Creating Requirements – Techniques and Experiences in the Policing Domain

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Abstract

Processes and techniques to discover and create requirements rather than elicit and acquire them from stakeholders have received relatively little attention in the requirements engineering literature. In contrast, researchers in artificial intelligence and cognitive and social psychology have been researching creativity for some time. More recently we have applied their theories and models to requirements engineering. In this experience paper we report results and lessons learned from 2 creativity workshops undertaken with the UK's Police Information Technology Organisation, in which theories and models of creativity informed creative thinking about requirements and opportunities for bio-metric technologies in policing. The main results are presented as lessons learned for the wider requirements engineering community.

1. Introduction

Requirements engineering is a creative process in which stakeholders and designers work together to create ideas for new systems that are eventually expressed as requirements. The importance of creative product design is expected to increase over the next decade. The Nomura Research Institute [1] argues that creativity will be the next key economic activity, replacing information. Creativity is indispensable for more innovative product development [2], and requirements are the key abstraction that encapsulates the results of creative thinking about the vision of an innovative product. It is a trend that requirements engineering researchers and practitioners, with their current focus on elicitation, analysis and management, have yet to grasp fully.

In this experience paper we describe how we applied creative thinking techniques including random idea combination, analogical reasoning and storyboarding as part of a requirements process. The UK Police's Information Technology Organisation (PITO) was seeking to discover new requirements and opportunities to exploit bio-metric technologies in its applications. To this end, the authors ran two facilitated workshops in which Police stakeholders were encouraged to use techniques to think creatively and discover new requirements and opportunities. Although the workshops were a success, the results suggest that different creativity techniques were more successful than others at discovering new requirements. We report the most important results from the workshops as lessons learned that the wider requirements community can learn from and apply in their own activities.

The remainder of the paper is in 6 sections. Section 2 reports work on creativity in other disciplines and its limited application in requirements engineering. Section 3 describes PITO, its bio-metric applications and the rationale behind its 2 creativity workshops. Section 4 describes the workshops themselves, then section 5 reports the main results and section 6 the important lessons learned from the workshops. The paper ends with a brief discussion and future work for both PITO and the authors.

2. Related Work

In spite of the need for creative thinking in the requirements process, requirements engineering research has largely ignored creativity and few processes, methods and techniques address it explicitly. Brainstorming techniques and RAD/JAD workshops [3] make tangential reference to creative thinking. Most current brainstorming work refers back to Osborn's text [4] on principles and procedures of creative problem solving. The CPS method describes six stages of problem solving: mess finding, data finding, problem finding, idea finding, solution finding and acceptance finding. The model was originally intended to help people understand and use their creative talent more effectively [5]. It has been through several waves of development. To better describe how problem solving occurs, and to improve the flexibility of the model, the six stages were arranged into three groups – understanding the problem, idea generation, and planning for action. A recent CPS manual [6]

describes activities for supporting each of model stage. Examples to support combinatorial creativity include *the matrix*, which involves making lists then selecting items from each list at random and combining them to generate new ideas, and *parallel worlds*, which uses analogical reasoning to generate new ideas. However, there are few if reported applications of the CPS model in the requirements domain.

Robertson [7] argues that requirements analysts need to be inventors to bring about the innovative change in a product or business that gives competitive advantage. Such requirements are not often things that a stakeholder directly asked for. Nguyen et al. [8] have observed that requirements engineering teams restructure requirements models at critical points when they re-conceptualize and solve sub-problems, and moments of sudden insight or sparked ideas trigger these points. However, elsewhere, there is little explicit reference to creativity in mainstream requirements engineering journals and conferences.

One exception, our RESCUE scenario-driven requirements process [9], incorporated creativity workshops to encourage creative thinking about requirements and the earlier stages of design for new ATM systems. Creative activities were grounded in the referenced theories of creativity from cognitive and social psychology, then data from the workshops was analysed to determine the relevance of these theories to creative requirements processes. We designed each workshop to encourage 4 essential processes based on existing theories of creativity [10,11]: preparation, incubation, illumination and verification. We also encouraged exploratory creativity by encouraging stakeholders to reason with analogical textile design and musical composition tasks. Likewise we encouraged combinatorial creativity through random idea generation and parallels with fusion cooking [12].

The RESCUE creativity workshops benefited the requirements process in two ways. Firstly, the candidate design space reduced the number of requirements to consider by rejecting requirements that could not be met by current technologies. Secondly, high-level decisions about a system's boundaries enabled the team to write more precise use cases and generate more precise scenarios that, in turn, enable more effective requirements acquisition and specification [9]. Lessons learned from these workshops were applied in the design of the PITO creativity workshops reported in this experience paper.

3. Creating Requirements to be Satisfied by Bio-metric Technologies

PITO provides information technology, communications systems and services to the police within the United Kingdom. It gathers requirements for these systems and services from the UK Police Forces. One of the problems experienced during PITO's requirements acquisition processes is the tendency for stakeholders to think in terms of solutions that can unnecessarily constrain the system design. In order to encourage innovation in new policing systems, stakeholders need to stop thinking about solutions during the requirements process and focus on creative thinking about their business needs. As such, PITO are currently looking for methods and techniques to support their requirement engineering processes. Creativity workshops based on the RESCUE process workshops were trialed as a source of innovation for producing more creative PITO requirements and systems.

PITO trialed the creativity workshops as part of its bio-metrics program to gather requirements for bio-metric technologies as a basis for future police applications. PITO is aware of the diverse sources of new requirements for information systems, for example reports of problems with existing systems or changes in business process, but new technologies are increasingly a source for new requirements [13]. For example the existence of web technologies led the UK Police Service to develop a web site that enabled citizens to report non-urgent minor crimes on-line – this requirement would not have existed as a viable requirement had the internet not been widely available to the UK public. As such, the PITO bio-metrics program was in a position to benefit from a new approach to discovering requirements which would encourage stakeholders to think creatively.

4. Two Creativity Workshops in PITO

This section describes the 2 prototype creativity workshops that were designed and ran for PITO's bio-metrics program.

4.1. Sequence and Structure

The 2 prototype creative workshops were based on the RESCUE process workshops designed and ran by City University's Centre for HCI Design and the Atlantic Systems Guild, but tailored to meet PITO's local needs. This meant that the principles of the RESCUE workshops could be re-applied but the workshop designs could not be.

Participants: the two workshops were attended by six participants representing a cross-section of roles often involved in producing requirements for a PITO project. These participants were two technical experts (in this case 2 bio-metrics experts), two experienced police officers, and two experienced requirement analysts. The objective set for these participants was to produce new and creative ideas for the use of bio-metric technologies within the UK police service. Each participant was chosen to represent one of these domains of expertise, but each also had knowledge of at least one of the other domains.

These six people had never worked as a team before, although the two technical experts had worked together before, as had the police officers and the requirement engineers. In addition, each workshop had an experienced facilitator and a scribe. The facilitator was Neil Maiden from City University who had facilitated the earlier RESCUE workshops for the CORA-2 project. The scribe was Alexis Gizikis, also from City University, who had also scribed for some of the RESCUE workshops. Unfortunately Alexis was unable to attend the first workshop and a participant acted as the scribe. Neil and Alexis also acted as pseudo-experts in air traffic management during the second workshop as part of the analogical reasoning activity reported in section 4.4. Both had considerable exposure to and knowledge of the air traffic management domain during the RESCUE CORA-2 project with Eurocontrol. However, this role should normally be preformed by a domain expert who would have more detailed knowledge of the domain.

Environment: Both workshops took place on PITO premises in a usability laboratory that enabled them to be recorded onto video. Presentations were displayed on a large LCD Screen and 2 monitors so the images could be seen from any part of the room.

The room was set up with two tables around which two groups of participants sat. The ideas that were generated during the workshops were placed on pin boards on the walls of the room so that the participants were able to see them and add to them throughout the workshop. Sufficient room was left for the participants to move around the room during both workshops.

Facilitation: The workshops were facilitated to encourage a fun atmosphere so that the participants were relaxed and prepared to generate and voice ideas regardless of how silly they may seem, without fear of criticism. Standard RAD/JAD facilitation techniques and rules [14], for example avoiding criticism of other people's ideas and time-boxing each topic under discussion, were applied throughout both workshops.

Figure 1. The bio-metrics workshop environment

Information Capture: Participants were supplied with snow cards, post-it notes, A3 paper, felt pens and blu-tack with which to capture the results from the workshops. Everything captured on the posters was subsequently documented electronically and sent to all participants.

Workshops Agenda: Each workshop lasted 3.5 hours. The second workshop took place one week after the first one. Each workshop was divided into two distinct creative activities. There was an introduction phase at the start of the first workshop, and an interim phase in the week between the two workshops, during which the participants were encouraged to undertake further creative thinking as input into the second workshop. The timings, structure, activities and deliverables of the most activities from the two workshops are shown in Figure 2.

Timings and Activities	Activity Description	Intended Outcome
Workshop 1, 30mns Introduction	Introduce creativity. Define creativity. Elicit participants' opinions about creativity.	Participants have a shared understanding of creativity as a starting point for the workshops.
Workshop 1, 30mns The how, why and where of people identification in policing	Participants brainstorm current ways that the police services identify people and the problems that occur when identifying people.	Knowledge of how, where and why the police services currently identify people. A baseline for subsequent creative thinking in the 2 workshops.
Workshop 1, 60mns Combinatorial creativity by combining current ideas together	Participants combine the problems identified in the previous activity with capabilities provided by bio-metric technologies as identified by the technology experts.	Participants start finding new ideas for how biometrics can help solve policing problems, from combinations of known and new ideas and technologies.
Workshop 1, 30mns Prioritising the new ideas from the preceding activities	Participants vote on the ideas generated from the first workshop, as a basis for focusing creative activities in the second workshop.	A prioritised list of ideas generated from creative thinking in the first workshop.
Between workshops Interim activities	The participants are encouraged to continue the combinatorial creativity activity between the workshops.	Participants continue finding new ideas for how biometrics can help solve policing problems, from combinations of known and new ideas and technologies.
Workshop 2, 75mns Analogical reasoning with a similar domain	The participants reason analogically about an air traffic management domain in order to create new ideas for a policing system.	Participants understand their domain from a different perspective, and generate new ideas for their domain from that perspective.
Workshop 2, 75mns Generate storyboards that encapsulate all creative ideas from the 2 workshops	The participants construct structured storyboards that depict scenarios that include as many ideas as possible that were generated during the preceding activities.	Complex and rich storyboards that integrate the created ideas into coherent potential solutions.

Figure 2. The agenda for the 2 workshops

Each workshop was designed to support the divergence then convergence of ideas as described in the CPS model [5]. Each workshop began with one divergence activity (random idea generation, analogical reasoning) and ended with one converge activity (idea voting, storyboarding).

The following sections describe some of these key activities, and relevant background literature, in more detail.

4.2. Brainstorming: How to Detect People

Nickerson [15] reports that one of the earliest attempts to develop a structured approach to the enhancement of creativity started with the promotion of brainstorming by Osborn. Brainstorming is intended to allow participants to produce lots of ideas and to enable their imagination to be stimulated by others ideas. It relies on creating an environment in which participants feel free to suggest any idea without fear of criticism. This can be difficult if the participants have only just met and may take a little time to get going. The PITO brainstorming activity was in 2 parts. In the first participants were asked:

- How do we (the police) identify people (e.g. by recognising face or voice)?
- Why and where do we identify people?

Answers were intended to focus participants on and share knowledge about the business domain. Using answers to these questions the participants were then asked to brainstorm answers to the question:

- What problems do the police have with identifying people?

The purpose of this was to focus the participants on the problems to be solved later in the workshops.

4.3. Combinational Creativity

Combinational creativity is, in simple terms, the creation of new ideas from combination and synthesis of existing ideas. As Boden [16] describes, models of creativity fall into two broad categories, because creativity itself is of two types. The first type is combinatorial creativity, where the creative act is an unusual combination of existing concepts. Examples of combinatorial creativity are poetic imagery, free association (e.g. viewing the sun as a lamp), metaphor and analogy. Combinatorial creativity is characterised by the improbability of the combination, or in other words, the surprise encountered when such an unusual combination is presented. Association and analogy are the main mechanisms for combinatorial creativity. Association is the recognition of similar patterns in different domains, sometimes in the presence of noise or uncertainty. The association may be retained and reinforced either by repetition or by systematic comparison of the internal structures of the two concepts. Koestler [17] describes association as the "biosociative act that connects previously unconnected matrices of experience". He states that most creative moments in science are the result of recognising a novel analogy between previously unrelated fields.

Combinatorial creativity by association was applied in the first workshop to create new ideas based on the problems and ideas generated in the preceding brainstorming session. Participants were familiarised with the combinatorial creativity process using an example from the RESCUE workshops, in which the organisers invited a fusion chef to talk about combining unusual ingredients, and to demonstrate fusion cooking. In our workshop the participants worked in 2 groups to generate new ideas to enable police services to identify people more effectively. Throughout the activity the facilitators randomly introduced new biometrics technologies that the participants had to include in the new ideas. The outcome was 2 sets of ideas that incorporated unusual bio-metric technologies in previously unforeseen ways.

4.4 Analogical Reasoning

Analogical reasoning is a useful but challenging technique for creative thinking. Analogical reasoning has been the subject of extensive research in both cognitive science and artificial intelligence. However, studies of analogical problem solving suggest that similarity-based reasoning is difficult [18]. Recognising analogies often needs syntactic similarities between problems [19] while inducing mental schemata during analogical matching has proven difficult even for expert software engineers [20].

We have already investigated analogical reasoning in requirements engineering. We define 2 requirement domains as analogous if the domains share a network of knowledge structures that describe goal-related behaviour in both domains [20]. Studies have shown that people can exploit such analogies to reuse requirements if they are given support to recognise, understand and transfer the analogies [20]. In the creative workshops we provided this support but encouraged the participants to go one step further and use the transferred knowledge from the non-policing domains to provoke creative thinking about requirements ideas in the bio-metrics policing domain.

We encouraged analogical reasoning to think creatively about one use of bio-metrics technologies that was prioritised as important by the stakeholders – detecting and monitoring the movement of people in crowds using technologies such as CCTV. The facilitators applied the NATURE Domain Theory [21], of which one of them was an author, to identify and elaborate an analogical match with air traffic management (ATM). Both domains are prototypical instantiations of 3 key NATURE object system models:

- OBJECT SENSING: detecting the complex movements of remote objects in the environment;
- AGENT MONITORING: agents monitor the movement of objects in a remote space;
- OBJECT-AGENT CONTROL: a designed agent seeking to control the movement of remote objects to achieve the goal state of keeping the objects apart in space and time.

The participants again worked in 2 groups of 3 participants. The facilitators encouraged analogical reasoning in 2 stages:

1. Identify and list mappings between agents, objects, actions, constraints and goals in the 2 domains;
2. Use each mapping in turn to generate one or more new ideas about the policing domain by transferring knowledge about problems or solutions from the ATM domain.

To support this process the facilitators used a simple example of analogical reuse between the two rental domains shown in Figure 3. The new ideas were recorded on snow cards and shared between the 2 groups at the end of the activity.

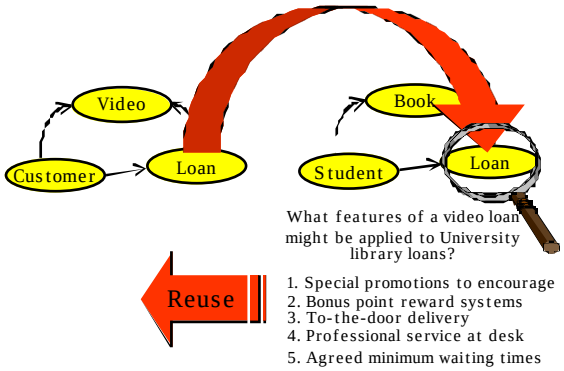

Figure 3. The rental example used to demonstrate and explain analogical reasoning to the participants

4.5 Storyboards

Storyboarding is a technique that is often used to elaborate creative ideas without constraining the creative process. Participants again worked in 2 groups of 3 participants. Each group was asked to produce a storyboard that described the integration and practical implementation of the ideas generated during the earlier analogical reasoning activity and documented from earlier activities. A practical idea was one that could be implemented in the next 5 years. As such the 2 storyboards were the culmination of the creative process during the 2 workshops, encapsulating many of the creative ideas generated during them.

To structure the storyboarding process each group was given A1-size pieces of paper which were annotated with 16 boxes to contain a graphical depiction of each scene of the storyboard and lines upon which to describe that scene. Examples of a blank and a completed storyboard are shown in Figure 4.

4.6 Expert Presentations

Creative thinking requires knowledge from other sources to be successful. One premise behind the workshops is that most people are creative. More creative thinkers search for new ideas by manipulating the knowledge and experience to see different problems, opportunities and solutions. Therefore we used short expert presentations to communicate the relevant domain knowledge to the participants. Each workshop had one such presentation. In the first workshop, one of the bio-metrics experts gave a 15-minute presentation of available bio-metric technologies – these technologies were then used in the subsequent combinatorial creativity activity. In the second workshop, the facilitator gave a 15-minute presentation on air traffic management systems based on his considerable expertise in this analogical domain.

5. Results from the Workshops

Both workshops took place and ran to schedule. All planned activities were followed without participant disruption or disagreement, thus making workshop management a relatively straightforward activity. Throughout both workshops we successfully applied standard facilitation rules and guidelines, for example ensuring and controlling all stakeholder involvement. The strong use of the reported techniques meant that potential conflicts about requirements and ideas from different stakeholders arose within each technique, were discovered across groups during presentations, and were resolved during voting at the end of the workshop.

The brainstorming session revealed 18 basic problems that needed to be overcome using bio-metrics technologies. These were: reliability, disguise, quality of information, legislative constraints, admissibility, cost budget, time, resources, memory, limitations of the technology (lack of automation), face blindness, linking to other systems, limitations (human memory, organisational, technological), individual differences, time limitations, sharing of knowledge, false memories, and change of appearance. These problems provided the baseline for subsequent creative thinking in the workshops.

All of the creative activities were undertaken. Both groups combined different problems and bio-metric technologies together according to random permutations generated by the facilitators to generate new ideas. Both groups reasoned analogically with the ATM to generate new ideas about people sensing and location systems in the policing domain – see the example analogical mapping table in Figure 4. Both groups also produced structured storyboards using all of the ideas – as shown in Figure 5.

Air Traffic	Policing
Norm = pattern – identifying abnormalities	Searching for norms and patterns to search for abnormalities
Surveillance space activities produce a trigger	Alert and face recognition/CCTV system from motion on a scene
Radar	CCTV
Mid air collision	Unusual group of people. Man U versus Spurs fans

Figure 4. Example analogical mappings produced by one of the groups

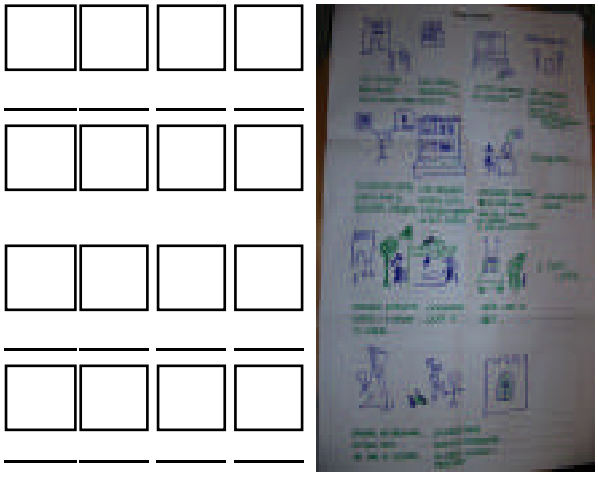

Figure 5. A blank and completed storyboard template from the second workshop

The 2 workshops generated a total of 29 new ideas for using bio-metric technologies in PITO applications – 14 in the first workshop and 15 in the second. The ideas from the second workshop tended to be more complete and developed than those from the first. Figure 6 shows the first 4 ideas from either workshop, to demonstrate this difference in the quality of the ideas.

1. Suspect
   Link with scene CCTV-Bio-metric
   Tracking – CCTV – Bio-metric
   Post event Analysis
2. Monitor Event
   2.1. On-line
   2.2. Face in crowd
3. Biometrics in the use of travel e.g. driving into London
4. The use of biometrics on the roadside may shift the balance of a business process

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1. Reducing paper while maintaining non-repudiation work by using a biometric signature instead of having to print off hard copies which can be signed.
2. Biometric device on a digital camera confirms that scene of crime officer was the person who took that picture at that time.
3. Human rights – A person uses their biometric to release their own information to prove to the police who they are. The person therefore makes the choice whether to release that information.
4. The police could make use (in the form described in 3) of biometrics captured by private organisations for the persons convenience e.g. supermarket privilege card. The public may be less resistant to this then the idea of the police or Home Office keeping this information.

Figure 6. The first 4 ideas generated from the first and the second workshop – ideas from the first workshop are above and ideas from the second workshop are below

Post-workshop interviews conducted with all of the 6 participants individually within 24 hours of the end of the second workshop revealed their perceptions about the level of creativity of the ideas. Of the 29 ideas, 25 were considered by at least one participant to be creative. However, participants had quite different views about what makes an idea creative. For example, one participant believed that a creative idea must be surprising but not necessarily useful. Another practical and another felt that to be creative the idea must not have existed before anywhere in any domain.

Figure 7 shows the number of ideas that each participant thought was creative. The participants identified more creative ideas from the analogical reasoning and storyboarding activities in the second workshop than from the brainstorming and combinatorial creativity activities in the first workshop. Another difference is the level of agreement between participants as to which ideas were creative. No more than two participants agreed that a particular requirement from the first workshop was creative, however most of the ideas from the second workshop which were identified as creative had at least 3 three participants in agreement.

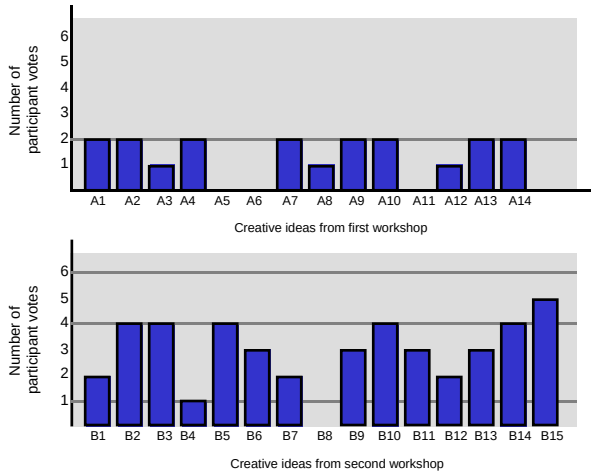

Figure 7. Creativity of ideas produced during the workshops

Although the workshops as a whole were seen to be successful, the post-workshop interviews revealed that the effectiveness of the activities varied. Participants claimed the analogical reasoning activity was particularly effective, even though it was new to the participants, which caused some of them to have reservations at the beginning of the activity. The storyboarding activity was also used to good effect. In contrast, the combinatorial creativity activity did not appear as effective at producing creative ideas. However, the fact that the two activities that produced the most creative ideas took place in the second workshop suggests that the activity ordering within the workshops could be a factor.

The brainstorming activity in the first workshop was intended both to stimulate creative thinking and to provide participants with the pre-requisite knowledge about the bio-metrics domain. The importance of allowing time for activities that encourage both

knowledge building and team building may be supported by the fact that the outcome of the combinatorial creativity, which also took place during the first workshop, was knowledge building rather than creative ideas as intended.

All participants agreed that they would consider running this type of workshop in the future due to the potential benefits that it can provide to PITO's requirements engineering processes. This suggests that, from a practical point of view, whether or not the workshops generated genuinely creative ideas was less important than the fact that the workshops enabled participants to produce ideas for requirements that would not normally have been elicited.

6. Lessons Learned

In this section we describe 5 lessons learned from the creativity workshops that both inform PITO's future use of creativity workshops in their requirements processes and provide more general lessons learned from this experience paper. Space precludes the inclusion of detailed data that underpins each lesson learned. Rather each lesson is presented as process advice that the reader can use in planning and running creativity workshops.

6.1. Explicitly Encouraging Creativity Works

In PITO the 2 prototype creativity workshops succeeded in encouraging the participants to generate new ideas for policing applications that they believe would not have generated using existing requirements processes in the organisation. As such the ideas generated were new to the participants were often new rather than radical and innovative – nonetheless this was perceived by the participants as valuable to PITO. Requirements acquisition techniques often lead to divergent activities [22], in which requirements engineers seek to elicit, acquire, surface, discover and create as many new stakeholder requirements as possible. In this regard the creativity workshops enhance the divergence of requirements early in the requirements process.

6.2. Creative Thinking Needs to be Built Up

Results from the retrospective interviews with the participants suggested that the second workshop was more successful at creating ideas than the first, in that more participants believed that more ideas generated in the second workshop were creative. A similar result was found in the RESCUE workshops – the first workshop involved several periods in which the participants cleared the air and understood each others' positions, before effective creative thinking could take place [9]. This finding, combined with our observations and anecdotal evidence from the 2 workshops, suggests that creative thinking requires a period of preparation and incubation [11] during which the participants build up knowledge of the problem domain, a team approach, and confidence in each others' abilities. Therefore, do not expect to encourage creative thinking from the start – it takes time to happen.

6.3. Making People Uncomfortable Can Make Them Think Differently

The 2 workshops placed the 6 participants in an unusual environment, working with different people with different roles in PITO to undertake unusual tasks. During some workshop activities some of the participants found the experience uncomfortable – some found it challenging to reason analogically, while others were not used to being told to combine problems, ideas and technologies together against the accepted rules and constraints of the domain. However, responses obtained during the retrospective interviews suggest this discomfort might be essential for creative thinking. The creative activities have the advantage of shaking people out of tried and tested ways thinking about requirements – an important precursor to creative requirements engineering.

6.4. Analogies Worked for Some People

The introduction of the analogical reasoning activity using the ATM domain was greeted by some skepticism from the participants. However, once explained, the analogical reasoning worked well for some participants, but not others. Some participants demonstrated the ability to create analogical mappings and transfer knowledge between the domains using these mappings, while others could not. Previous research suggests that analogical reuse is cognitively difficult [20]. This experience supports that, but reveals that effective facilitation of the mapping process as described in this paper can enable some participants to exploit analogical reasoning very effectively. Structure is critical, in contrast to our previous experience. Step-wise, very structured approach to creativity, leaving little to chance. Mapping-by-mapping reduces cognitive effort, but nonetheless difficult for some people, so allow for individual differences.

6.5. Storyboarding Worked for Some People

The storyboarding activity was successful in both groups, however one group was able to use storyboards more quickly and effectively than the other. There is a range of possible reasons for this, and we do not have all of the data needed to analyse them. However one observation of this activity was that the more successful group quickly allocated roles to the participants – one participant led the storyboard authoring process, even producing a storyboard of the storyboard in order to structure ideas. The second participant acted as a critic to the storyboard as it was developed, while the third participant, who had good

artistic ability, produced the storyboard in response to instructions from the first 2 participants. In contrast, the other group delayed the start of its storyboarding due to an uncertainty over the structure of the story, and differences of opinion about how to draw the storyboard. Future storyboarding activities should impose a clear structure and role allocation on groups to provide a framework for the thinking creatively and documenting the results of that thinking. Indeed, this apparent dichotomy runs throughout our ongoing planning of creativity workshops – the more successful you want the workshop to be, the more background planning and control is needed to ensure that the right style of creative thinking is encouraged.

7. Conclusions and Future Work

This experience paper reports the prototyping of adventurous creativity workshops in a real-world project funded by PITO, the owner organisation. The main finding was that the workshops were effective, in that both generated new ideas that might not have emerged using more traditional requirements acquisition techniques. . The workshop results were accepted by PITO as useful. Retrospective interviews revealed the benefits of some of the activities to the participants.

The improved design of the workshops overcame some of the reported problems in the earlier RESCUE creativity workshops, for example more facilitation for analogical reasoning and structure for storyboarding [9], suggesting that our understanding of how to encourage creative thinking about requirements is increasing. More specifically, some techniques more successful than others. During creative thinking it is important to allow for individual differences between people. One solution is to design in complementary but overlapping techniques might be useful.

We will apply the results and lessons learned from these workshops to a new series of RESCUE creativity workshops as part of a process with Eurocontrol to determine requirements for a Departure Manager system for major European airports. More generally the experience, as part of an effort to improve requirements processes in a large UK organisation, reveals both the opportunities and benefits from thinking about requirements engineering as a creative process. It is one more brick in the wall of evidence that the requirements engineering community needs to think about requirements processes in new and exciting ways.

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References

1. Nomura 2001, http://members.ozemail.com.au/~caveman/Creative/Admin/crintro.htm
2. Hargadon A. & Sutton R.I., 2000, Building an Innovation Factory, Harvard Business Review, May-June 2000.
3. Floyd, C., Mehl, W.-M., Reisin, F.-M., Schmidt, G., & Wolf, G. (1989). Out of Scandinavia: Alternative Approaches to Software Design and System Development. Human-Computer Interaction, 4(4), 253-350.
4. Obsorn A.F., 1953, 'Applied Imagination: Principles and Procedures of Creative Problem Solving', Charles Scribener's Sons, New York.
5. Isaksen, G. & Dorval, K. (1993) Changing views of creative problem solving: Over 40 years of continuous improvement. ICN Newsletter. 3 (1).
6. Daupert, D. (2002) The Osborn-Parnes Creative Problem Solving manual. Available from www.ideastream.com/create.
7. Robertson J., 2002, 'Eureka! Why Analysts Should Invent Requirements', IEEE Software July/August 2002, 20-22.
8. Nguyen L., Carroll J.M. & Swatman P.A., 2000, "Supporting and Monitoring the Creativity of IS Personnel During the Requirements Engineering Process," Proc. Hawaii Int'l Conf. Systems Sciences (HICSS-33), IEEE Computer Society.
9. Maiden N.A.M., Jones S. Flynn M., 2003, 'Innovative Requirements Engineering Applied to ATM', to appear in the ATM'2003 Conference, June 2003, Budapest.
10. Hadamard, J., 1954, 'An essay on the psychology of invention in the mathematical field', New York: Dover.
11. Poincare H., 1982, The Foundations of Science: Science and Hypothesis, The Value of Science, Science and Method, Univ. Press of America, Washington 1982.
12. Maiden N. & Gizikis A., 2001, 'Where Do Requirements Come From?", IEEE Software September/October 2001 18(4), 10-12.
13. Stevens R., Brook P., Jackson K. & Arnold S., 1998, 'Systems Engineering: Copying with Complexity', Prentice-Hall.
14. Andrews D.C., 1991, 'JAD: A Crucial Dimension for Rapid Applications Development', Journal of Systems Management, March 1991, 23-31.
15. Nickerson, R.A. (1999) Enhancing creativity. In The handbook of creativity, edited by R.J. Sternberg (New York: Cambridge University Press) 392-430.
16. Boden M.A., 1990, The Creative Mind, Abacus, London
17. Koestler, A., 1964, The Act of Creation, London Hutchinson.
18. Gick M.L. & Holyoak K.J., 1983, 'Schema Induction & Analogical Transfer', Cognitive Psychology 15, 1-38.
19. Ross B.H., 1987, 'This is Like That: The Use of Earlier Problems and the Separation of Similarity Effects', Journal of Experimental Psychology: Learning, Memory and Cognition 13(4), 629-639.

20. Maiden N.A.M. & Sutcliffe A.G., 1992, 'Exploiting Reusable Specifications Through Analogy', Communications of the ACM. 34(5), April 1992, 55-64.
21. Sutcliffe A.G. & Maiden N.A.M., 1998, 'The Domain Theory for Requirements Engineering, IEEE Transactions on Software Engineering, 24(3), 174-196
22. Maiden N.A.M. & Rugg G., 1996, 'ACRE: Selecting Methods For Requirements Acquisition, Software Engineering Journal 11(3), 183-192.