural and/or social considerations/sensitivities are relevant to the participants in this research project? There won't be any kind of invasion of the participants' privacy or beliefs. The research will be conducted in the participants' workplace, during working hours and on work related matters only. No confidential or personal information is required. Although the participants are English speakers, they are free to conduct their meetings in other language (Arabic or French) as long as they all understand it and agreed to use it.

Incentives

Will participants be paid or any incentives offered? If so, provide justification and details. No. It's voluntary

Benefits

What are the anticipated benefits of the research? Exploring the potential of using adapted SCREUM for improving administrative practices and opening the door for further research in this domain

To whom will the benefits flow? The investigator, Software engineering research group, and the administration of the organization

Informed Consent

Indicate how informed consent will be obtained from participants. At least one of the following boxes MUST be ticked 'Yes'.

In writing Yes
Return of survey or questionnaire No
Orally No
Other No

If Oral Consent or Other, provide details. N/A

Confidentiality

Describe the procedures that will be adopted to ensure confidentiality during the collection phase and in the publication of results. Only the investigator, the supervisors and the management at the intended organization will have access to the data. None of the participants names, positions and roles will be mentioned in the research report.

Data Storage Procedures

Provide an overview of the data storage procedures for the research. Include security measures and duration of storage. During data collection, the data will be kept on the investigator's password protected laptop and kept for 5 years from publication. A backup secured copy will also be kept on an external hard drive (investigator)

Feedback
Provide details of how the results of the research will be reported / disseminated, including the appropriate provision of results to participants. If appropriate, provide details of any planned debriefing of participants. The results of the study will be written in the form of a report submitted to the supervisor, as per the requirements of the CECS for the relevant unit (COMP8790).

Supporting Documentation

Please ensure electronic copies of any supporting documentation have been uploaded the documents tab of the relevant protocol.

Has this work been approved by another Human Research Ethics Committee (HREC)?
No

If yes, please give the name of the approving HREC. N/A

Funding

Is this research supported by external funding? No

Provide the name/s of the external sources of funding. Please include grant number/s if available. N/A

Is the research conducted under the terms of a contract of consultancy agreement between the ANU and the funding source? No

Describe all the contractual rights of the funding source that relate to the ethical consideration of the research. N/A

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High Risk Two Summary

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Appendix E – Statistical Analysis Report – Comparison between SCRUM and Non-SCRUM

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33302  DELETE [REDEFINE=yes] _ausave
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33304  COMBINATIONS=present; ADJUSTMENT=marginal;\
33305  FACT=3; FPROB=yes] log10Processing_Daysp1; SAVE=_ausave
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Screening of terms in an unbalanced design

Variate: log10Processing_Daysp1

Marginal and conditional test statistics and degrees of freedom

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P-values of marginal and conditional tests

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Analysis of an unbalanced design using GenStat regression

Variate: log10Processing_Daysp1

Accumulated analysis of variance

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<th>m.s.</th>
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Predictions from regression model

Response variate: log10Processing_Daysp1

Prediction

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<th>SCRUM</th>
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Standard error of differences between predicted means 0.006081

Predictions from regression model

Response variate: log10Processing_Daysp1

Prediction

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Minimum standard error of difference 0.00691
Average standard error of difference 0.01265
Maximum standard error of difference 0.02081

Predictions from regression model

Response variate: log10Processing_Daysp1

Prediction

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RevisedWeight_1 6
Methodology
Non-SCRUM 0.5801
SCRUM 0.4599

Minimum standard error of difference 0.00771
Average standard error of difference 0.01860
Maximum standard error of difference 0.03139

Data imported from Excel file: C:\Workspace\Jin\Maha\Final Data - SCRUM & Non SCRUM - Revised.xlsx
on: 19-Feb-2015 6:38:22
taken from sheet "All Data with Revised weights", cells A2:K4094

33313 DELETE [REDEFINE=yes] Task_Creation_Date
33314 UNITS [NVALUES=*
33315 DELETE [REDEFINE=yes] _levels_
33316 VARIATE [NVALUES=136] _levels_
33317 READ _levels_

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Minimum</th>
<th>Mean</th>
<th>Maximum</th>
<th>Values</th>
<th>Missing</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>levels</em></td>
<td>151199</td>
<td>151303</td>
<td>151476</td>
<td>136</td>
<td>0</td>
</tr>
</tbody>
</table>

33336 FACTOR [MODIFY=no; NVALUES=4093; LEVELS=!(_levels_); LABELS=*
33337 ; REFERENCE=1] Task_Creation_Date; DREP=9
33338 READ Task_Creation_Date; FREPRESENTATION=ordinal

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Values</th>
<th>Missing</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task_Creation_Date</td>
<td>4093</td>
<td>0</td>
<td>136</td>
</tr>
</tbody>
</table>

33521 %PostMessage 1129; 0; 100002 "Sheet Update Completed"