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Citation: Hollis, B. & Maiden, N. (2013). Extending Agile Processes with Creativity Techniques. *IEEE Software*, 30(5), pp. 78-84. doi: 10.1109/ms.2012.171

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Extending Agile Processes with Creativity Techniques

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Abstract. Agile processes seek just-enough requirements. However, this focus on simple software solutions can be at the expense of ones that meet more creative requirements. To explore alternatives, this paper reports the extension of one agile process with creativity techniques in a project in a large media organization. Domain experts ranked the requirements generated with the process as more novel than baseline epics from the product backlog of the same project, while usefulness of the requirements increased overall after incubation over the duration of a sprint.

1. Agile, Requirements and Creativity

Although advocates of agile claim that it can deliver innovative requirements and software in uncertain situations [Highsmith 2004], concrete evidence for this claim is lacking. Indeed, agile processes make little concrete reference to established creativity theories and techniques. Some now question whether agile processes can deliver innovation [e.g. Oza & Abrahamsson 2011].

One obvious weakness is that agile processes do not exploit working software for creative thinking about new requirements. Indeed, the short durations of sprints can discourage the incubation and reflection needed for creative thinking [Poincare 1928]. Often the principle of simplicity, eliminating waste and reducing complexity, is taken too far. For example Beck [2005] advises agile developers to think of the simplest solution. Whilst often effective [e.g. Cooper 2004], unless a concerted effort is made to see the potential beyond the simplest solution, customers will continue to settle for solutions developed in ignorance of what is possible. This limitation is reinforced by agile's adoption of data-driven techniques that focus on current practices such as competitor analysis [Cohn 2004]. Therefore, a challenge is how to integrate creative thinking about requirements more effectively into agile processes.

This paper reports the extension of one agile process with creativity techniques, and the evaluation of the extended process in one project at BBC Worldwide.

2. Extending Agile Processes with Creativity Techniques

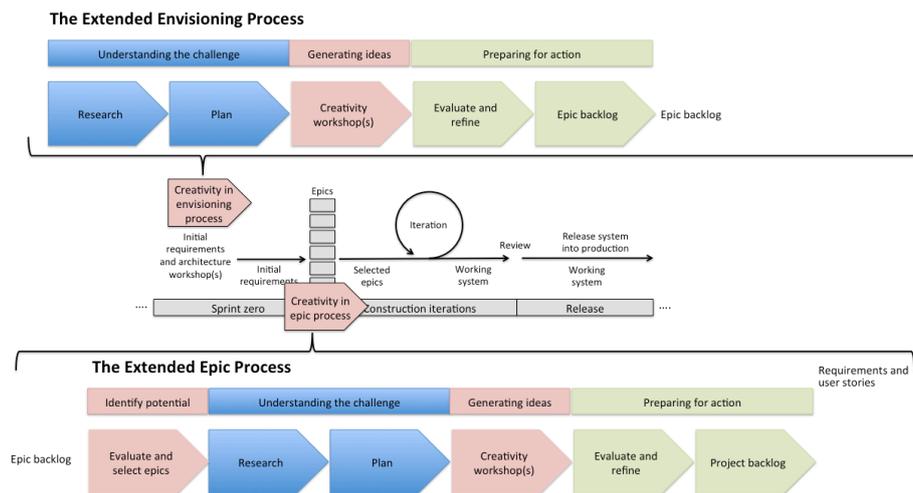
We reviewed agile processes to determine where and how to inject creativity techniques into them. We adopted Sternberg's [1999] definition of creativity as "*the*

ability to produce work that is both novel (i.e. original, unexpected) and appropriate (i.e. useful)”, so we were seeking to inject techniques to generate novel and useful requirements. By useful, we are seeking requirements that, if satisfied by the software solution, can contribute positively to achieving one or more goals specified for a project.

Our solution was to extend part of the Ambler agile process [2002] in two places with the creative activities shown in Figure 1:

1. During the envisioning process in sprint zero, to discover a more novel system vision and high-level requirements, known as epics.
2. At the beginning of some sprints, when highest priority epics are developed into system requirements to implement during the sprint. Epics with more potential for creative outcomes become the focus of the creative activities.

Figure 1. The stages of the extended envisioning and epic processes applied to Ambler’s agile process [2002], showing the phases and stages that a project undertakes in the envisioning process and a single iteration of an epic process. The new creative stages are shown in pink.



To explore which creativity techniques to implement in each new creativity stage, we framed the stages of the extended envisioning and epics processes using the stages and techniques of version 6.1 of the CPS (Creative Problem Solving) process [Isaksen et al. 2011]. The CPS process provides comprehensive guidance for individuals, teams and organizations to treat people, content and context as part of a problem solving system. The stages of the CPS process are divided into three phases: *understanding the challenge*, *idea generation*, and *preparing for action*, with an optional pre-phase called *identifying potential* undertaken at the start to discover potential challenges. Key stages within the three main phases include *constructing opportunities*, *exploring data*, *framing the problem*, *generating ideas*, *developing solutions* and *building acceptance*.

In our framing, some stages in the CPS and agile processes were equivalent. The *exploring data* stage could be mapped to the use of effective agile data analysis

techniques such as personas – direct involvement of stakeholders in agile processes is not always possible, so personas are one form of proxy user with which to explore a domain. Likewise the *framing the problem* stage could be mapped to the development of epics and user stories in sprint zero and beyond. The *developing the solution* stage could be mapped to model storming in early sprints. And the *building acceptance* stage could be mapped to later sprint activities such as iteratively reviewing the working software with customers and releasing the system into production.

However, mapping agile techniques to the *generating the ideas* stage was more difficult. Initial requirements and architecture workshops offer little support for creating requirements, a weakness exacerbated by the short durations of sprints. Therefore, the *generating the ideas* phase became the focus of our new process. We extended the envisioning and epic processes with the explicit use of *idea generation* techniques.

Figure 1 graphically depicts the extended envisioning process. The process defines a product's vision and producing epics using the three CPS phases of *understanding the challenge*, *generating ideas* and *preparing for action*. The *generating ideas* phase is new to the process. It implements one or more short creativity workshops to discover more novel ideas with which to form the vision and epics. The workshops ran established creativity techniques [e.g. Michalko 2006, Higgins 2005].

Figure 1 also graphically depicts the extended epic process. The process discovers new ideas that become the required baseline requirements in the product backlog. It also implements the three CPS phases, and has been designed around *idea generation* in the form of one or more short creativity workshops to discover novel requirements from one epic at a time. Furthermore, the themes of these creativity workshops are determined by one new stage taken from the CPS process called *identify potential*. During this, the team evaluates existing epics in the product backlog to select one or more that have more potential for leading to creative requirements using four criteria from CPS [Isaksen et al. 2011]. These criteria, adapted a little to fit to the agile process, are:

- (i) The epic is *ambiguous*;
- (ii) The epic is *complex*;
- (iii) The epic necessitates *novelty to offer competitive advantage*, and;
- (iv) The epic offers *openness for creative potential*.

For selected epics, one or more creativity workshops are then run during sprints to create new outline requirements on the future system, informed by *research* and *planning* stages similar to the envisioning process. During the *evaluate-and-refine* stage, at least one meeting takes place to evaluate the requirements and identify the ones to be taken forward. The process recommends one week between the workshop and evaluation to provide crucial incubation time about the requirements.

Details of the extended envisioning and epic processes [Hollis 2011] were then made available to agile projects at BBC Worldwide, the wholly owned commercial subsidiary of the principal public service broadcaster in the United Kingdom, to enable evaluations of it to take place.

3. Evaluating the Extended Epic Process

At BBC Worldwide we collected evidence to investigate whether the extended epic process, under real-world time constraints, could lead to the generation of requirements that were more novel than the baseline epics in the project backlog. Several projects were evaluated. In this paper we report one – the redesign of a television listings website. We evaluated the project by comparing ratings made by independent domain experts about the novelty and usefulness of both requirements generated using the extended process and the epics generated using the original agile process in the project's product backlog. Statistical analyses were applied to the ratings to explore two hypotheses:

- H1 Requirements generated from the application of the extended epic process were rated *more* novel than epics in the original product backlog for the same project;
- H2 Requirements generated from the application of the extended epic process were rated *less* useful than epics in the original product backlog for the same project.

We investigated the hypothesis H2 because previous studies of creativity support for requirements work revealed a trade-off between requirement novelty and usefulness [e.g. Zachos & Maiden 2008]. We also chose to compare the requirements from the extended epic process to the project's original backlog of epics to investigate whether the addition of the *idea generation* stage generated outputs that were more novel than the inputs to the process. One alternative that we considered but rejected was to compare the requirements generated using the original and extended epic processes, but this would have introduced new uncontrolled variables arising from our inability to isolate the original epic process from the effects of the extended one.

3.1 The Television Listings Website

The product owner and key stakeholders had already produced a clear product vision and backlog of epics for the television listings website. The competitor analysis had identified the need for capabilities for a user to *personalise* their access to the website and become a member of a *community*, equivalent to being able to connect with friends via social networking sites. These epics had been balanced with the product's core values and unique selling points to produce a product proposition statement and backlog of 216 epics. At that point a team composed of the lead developer, head of design, a business analyst and a second developer agreed to use the extended epic process with facilitation from the first author. The team had formed 6 weeks earlier, and each member had between 3 and 6 years of experience in agile projects.

The original agile process had combined standard practices derived from the Agile Manifesto. For example, it had applied Kanban to visualize work progress, Scrum to provide regular feedback cycle, XP development practice to control software quality, and automated tools to document software. We considered it to be typical of the processes used in agile projects.

3.2 The Epic Process

The project followed the six stages of the extended epic process shown in Figure 1 over two weeks. The *identify potential* stage selected which epic had the greatest potential for creative exploitation using the four CPS characteristics *ambiguity*, *complexity*, *novelty for competitive advantage* and *openness for creative potential*. One epic was selected to generate a challenge statement for a creativity workshop:

In what ways might the system change a user's profile based on their behaviour inside or outside of the website?

The *research* and *planning* stages then took place over five days to prepare for one creativity workshop that ran for sixty minutes with the same head of design, business analyst and two developers, all of whom had knowledge of the domain and backlog of epics. No end-users participated due to the agile project timescales, so the participants acted as proxy users.

At the start of the workshop the facilitator prepared the 4 participants for creative thinking. The challenge statement was communicated and clarified to ensure that the participants shared a common starting point. The rules for creativity were set – respect, acknowledge and build on the ideas of others, avoid negative feedback and comments, generate as many as ideas as possible, and do not think about how to implement them. A short fun task was undertaken together to break the ice between team members.

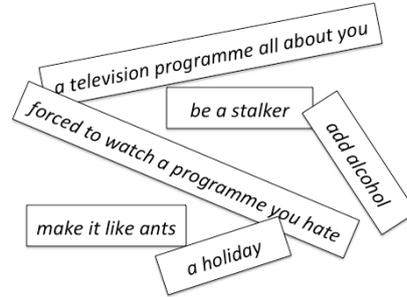
Three creativity techniques were then used in the workshop: (i) *brainstorming*; (ii) *random stars*, a new technique inspired by the *hall of fame* technique from Michalko [2006], and; (iii) the *PICL* technique from Higgins [2005]. Ideas were documented on large post-it notes to enable the participants to sketch and draw.

The *brainstorming* technique was familiar to the workshop participants, but it had not been used effectively within the department. An open brainstorm was facilitated to allow the participants to share their favourite ideas and allow others to build on them to generate requirements.

The *random stars* technique was designed to provoke creative thinking by asking the right questions at the right time from different perspectives. It was adapted from the *hall of fame* technique [Michalko 2006] to the domain of television programmes to make it fun and relevant. The facilitator chose 14 programmes, represented by their main characters such as *Vicky Pollard* from *Little Britain*, *Alan Sugar* from *The Apprentice* and the *Top Gear* presenters, then photographs of each one were printed out, cut-up and placed into a bag. Participants used the characters to force connections to generate new requirements for the website according to themes.

The photographs were supplemented with twenty-five short statements invented to trigger new lines of thought based on the *PICL* technique [Higgins 2005]. During the technique participants randomly selected one item at a time and used it to discover new requirements for the website. Example items are shown in Figure 2. Again, participants used the statements to force the generation of new requirements for the website according to the themes of the statements.

Figure 2: Characters from the fourteen television programmes used in the *random stars* technique, and example statements used to generate in the *PICL* technique.



During the *evaluate-and-refine* stage, a one-week period of incubation took place to allow more creative thinking about the requirements from the workshop. The project team met once to review workshop outcomes and decide which requirements to take forward.

3.3 Workshop Results

The creativity workshop lasted for 55 minutes, during which the four participants generated 40 new requirements – 30 with the *brainstorming* technique and 10 with the *random stars* and *PICL* techniques.

The *brainstorming* session led to requirements that involved novel uses of other websites and technologies. One requirement described a chat-roulette style feature that would allow users to digitally drop-in on friends to see what they are watching. Another described a feature to view people’s reactions to a television programme using a webcam. These requirements were produced at a rate of one per minute, and the facilitator observed that there was rarely a moment without someone talking about a requirement.

The *random stars* and *PICL* session led to ideas associated more with emotional connections with programmes. One requirement described the need for a capability to capture a user’s emotional response to a programme or character. Another described a capability that allowed the users to indicate which actors they lusted for. A third used the characters as personas, for example Vicky Pollard led to an idea that missing a television programme would leave a viewer a social leper. The 10 requirements were generated more slowly than with *brainstorming*, due in part to the need to draw prompt items out of the bag, read them and find connections with the website.

Two days after the workshop, during the *evaluate-and-refine* stage, the lead developer and business analyst from the workshop presented the 40 requirements to the product owner using the original post-it notes. At the time the product owner showed greatest interest in two requirements: the *coloured mood board* and the *site being a personality*, but neither were selected to implement. However, one week later, after more incubating of the requirements, the agile project team reported that the workshop had influenced their thinking and, as a result, changed their requirements on the website.

3.4 Post-Workshop Analysis

We used domain expert ratings of the requirements from the extended epic process and epics in the original epic backlog to investigate the two hypotheses H1 and H2.

The same number of selected individual requirements from the creative epic process and epics in the original epic backlog in the project were used to generate two data sets that were then rated independently for their degrees of novelty and usefulness by domain experts.

We limited the comparison to 40 requirements and epics. This was the total number that, we reasoned, one domain expert might be able to rate accurately in one session lasting 45 minutes. The backlog contained 216 epics and the extended epic process generated 40 new requirements. We discounted 85 epics that requested features common to most websites, then randomly picked 20 epics from the rest of them and 20 requirements from the 40 generated in the extended epic process. Each of the 20 requirements from the epic process was then transcribed from the post-it notes and audio recording of the workshop and described in 20-50 words. This required the omission and addition of some words to capture the essence of the idea into the short format, noted by the ellipsis '...' and square brackets '[]', for example: *we [could] see when people have searched for film times... and what kind of films they are interested in and then... feed that data back into their preferences... we could tell them when it's [showing] on TV.*

The backlog epics had been documented as more concise factual statements than the requirements from the extended epic process. To remove this potential source of bias, both sets were presented in the same format. One independent analyst was asked to describe the 20 selected backlog epics in a similar fashion to the requirements generated in the extended epic process. The analyst was not told how the data would be used and was instructed to describe each requirement with passion. She was asked to talk in the future tense as if she had just thought of the requirement. The same process was then used to transcribe and condense the epics into brief 20-50 word descriptions, thereby ensuring equivalent style and length to the requirements from the extended epic process.

The selected requirements and epics were written in random order into a questionnaire with a numerical scale of 1-5 to rate the novelty of each requirement/epic and usefulness of each requirement/epic. The questionnaire defined novelty as:

In the context of a television listings website, the idea is original, imaginative or unique

And usefulness as:

In the context of a television listings website, the idea is of some potential value to the website or its users. For example, a game may not be 'useful' in the classic sense but it may add some commercial or user value in the right context

Ten volunteer domain experts not associated with the television listings website project then independently rated the novelty and usefulness of the 40 requirements and epics in the questionnaire.

We applied an unpaired two-tail, unequal variance t-test to the 400 novelty ratings collected from the 10 domain experts who independently rated the 20 requirements

from the extended epic process and the 20 epics from the product backlog. The average novelty rating given to the epics from the backlog was 2.69 out of 5 and the average novelty rating given to requirements from the extended epic process was 3.28 out of 5. A statistical analysis revealed that requirements generated during the extended epic process were rated as significantly *more* novel than epics in the original product backlog. The result supported hypothesis H1.

Moreover, five of the 20 requirements from the extended epic process were given an average rating of 3.9 or higher out of 5. The requirement with the highest rating of 4.7 was: *the [site] should serve up content based on what you're watching now, for example, "Here's Season's 1-5 available now on DVD or video on demand... so [if you want to, you can] start right from the start.* Such a high rating suggested a potential *killer* requirement that transforms a new application into an innovative one. The result revealed that the extended epic process led the team to generate some very novel *killer* requirements, some requirements that were novel and could lead to innovative change, and some requirements that were not novel.

We also applied an unpaired two-tail, unequal variance t-test to the 400 usefulness ratings collected from the 10 domain experts who independently rated the 20 requirements from the extended epic process and the 20 epics from the product backlog. The average usefulness rating given to the epics from the backlog was 3.37 out of 5 and the average novelty rating given to requirements from the extended epic process was 2.97 out of 5. A statistical analysis revealed that requirements generated from the application of the extended epic process were rated as significantly less useful than epics in the original product backlog. The result supported hypothesis H2.

4. Threats to Validity

Of course, these results are subject to potential threats to their validity [Wohlin et al. 2000]. With respect to conclusions validity, the extended epic process was open to other project influences, although this threat was mitigated by the short duration of the process during which personnel and other key factors did not change.

Threats to internal validity include the possibility that use of the extended epic process might have increased stakeholder motivation to be more creative, independent of the process stages. However, the domain experts reviewed the new requirements as documented at the end of the creativity workshop, so this effect on motivation would be limited to the *identify potential*, *understanding the challenge* and *idea generation* stages. Another obvious threat to internal validity was our decision not to compare the new requirements to requirements generated during the original epic process directly. However, the original process had previously been applied to some epics, and outcome requirements had fed back into the product backlog, so to some extent, our comparison against epics in the product backlog did take these requirements into consideration. A third threat was the use of just one independent analyst to author all 20 selected backlog epics. We acknowledge this, and sought to mitigate the threat with clear guidelines about how to write each epic in a form similar to the new requirements.

One threat to external validity was that the results reported in the paper come from just one agile project. We also acknowledge this. However, given the absence of published empirical data about creativity in agile projects, our aim was to demonstrate

feasibility rather than make general claims. Qualitative data from extending a second agile project at BBC Worldwide did support the results from this project [Hollis 2011], and others are currently using the extended agile processes in their projects. We also acknowledge that the sample of 40 requirements and epics might not have been representative of all of the requirements: the size was constrained by the number of ideas that one domain expert could rate reliably in an experimental setting.

5 Conclusions and Future Work

Cao and Ramesh [2008] reported evidence that agile processes enabled customers to steer projects to meet unanticipated requirements. In our view, this capability is necessary but not always sufficient to generate the requirements needed to innovative new software solutions. The preliminary research reported here reveals that, selecting an epic with creative potential and deliberate idea generation during a sprint can produce more requirements ranked as more novel. And although these requirements were less useful, a period to allow subsequent idea incubation during the sprint appeared to increase their potential usefulness. Our initial research suggests that agile projects can reach beyond the simplest solution without the costs often associated with upfront creativity workshops [e.g. Maiden et al. 2007]. It provides preliminary evidence that people can deliver creativity on a shoestring in agile projects. That said, not all agile projects will be seeking more novelty at the expenses of usefulness. Therefore, we recommend that creativity techniques be used in projects seeking step rather than incremental change.

So what next? Other researchers and agile practitioners are currently repeating our use of lightweight creativity techniques in other agile projects, and are encountering outcomes similar to ours. We want more practitioners of agile to use lightweight creativity techniques. So if you want to take part, let us know.

References

1. S. Ambler, *Agile Modeling: Effective Practices for Extreme Programming and the Unified Process*. New York: John Wiley & Sons, Inc. New York, 2002.
2. K. Beck, *Extreme Programming Explained: Embrace Change: Embracing Change*. 2nd edition, Addison Wesley, 2005.
3. L. Cao & B. Ramesh, "Agile Requirements Engineering Practices: An Empirical Study", *IEEE Software*, 25(1), 60-67, 2008.
4. M. Cohn, *User Stories Applied: For Agile Software Development*. Addison-Wesley Professional, 2004.
5. J. Higgins, *101 Creative Problem Solving Techniques: The Handbook of New Ideas for Business*. New Management Pub. Co, 2005.
6. J. Highsmith, *Agile Project Management: Creating Innovative Products*. Addison-Wesley Professional, 2004.
7. J. Highsmith & A. Cockburn, "Agile software development: the business of innovation", *IEEE Computer*, vol.34, no.9, pp.120-127, 2001.

8. B. Hollis, Extending Agile Methodologies with Creativity Techniques, Masters Dissertation, School of Informatics, City University London, 2011.
9. S. Isaksen, B. Dorval & D. Treffinger, *Creative Approaches to Problem Solving: A Framework for Innovation and Change*. Sage Publications, Inc; Third Edition edition, 2011.
10. N. A. M. Maiden, C. Ncube & S. Robertson, "Can Requirements Be Creative? Experiences with an Enhanced Air Space Management System", *Proceedings 28th Int'l Conf on Software Engineering*, ACM Press, 632-641, 2007.
11. M. Michalko, *Thinkertoys: A Handbook of Creative-Thinking Techniques*, (2nd Edition). Ten Speed Press, 2006.
12. N. Oza & P. Amrahamsson, *Building blocks of agile innovation*, [http://www.agileinnovationbook.com/ welcome](http://www.agileinnovationbook.com/welcome), 2011.
13. H. Poincare, *The Foundations of Science: Science and Hypothesis, The Value of Science, Science and Method*, Univ. Press of America, Washington, 1928.
14. R. J. Sternberg (Ed.), *Handbook of creativity*. New York, Cambridge University Press, 1999.
15. C. Wohlin, P. Runeson, M. Host, M.C. Ohlsson, B. Regnell & A. Wesslen, *Experimentation in Software Engineering: An Introduction*, Kluwer Academic Publishers, Boston/Dordrecht/ London, 2000.
16. K. Zachos & N.A.M. Maiden, "Inventing Requirements from Software: An Empirical Investigation with Web Services", *Proceedings 16th IEEE Int'l Conf. on Requirements Eng*, IEEE Computer Society Press, 145-154, 2008.