**Investigating the Scope for Agile Project Management to Be Adopted by Higher Education Institutions**

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**Introduction**

**Background on Agile Project Management**

The practice of agile project management [1] has been proliferating over recent years [2], and this includes application to different sectors [3] thereby extending beyond the initial technology arena. Indeed agile continues to be an emerging trend in management that is making a positive impact to projects in many organisations. A key feature of the agile management approach is the focus on meeting the underlying business needs [4] of the organisation along with the people dimension of projects being emphasised, for instance, through joint decision-making in projects as well as joint working where possible with partners, suppliers and customer representatives. In this regard, the agile approach seeks to be implicitly more inclusive when compared to more conventional forms of process-driven project management methodologies.

Originally developed in the IT (information technology) sector, agile project management was initially seen as an alternative to the so-called waterfall methodology of project management, where IT design projects are delivered via a highly ordered linear sequence that is analogous to the action of a waterfall. Conversely, agile-related methodologies, such as Scrum [5], extreme programming [6] and DSDM (dynamic systems development method) [7], are more akin to lean management and Six Sigma practices [8]. Moreover, excessive levels of project planning are avoided, and project activities are undertaken in an iterative manner. Therefore, agile management can be viewed as a flexible approach that seeks to reduce the level of early-stage planning as well as minimizing the amount of documentation that is in place for a project.

**Agile Applications**

Agile has been adopted across a number of high-tech industrial applications [9], and this extends to governmental applications [10]. However, there are different types of organisations that also undertake projects, such as charitable organisations and academic institutions. The question therefore arises: How can agile project management techniques be adopted by higher education institutions? Moreover, should academic institutions be considering new management practices and leveraging the latest and emerging management trends from industry? Indeed some initial studies have looked into the potential application of agile techniques at academic institutions [11], where a simplified agile approach was evaluated for suitability for small teams working both in academia and in industry.

Other work has looked into the use of agile approaches to support idea generation and related creative processes at universities [12]. There has also been work reported on how agile techniques can potentially support the processes and operations in research and development (R&D) laboratories [13]. Conversely, the applicability of complementary methodologies, such as BPM (business process management), has been investigated for higher education institution (HEI) applications, with such application being found to largely rest on the university having a supportive set of organisational values and strategic intent as well as the necessary leadership and people skills to support an effective introduction of BPM [14]. Consequently, these studies would appear to indicate there is an emerging interest in applying new project management methodologies in higher education institutions, organisations that can often be very traditional in their approach to managing work-based activities. Moreover, when implementing new management approaches in such organisations, it will be important to consider the organisational landscape and the underlying culture, specifically whether a culture that supports changed working practices exists.

**Projects at Higher Education Institutions**

Universities are often large and complex organisations where there can be a significant number of management challenges as well as various types of projects delivered [15]. Challenges can include the availability of funding, competition for staff and students as well as the need to deliver various types of projects. Indeed projects are a constant feature of research activities carried out by universities, and most research initiatives are delivered according to a certain project approach, i.e. to meet schedule, budget and scope or specification requirements.

Education and teaching at universities can also be viewed through a ‘project lens’, such as a project to develop and deliver a new Master’s degree programme or implementation of new technology to improve the quality of educational delivery. In this regard, implementation of new technology to improve educational delivery has been found to be hampered in many cases with only a minority of the projects from the study resulting in improved student learning outcomes [16]. Moreover, there is a need to ensure adequate quality levels are achieved for new educational platforms and in particular online programmes if they are to be viewed as legitimate and valuable [17]. Adopting improved management techniques, such as agile management, provides scope to support such goals and contribute to quality assurance for educational programmes especially where risk can be higher through the use of new technologies.

The exchange of knowledge by universities with partner organisations, such as through technology transfer and the commercialization of IP (intellectual property) with industrial companies [18], can be viewed as project-based activities. This is because the commercialization of foreground IP that has been generated, for instance, from a scientific research study, needs to be undertaken in a timely manner so that commercial value can be secured while appropriate partners remain motivated to take the research to market. Hence, there is a need to adhere to a required schedule in addition to the financial aspects of the commercialization as well as achieving the required specification in terms of the suitability of any contractual documentation needed to underpin the transaction. Managing research projects that are funded by industry can also involve two-way knowledge exchange that is dependent on social, commercial and process-driven factors [19], where adoption of project management techniques can make a positive impact to the performance of such projects. Therefore, higher education institutions present an emerging opportunity for agile project management techniques to be applied in order to improve the efficiency and effectiveness of operations. There is a need for projects to be delivered, and this need extends to a growing interest in the application of new techniques and methodologies that have been successfully applied in industry. Hence, the application of agile management techniques at higher education institutions is a valid line of enquiry.

Consequently, the objectives of this chapter are to provide a review of agile project management and to explore in conceptual terms how certain agile techniques can be adopted at higher education institutions. This will be undertaken via a literature review of agile project management followed by discussion of three illustrative examples of the application of agile techniques at higher education institutions.

**Chapter Organisation**

This chapter is organised as follows. After the introduction section, there is a section that provides a summary and supporting information on agile project management. This is followed by a section on identifying the scope for agile project management at higher education institutions. The next section is focused on detailing three illustrative cases that describe how agile techniques can potentially be adopted by higher education institutions. Each case study includes an initial assessment of the system requirements for implementation of the agile technique including consideration of the appropriate ICT infrastructure. This section is followed by discussion and conclusions and finally the future work.

**Agile Project Management**

**Manifesto for Agile Software Development**

A key development for the agile project management movement was the publicationof the Manifesto for Agile Software Development [20]. This document includesa number of statements that essentially capture the essence of the agile approach,and while it is focused on software development, the messages can also be appliedto other applications and industries. The agile manifesto [21] is as follows:

*We are uncovering better ways of developing software by doing it and helping others do*

*it. Through this work we have come to value:*

* *Individuals and interactions over processes and tools.*
* *Working software over comprehensive documentation.*
* *Customer collaboration over contract negotiation.*
* *Responding to change over following a plan.*

*That is, while there is value in the items on the right, we value the items on the left more.*

The manifesto is accompanied by 12 guiding principles [21], which are provided in the following Table along with an interpretation by the author of the meaning of each principle. The manifesto and the accompanying principles provide a useful summary of the agile management approach, and it can be observed that there are a number of themes that emerge. There is a clear emphasis on the people dimension of projects, working collaboratively together as opposed to rigidly sticking to predefined rules and procedures. There is joint working that involves team members setting the direction of the project and also joint working where possible with customers or clients as well as suppliers. Agile is therefore an inclusive approach, where issues and challenges are effectively shared across the team and all team members are able to contribute to the achievement of the project’s goals.

|  |  |  |
| --- | --- | --- |
| **No.** | **Agile Management Principle** | **Interpretation** |
| 1 | *“Our highest priority is to satisfy the customer through early and continuous delivery of valuable software”.* | The preeminence of customer requirements that should be delivered as early as possible with workable solutions that create value for the customer. |
| 2 | *“Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage”.* | The ability to cope with changes, issues and risks encountered throughout the project lifecycle and to accommodate such changes for the ultimate benefit of the customers. |
| 3 | *“Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale”.* | Providing early delivery of working project outputs that have partial functionality with full functionality only provided later in the project. Essentially it is better to have a working solution than no solution at all. |
| 4 | *“Business people and developers must work together daily throughout the project”.* | The need for commercial and business oriented people to work side by side with technical oriented people, thereby avoiding a stovepipe mentality arising. |
| 5 | *“Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done. The most efficient and effective method of conveying information to and within a development team is face-to-face conversation”.* | The overall importance of the people dimension of projects and the need to support the people working on projects through providing a trusting and open environment that encourages joint working and sharing of information across the project. Also emphasizing direct face-to-face communication when compared to other forms such as electronic communication. |
| 6 | *“Working software is the primary measure of progress”.* | Further highlighting that a working solution for a project is better than no solution at all. This underscores that a partial completion of project specification can be acceptable. |
| 7 | *“Agile processes promote sustainable development”.* | The importance of projects being undertaken in a manner that will survive into the future and will not result in negative impacts on the project environment (either locally or more widely). |
| 8 | *“The sponsors, developers, and users should be able to maintain a constant pace indefinitely”.* | Those involved in the project need to work according to a consistent approach that can be maintained and does not result in burn-out of anyone involved through excessive levels of project contributions. |
| 9 | *“Continuous attention to technical excellence and good design enhances agility”.* | In order to achieve high levels of excellence and flexibility there is always a need to maintain a focus on technical quality for any kind of project. |
| 10 | *“Simplicity--the art of maximizing the amount of work not done--is essential”.* | Projects can be completed without excessive levels of operating procedures and documentation, although there should be enough to provide adequate structure and support the planning and delivery process. |
| 11 | *“The best architectures, requirements, and designs emerge from self-organizing teams”.* | Agile methods rely on teams of people jointly taking ownership of project success and not relying solely on the coordination provided by a project manager. |
| 12 | *“At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly”.* | The importance of looking back and reflecting on achievements as well as difficulties encountered to support lessons learnt and continuous improvement across the project. |

**Table. Agile management principles and corresponding interpretations**

The ability to adapt and an inherent flexibility are also key features, changing thecourse of the project to adapt to emerging challenges or changes in the externalenvironment. The ability for project workers from different disciplines and backgroundsto work together is an important feature as well as the overall benefits fromadopting a trusting and open environment through sharing knowledge across projects.Clearly, these attributes would be sensible to adopt for projects delivered inall kinds of organisations.

**Agile Methodologies**

There are a number of different versions of agile management, and the Scrummethodology [22] is used widely in industry. A key feature of the Scrum approachis the articulation of project work in terms of product features and the so-calledproduct backlog, which can be viewed as a prioritized list of all the features to bedelivered by the project (see the following Figure). As depicted in this diagram and throughreference to the product backlog, it is possible to develop the highest-priorityfeatures for a project first thereby leaving only low-priority features to the end ofthe project.

Consequently, where resources or time is no longer available as the projectapproaches the scheduled completion date, the project work that has not beencompleted will by definition be lower priority when compared to the completedwork and corresponding features. A further aspect of the scheme in the diagram isthe work cycle, where each feature is delivered via a time-boxed iteration (say overa week or month), and each iteration for a technology-based project would involveexploration (or design) followed by development (or engineering) and then deployment(or implementation). This iterative process is repeated for each featureaccording to the aforementioned prioritization process.



**Figure. Development cycle for agile project**

Central to the agile approach is the clear focus on delivery of the project according to a fixed schedule and within the financial budget, but when needed, there can be ‘flexing’ or controlled modifications of the project scope. This is an implication of the sequential delivery of the higher-priority features during earlier stages in the schedule, and in cases where there is no more time remaining, only lower-priority features are not delivered. This approach does not mean quality standards are compromised, but it does mean that projects can be delivered with some working level of functionality but still within the schedule and budgetary envelopes available.

This approach fundamentally sets the agile approach apart from the traditional view of project management [23], where the so-called iron triangle of requirements have to be delivered, i.e. according to fixed schedule, financial budget and project specification. However, as many studies and reports have identified, such an approach often results in project failures and problems with delivery, for example, as reported for IT projects by the Standish Group [24]. Furthermore, construction projects continue to be delivered with time delays and cost overruns, and agile has recently been found to be a promising strategy to help cope with engineering complexity and improve the performance of such projects [25].

Agile techniques can also involve sprints over shorter timeframes, where each sprint has an interim target that must be met within a fixed ‘time box’ [26]. Breaking down projects into such sprints and corresponding ‘time boxes’ represents another approach to ensure projects are delivered within the required schedule. Although agile is an overall approach to projects, it is characterized by a wide selection of techniques that when employed collectively support the achievement of agile working according to the previously defined principles. A number of these techniques associated with agile project management will be explored further in the illustrative case studies that are discussed in this chapter.

**Identifying the Scope for Agile Management at HEIs**

**Organisational Landscape for HEIs**

Higher education institutions (HEIs) are complex organisations, often large in size spanning academic departments and various support services along with a wide array of stakeholders to serve. Universities need to remain relevant if they are to continue to attract high-quality students and staff. They need to respond to emerging needs and trends, such as globalization [27], improving student engagement [28] or the current strong interest in entrepreneurial activities and related educational provision [29]. Universities are also actively adopting more commercial practices, such as business planning methodologies to support the development of strategic academic programmes [30].

Moreover, universities can be powerful engines to support economic development through the knowledge that is created as well as through producing educated and trained individuals that are able to work in knowledge-based jobs in industry and in wider society. Universities are able to generate research and technology outcomes that can be adopted by industrial companies to enable improved products, services and manufacturing processes thereby helping to improve industrial competitiveness.

Universities also face a number of challenges, such as pressure on budgets, increasing levels of competition for funding and attracting the best students and staff – increasingly on an international level. Plus, there is a need to respond to the opportunities offered through pursuing collaborative partnerships with industrial organisations [31] as well as adopting ICT (information and communications technology) to improve the teaching experience. In regard to the primary organizational strategy of most universities, it can be articulated according to three core capabilities that are education, research and knowledge exchange and as depicted in the following Figure.

**Supporting the HEI Strategic Agenda**

Adoption of new management systems at HEIs will therefore need to be able to make a positive impact on a university’s ability to pursue a successful strategic trajectory that generates value across all three core capabilities [32]. Consequently, it is useful to explore where there is scope for agile project management to result in improvements in these three areas, and a useful framework to adopt is the so-called four E’s, i.e. assessing performance in regard to improvements in efficiency, effectiveness, economy and ethical considerations [33]. Therefore, the following Table provides the results of this assessment, which highlights that there is significant scope for agile practices to make a positive impact to the performance of universities across the education, research and knowledge-exchange domains.



**Figure. Higher education institution core capabilities**

|  |  |  |  |
| --- | --- | --- | --- |
| **Performance** | **Education** | **Research** | **Knowledge**  **exchange** |
| Efficiency | Maximising the value and quality of knowledge and skills transferred to students through optimal delivery of teaching and tuition services. | According to a given level of funding, generating the optimal level of knowledge from research activities that are delivered. | Translation of research outcomes to enable the optimal level of value creation in terms of industrial, societal or knowledge impact. |
| Effectiveness | Generating improved skills and knowledge of the students through ensuring scholarship is fit for purpose and regularly updated. | Achieving knowledge goals from research conducted in regard to the required deliverables, milestones and quality levels. | Two-way exchange of knowledge with partners and stakeholders undertaken according to defined plans and against specified key performance indicators |
| Economy | Delivery of teaching and scholarly work delivered according to a minimized cost base while still at appropriate quality levels. | Research projects delivered according to required performance and quality levels while costs are minimized as appropriate. | Ensuring the transaction and follow-on costs for research translation activities with appropriate partners are minimized. |
| Ethics | Adopting a transparent and honest approach to teaching work that is applied consistently to student cohorts along with fairness and integrity. | Research conducted according to probity, integrity and ethical dimensions while avoiding any conflicts of interest that could conceivably arise. | A consistent approach used to the exchange of knowledge with partners that is based on integrity, probity and diligence of application. |

**Table. Scope for application of agile to academic institution core capabilities**

**Evaluation of Agile Techniques Through Illustrative Cases**

The previous assessment exercise has highlighted the scope for agile practices to be potentially applied at universities, and it is useful to examine specific instantiations in order to provide context as well as an improved understanding of the outcomes of such an application. Therefore, three illustrative cases are provided in this chapter that highlight how agile techniques can be applied across education, research and knowledge-exchange provision at higher education institutions.

The case studies have been developed through drawing on the author’s experience in research and technology projects at universities. Supporting material from the literature has been considered for each case, and through a process of reflective inquiry [34], the key findings from the cases have been synthesized. Each case also includes identification of the proposed system requirements for the corresponding agile application.

**Case 1: Development of Online Master’s Degree Programme**

The development of a new online Master’s degree programme can be a challenging initiative [35] for universities and the staff involved as there is a significant amount of planning required across a range of underlying areas, including consideration of blended learning options [36]. This includes making a supporting case to secure the necessary approvals within the university, ensuring the programme is intellectually demanding and designing the programme so that it provides an appropriate balance between theoretical and practical aspects where appropriate as well as making sure that the degree will be appealing to the targeted student cohorts. There is also a need to ensure the learning materials, teaching notes and scholarly content are prepared in a timely manner and for the appropriate ICT infrastructure to be available to enable delivery of the online programme.

Development of all this material in a timely fashion represents a significant challenge that would potentially benefit from the adoption of the agile Scrum approach and in particular the sprint planning technique [37]. Basically, a sprint is a fixed period of time where specified work has to be completed in preparation for review and acceptance of the project work. Each sprint period begins with a planning meeting, where the development team needs to agree on what can be realistically achieved in the given timeframe and the relevant product owner will need to make a final decision on the review criteria that need to be met in order for the work to be approved and accepted.

The sprint planning approach can be undertaken through assembling a task tracking table, and in terms of project delivery, a sprint burndown chart is used to required tasks [38]. Consequently, the following Table provides a task tracking table, and the following Figure represents a corresponding sprint burndown chart for the illustrative development of an online Master’s degree programme.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Task #** | **Task**  **description** | **Task**  **status** | **Task**  **owner** | **Projected days** | **Remaining days** |
| 01 | Development of programme specification. | Closed | Course director (Professor) | 5 | 0 |
| 02 | Programme proposal and business plan. | In work | Course deputy director (Lecturer) | 15 | 5 |
| 03 | External assessor’s report commissioned and delivered. | Open | Course director (Professor) | 10 | 10 |
| 04 | Preparation of degree regulations. | In work | Departmental administrator | 10 | 5 |
| 05 | Degree programme structure with details of compulsory and elective modules. | In work | Course deputy director (Lecturer) | 15 | 5 |
| 06 | Preparation of outline teaching materials prepared. | In work | Course director (Professor) | 25 | 20 |
| 07 | Information and communications technology (ICT) infrastructure development. | Open | Departmental administrator | 10 | 10 |
| 08 | University approvals, i.e. at Department, Faculty and Senate levels. | Open | Course director (Professor) | 10 | 10 |

Note on project task status:

* Open: Task not started.
* In work: Task started but not completed.
* Closed: Task completed.

**Table. Task tracking table for online Master’s degree programme development project**

The task tracking table captures key information and can be updated throughout the term of the project, including information on the task description, status (either open, closed or in work), task owner, projected days for the task and remaining days for the task. The table is maintained throughout the project and can be used to readily track tasks and the remaining time to the completion of the project.

In regard to progress of the project, it can be seen from the table that there is one closed task, four in work tasks and three open tasks. Furthermore, the sprint burndown chart plots a linear trend line of tasks remaining (for this case, there is a total of 120 project working days over a 12-week project duration) and also the actual tasks remaining, which are recorded in real time. In the example, the sprint burndown chart is at the end of week 6, and it can be observed that the actual tasks remaining amount to 65 days’ worth of work, which is a summation of the remaining days for tasks 01 through 08. In this example 55 days of work has been completed on the project.

Using this agile approach would ensure there is a clear and transparent view on the progress of the education project to develop a new online Master’s degree programme, thereby making sure all the task owners (namely, the course director, deputy director and departmental administrator) are updated on progress. The impact of issues and risks can be readily observed and managed through the tracking process, and use of a sprint burndown chart would allow any significant variations to the trend line to be observed so that corrective action can be undertaken rapidly to maintain the performance of the project and meet the required schedule.



**Figure. Sprint burndown chart for online Master’s degree programme development project**

In terms of ICT design and implementation, it is possible to synthesize the system requirements (SR1/1–6) [39] for this application of agile project management to the development of an online Master’s programme, which are summarized as follows:

* SR1/1: The work-based information system will allow input by users of the initial task-related data (qualitative and quantitative) according to the predefined data fields in the task tracking table.
* SR1/2: The work-based information system will allow subsequent input by users of the remaining days’ data field for each given task. Such input is likely to be on a periodic basis, e.g. every week.
* SR1/3: The work-based information system will automatically generate a graphical output based on a sprint burndown chart according to the sum of tasks (trendline of tasks remaining and actual tasks remaining) versus the sprint timeline.
* SR1/4: The work-based information system will allow users to assess the variation between the trend line of tasks remaining and the actual tasks remaining on a periodic basis, e.g. every week.
* SR1/5: Users will be able to engage with the work-based information system via traditional hardware interfaces (keyboard and mouse) in addition to mobile devices, thereby increasing functionality. App-based implementation is also recommended.
* SR1/6: The work-based information system to be available via cloud-based applications with scope for integration with other ICT project management applications.

This set of initial system requirements highlights the data and user aspects, interfaces as well as hardware configurations. Further refinement of these requirements is suggested through use of a more formalized requirements capture process with targeted users. Nevertheless it is useful to establish these system requirements so that practitioners contemplating adopting agile techniques can have an improved appreciation of the areas to be considered when designing and implementing the agile management systems.

**Case 2: Multidisciplinary Medical Research Project**

Medical research projects generally require contributions from different academic disciplines and are by nature multidisciplinary, for example, the development of a drug compound involving testing of an NCE (new chemical entity) [40] along with pharmacological and biochemical research that is required before the eventual testing is carried out. Open communication across multidisciplinary teams is a key factor that determines the success of collaborative research projects [41], and remote working of researchers can also be a feature.

This could, for instance, be associated with participation in international collaborative projects such as Horizon 2020 consortium projects funded by the European Commission, for example, involving health systems and policy research [42] or construction management and building materials research [43]. Indeed, the ability of the principal investigator and project researchers to work together in a collaborative fashion will likely have a significant impact on the performance of such a research project. Therefore, adopting agile processes and systems that support optimized communications as part of collaborative working will ensure data and information are shared in an open and efficient manner.

Agile project management is geared towards supporting transparent communications across the project, and a technique that can be adopted is the so-called Kanban board [44], which is a visual representation of project status that is placed on the wall so that members of the project team can become rapidly appraised of the status of the project and issues that need to be addressed. Where team members are working remotely, this concept can be delivered through a digital information radiator, which provides real-time data and information on the status of the project, such as the product backlog, identified tasks as well as complete and incomplete assignments [45]. Consequently, Fig. 14.4 provides an illustrative representation of a digital information radiator for a multidisciplinary medical research project undertaken by a university.

The example provided includes illustrative update information that would be entered into an appropriate ICT system in real time and be accessible by project team members wherever they are located, i.e. remotely. In the example, there are four products being worked on during development stage 2 (month 4), which are biochemical validation, toxicology testing, formulation studies and clinical efficacy.

The toxicology testing product has been completed and is closed, whereas the other products remain in work with further activities to be carried out. The information radiator allows the requirements and deliverables to be easily interpreted along with the progress and next steps recorded in real time for each of the products.



**Figure. Representation of digital information radiator for medical research project**

In the example, it can therefore be observed that from the ‘in work’ products, the biochemical validation product is nearly complete, although the formulation studies and clinical efficacy products still have a significant amount of project work remaining in order to be completed. Adoption of this agile methodology would therefore enhance knowledge availability across the medical research project and for use by the participants (namely, the principal investigator, researchers and postgraduate students), thereby supporting an open and trust-based environment that is a key feature to the success of multidisciplinary research collaborations.

In terms of ICT design and implementation, it is possible to synthesize the system requirements (SR2/1–6) for this application of agile project management to the multidisciplinary medical research project, which are summarized as follows:

* SR2/1: The work-based information system will allow input by users of the product backlog-related data (qualitative and quantitative) according to the predefined data fields in the digital information radiator.
* SR2/2: The work-based information system will allow subsequent input by users according to the updated data fields for each product backlog, namely, progress, status (open/closed/in work) and next steps. Such data input is likely to be in real time or when the situation on the project has changed.
* SR2/3: The work-based information system will provide a readily accessible visual overview of the key data and information for the product backlog thereby supporting real-time project communications.
* SR2/4: The work-based information system will allow different users from across the project to input data and where appropriate support joint working with client and partner-based users. Configuration control and version control will also need to be implemented.
* SR2/5: Users will be able to engage with the work-based information system via traditional hardware interfaces (keyboard and mouse) in addition to mobile devices, thereby increasing functionality. App-based implementation is also recommended.
* SR2/6: The work-based information system will be available via cloud-based applications with scope for integration with other ICT project management applications.

As before, this set of initial system requirements highlights the data and user aspects, interfaces as well as hardware configurations. Further refinement of these requirements is also suggested.

**Case 3: Negotiation of Industry-Funded Research Agreement**

Universities are able to undertake a range of knowledge-exchange activities with industrial companies, including licensing of intellectual property (IP) [46] and working on industry-funded research projects [47]. These projects are required to generate research and technology outputs that can be transferred to industry to help improve industrial products and services or support the development of new manufacturing processes.

Both universities and companies are able to secure benefits from working together including those associated with knowledge, resources and economic aspects. However, the negotiation of industry-funded research agreements can sometimes be a particularly lengthy process due to the university and the company often having different commercial perspectives, such as those regarding the allocation of IPR (intellectual property rights). Indeed, adopting process methodologies can support the development and management of university-industry research collaborations, and it is useful to consider whether agile techniques can be applied to the negotiation of industry-funded research agreements.

Timeboxing is an agile technique [48] that involves breaking up tasks into smaller parts that can be closely managed to ensure the project schedule is met. The small parts are managed according to fixed periods of time with each period corresponding to a sprint or iteration. In a software project, a typical sprint could be 30 days in length, but this duration may be shorter for more intensive projects. Timeboxing is a technique focused on ensuring project schedules are kept under control with the project features delivered according to the specification. Consequently, the following Figure provides an illustration of the timeboxing technique employed in support of the negotiation of an industry-funded research agreement.



**Figure. Use of timeboxing for industry-funded research agreement project**

In the example, negotiation of the research agreement is considered in regard to three main increments, which are as follows: agree commercial principles, develop outline agreement and conclude full agreement. Each of the increments is further subdivided into three main tasks and corresponding time boxes that are to be completed according to the fixed end dates. In the case provided, each time box could be say 4 working days long meaning that each increment would be 12 working days long, and the overall negotiation project would therefore be 36 days long.

The tasks that are allocated to each increment would be ascertained through an initial meeting of the project team involving the principal investigator (academic), university contracts manager as well as the technical and legal representatives from the company. The project team would establish the overall commercial framework from the outset and then jointly work towards achievement of the tasks within the required time. There would of course be commercial sensitivities between the two organisations associated with contractual negotiation, but nevertheless fostering an open communication channel through initial face-to-face meetings (backed up by regular video teleconferences) is more likely to result in any major contractual issues being tackled in a productive and positive manner.

Furthermore, managing the negotiation process for the research agreement would require the key tasks to be carried out according to the fixed schedule, and as long as the ‘must haves’ are completed for each time box, the project should remain on schedule. ‘Must haves’ are the requirements that basically must be delivered for the project to be successful, as opposed to ‘should haves’, ‘could haves’ and ‘won’t haves’, which can be developed for a project using the MoSCoW technique [49]. This is an approach to help prioritize tasks and features for a project and would be applied to help define the tasks and time boxes for the industry-funded research agreement project.

In terms of ICT design and implementation, it is possible to synthesize the system requirements (SR3/1–6) for this application of agile project management to the negotiation of an industry-funded research agreement, which are summarized as follows:

* SR3/1: The work-based information system will allow input by users of the project schedule data (qualitative and quantitative) including increments, timeboxes and tasks aligned to the schedule and according to the project plan.
* SR3/2: The work-based information system will allow subsequent input by users of the status of the time boxes and tasks, including percentage completion data at given points in the schedule.
* SR3/3: The work-based information system will allow users to be able to rapidly determine via a visual interface the status of the project in terms of task completion according to the overall schedule.
* SR3/4: The work-based information system will also allow appropriate flexing or controlled modification of the tasks so as to support delivery of the project according to the fixed schedule but only where such flexing does not diminish the quality of the project outputs.
* SR3/5: Users will be able to engage with the work-based information system via traditional hardware interfaces (keyboard and mouse) in addition to mobile devices, thereby increasing functionality. App-based implementation is also recommended.
* SR3/6: The work-based information system will be available via cloud-based applications with scope for integration with other ICT project management applications.

As before, this set of initial system requirements highlights the data and user aspects, interfaces as well as hardware configurations. Further refinement of these requirements is also suggested.

**Discussion and Conclusions**

The implementation of agile project management is gathering pace across many organisations including both industrial companies and governmental agencies. Indeed many different types of organisations are increasingly dependent on projects to be delivered in order for operational and strategic performance to be maintained, and this includes academic institutions. Universities also face a number of challenges and opportunities, not least through responding to the availability of new technologies as well as adapting emerging management approaches and methodologies to the not-for-profit (NFP) environment. Therefore, the question arises: Can agile project management be adopted at higher education institutions? The simple answer is yes, and this chapter has explored how this can be achieved.

Universities often rely on projects to support delivery of outputs in terms of research, education and knowledge-exchange activities. Indeed, there is much scope for agile to make a positive impact at universities in regard to performance improvements across efficiency, effectiveness, economic and ethical considerations. It is recognized that universities are places where creativity needs to be promoted and new ideas nurtured, not necessarily a place where new management practices are readily adopted. But nevertheless the opportunity to adopt agile can be viewed in the context of the general trend by universities to implement management frameworks while maintaining necessary freedoms across research and education provision [50] as well as recognising the need for greater levels of accountability [51] in the work that is delivered by universities to meet wider societal needs.

Agile management promotes a number of overriding themes, such as the importance of people working together and avoiding excessive use of standard operating procedures and unnecessarily long documentation. The ability, where and when possible, to work jointly with the customer is important as well as delivery of a working solution as opposed to holding out for the perfect solution. Originally developed in the IT sector as an alternative to the waterfall methodology, agile project management is accompanied by a raft of techniques that can be deployed to support the achievement of the agile way of working. Such techniques and related methodologies include Scrum and sprint planning, task tracking and sprint burndown charts, Kanban boards and digital information radiators, incremental management and time boxes and MoSCoW.

These techniques have been applied to three illustrative case studies through drawing on the author’s experience in the higher education sector. The cases have included the development of an online Master’s degree programme, a multidisciplinary medical research project and the negotiation of an industry funded research agreement. The cases have also allowed corresponding sets of system requirements to be developed for each case instantiation. These system requirements include definition of the data entry fields (both quantitative and qualitative), baseline and update data fields, tabular and graphical interfaces, visual interfaces as well as hardware and software configurations, including remote working/app-based implementations. These requirements can be further refined through more detailed integrated system design work, and this can be supported by further requirements capture to ensure user needs are fully documented.

Although the research reported in this chapter is conceptual in nature, the illustrative cases have highlighted a number of findings and insights. Core to the agile approach is the importance of communication across projects, which can even represent a new mindset of working on projects [52]. The multidisciplinary medical research project benefits from transparent communication via the use of a digital information radiator that is accessible by collaborative team members working remotely. The development of the online degree programme benefits from rapid communication of the task status through the sprint burndown chart and the remaining work to be completed thereby supporting development of the programme by the faculty members and administration staff. Similarly, negotiation of the industry research agreement benefits from transparent communication between the university and the company. This allows achievement of the required tasks according to the specified time boxes thereby enabling negotiation of the research agreement to be completed in the required timeframe.

Communication is a two-way process; indeed there needs to be a transmitter and a receiver, and both parties need to be responsive to open communications. Adoption of agile management practices at higher education institutions has the capacity to support those who work at universities as well as partners and funders to exercise and participate in more open forms of communication. Ultimately this enables knowledge sharing and trust-based working, which can impact enormously on the performance of higher education institutions.

It is recognized that a supporting culture will be needed to facilitate adoption of agile practices and an ability of the organization to embrace change management initiatives. The role of senior management will be important in this regard in order to drive through new working practices and ensure appropriate buy-in and adoption of agile techniques and related systems by staff members. The challenges for such implementations should not be underestimated, and any agile implementation should therefore be adapted to the local organizational context as appropriate.

System implementations will need to be based on a robust understanding of the user requirements for agile working (for instance, enabling joint working by suppliers and clients as well as remote working), and where possible any agile based systems will need to be integrated with other existing systems in use by the organization, such as an ERP (enterprise resource planning) system. Moreover, it is recognized that there are still be many instances where traditional management and close adherence to standard operating procedures (SOPs) may still be required (such as the need to accommodate government legislation on employment relations), but equally the research reported in this chapter has highlighted that there is significant scope for the adoption of agile working at higher education institutions.

**Future Work**

Future work is suggested to enable a more detailed examination of the implementation of agile project management at universities to build on these findings. This could involve comparative studies of agile adoption alongside other management frameworks to highlight the benefits of the more flexible and adaptable agile approach. Other studies may involve implementation of agile management at universities followed by the use of a survey instrument to support quantitative analysis of the findings and further development of the agile research agenda. As mentioned previously, more detailed work to capture user requirements and inform system design studies for implementation of agile management on ICT infrastructure is also recommended.

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