The Role of the User Story Agile Practice in Innovation

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Abstract. The concept of an innovation space where different knowledge and perspectives can interact leading to innovation is central to lean thinking. The SECI framework of organizational knowledge creation identifies five enabling conditions which impinge on this space, namely intent, autonomy, fluctuation, redundancy and variety. User Stories, introduced in XP and now commonly used in Scrum, are a key practice in requirements capture. In common with lean thinking, they are user value centric, encourage rich dialogue between project stakeholders and avoiding premature specification of solutions. This conceptual paper examines user stories through the dual lenses of an innovation space and the five SECI enablers. The authors conclude that expressing user needs as user stories can support the development of innovative solutions, but that care must be taken in the design of the user stories and their application. This paper concludes with a set of recommendations to support innovation through user stories.

Keywords: agile methods, user stories, innovation space, lean thinking, knowledge creation, SECI

1 Introduction

One of the seminal events for the development of the agile software development movement was the 1986 publication in Harvard Business Review of "The New New Product Development Game" (Nonaka and Takeuchi 1986). Describing lean production principles applied to new product development, the paper introduced the metaphor of a rugby team where a clear goal, overlapping skill sets and joint accountability allow teams dynamically adapt and self-organize to achieve their objectives despite unforeseen setbacks and challenges. From this, the term scrum was used by Sutherland and Schwaber in 1995 to describe an incremental, team based approach to software development. In this way, agile development and innovating new products share a common lineage.

Agile methods have long been advocated in supporting innovation (Highsmith 1999). Proponents argue they explicitly call for self-reflection and improvement of the method through retrospection. Close customer contact and an understanding of the business problem to be solved can help the development team create more innovative solutions than if they were coding to a static functional specification. Advocates have written of 'hyper-productive' scrum exhibiting 'punctuated equilibrium' leading to discontinuous or radical innovations (Sutherland, Downey et al. 2009).

User stories are a common practice in agile methods for feeding user requirements into the development process. Unlike traditional requirements engineering approaches, they do not call for comprehensive specification of the solution 'up-front' but instead encourage rich dialogue between customers and the technical team at implementation time to arrive at the best solution. As the name implies, user stories express user centric functionality, and are written in a story style. They reflect what the user would like the system to do, rather than how it should do it.

This lack of specificity introduces considerable uncertainty and ambiguity to requirements management. Both uncertainty and ambiguity are held to foster innovation and are considered essential ingredients in developing novel solutions and supporting organizational learning (Kline and Rosenberg 1986; Nonaka 1991; Lester and Piore 2004). Deploying these elements in an innovation space, 'ba' (Nonaka 1991) or 'conversation' (Lester and Piore 2004), along with other recognized innovation enablers (Nonaka 1991) suggests the user story practice should support innovation. However, as far as we are aware, little rigorous research has focused on how exactly user stories facilitate innovation. Using the concepts of an innovation space and the organizational knowledge creation framework (Nonaka and Takeuchi 1995) – commonly referred to as SECI after its four core processes of Socialisation, Externalisation, Combination and Internalisation, this paper will examine further how user stories enhance the ability of agile methods to support innovation. The aim of the paper is to establish aspects of user stories that are likely to support the emergence of innovative solutions from the agile development team.

Section 2 describes the concept of an innovation space and summarizes some of the approaches to it described in the literature. Section 3 provides an overview of the SECI framework, particularly the 5 enabling conditions necessary for organizational knowledge creation, while section 4 describes the agile user story practice in further detail. Section 5 then discusses how this practice provides an innovation space and supports and constrains the 5 enablers. This discussion draws on both the authors experience as agile practitioners, and on theoretical arguments. Finally, section 6 summarizes conclusions and recommendations for the use of user stories in supporting innovation within Information Systems Development (ISD) teams. Note that this paper is conceptual in nature and these conclusions have yet to be tested empirically.

2 Innovation Space, Knowledge Creation and Variability

The concept of an 'innovation space' (Figure 1) is widely evident in the literature. It represents a mental space where an understanding of both the problem to be solved and the components of a solution available can be brought together to create an environment where a more innovative solution can emerge (Hippel 2005). An associated concept is that of boundary objects (Carlile 2002) which serve as *"as a means of representing, learning about, and transforming knowledge*" across boundaries, such as the problem and solution domains. Agile user stories can be used to create an innovation space and serve as boundary objects in supporting innovation. This section explores these concepts further with the aim of examining exactly how user stories can positively impact innovation.

In plan-driven ISD methods, the problem and solution domains are represented by two different functions in the organization, and usually by two different teams with different skill sets. The problem is articulated by customers, users and analysts, usually in terms of a solution which they believe will solve the problem. That is, requirements are normally expressed in terms of software features described in various levels of detail, even down to screen layouts, data fields and menu structures. This is passed to the designers, developers and operations teams who implement such a solution based on the technologies available. In this case the innovation space can be very restricted – the requirements as expressed can reflect a limited understanding of the possible opportunities offered by the available technologies. This in turn leads to sub-optimal solutions which can reflect previous patterns of application already familiar to those in the problem domain. The technologists similarly gain little understanding of the business problem being addressed, and therefore are not in a position to pursue alternate, more effective solutions offered by the solution space but not considered by the customer. This reflects the demarcation of roles underpinning many traditional product development methods which results in a tendency to identify 'what' the customer wants, rather than 'why' the customer wants it (Reinertson 1998). Indeed, many waterfall methods explicitly advocate the separation of the problem and solution spaces by requiring full and final requirements be 'signed-off' by the customer or business. Even the term 'requirement', used universally to mean features to be included, implies they are mandatory and non-negotiable (Cockburn 2007). This is accompanied by 'change management systems' which minimize variability in the design, development and delivery phases. In summary, waterfall methods do not nurture an innovation space – on the contrary, they tend to severely restrict or even eliminate it.

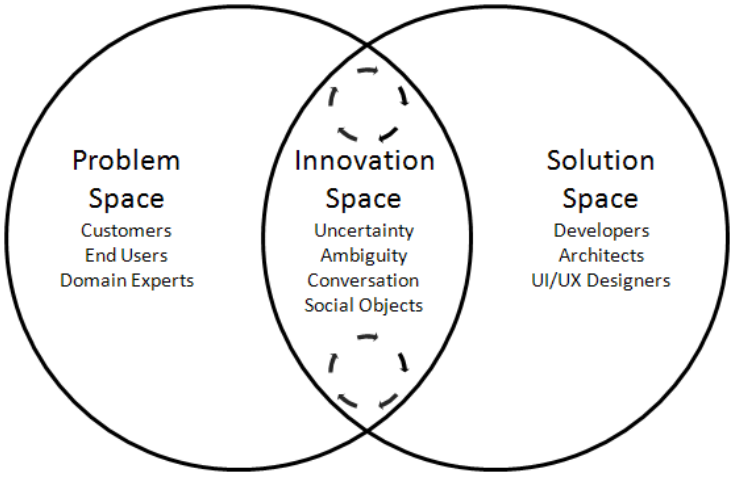

Figure 1 Innovation Space

In knowledge creation literature, Nonaka and Konno introduce the concept of 'ba' which they describe as "a shared [physical, mental or virtual or any combination] space for emerging relationships" for the purposes of knowledge creation (Nonaka and Konno 1998). Building on this existentialist concept they contend that

knowledge exists in a tacit, intangible form within ba and becomes information when detached from it. Ba is the "frame […] within which knowledge is activated as a resource for creation" and is essential to both individual and collective knowledge creation and therefore learning. Lean thinking argues that the objective of product development is to 'out-learn the competition' (Reinertson 1998) indicating that knowledge creation, and the associated 'ba', is essential for product innovation.

Innovation and product development literature also highlight the importance of uncertainty and variability in innovation. The chain-link theory of innovation (Kline and Rosenberg 1986) stresses the iterative nature of the innovation process, rejecting the linear, deterministic model driven by scientific discovery and invention and underlying the traditional R&D organizational structure and process. Uncertainty is an inherent trait in innovation and structures or processes which try to constrain or deny it have been thoroughly discredited. This view is further developed in information theory which positively values variability, and consequently 'failure' in terms of not conforming to predetermined plans, as being the source of information creation (Reinertson 1998). The value of such information is increased where it is created early and is efficiently absorbed and used in creating new knowledge which can contribute to innovation. Indeed, a process without variability cannot create new information, and cannot therefore develop new learning and products. That is, while repeatability may be a virtue in production, it renders development utterly sterile.

Another concept contributing to innovation is that of ambiguity and the conversation required to resolve it (Fonseca 2002; Lester and Piore 2004). Precise specification of a requirement limits or even eliminates the opportunity to interpret it from a different perspective. Ambiguity can be used positively to accommodate the variability essential to innovation. Progressing from such ambiguity to a precise specification involves conversation between those representing the problem and the solution domains.

From the above we can see that innovation and knowledge creation literature identify an 'innovation space' as a key element in arriving at novel solutions. This space brings together and activates knowledge from both the problem and solution domains and nurtures productive conversations which leverage variability and ambiguity to arrive at novel solutions. We discuss later how the user story practice can be used to enable many of these factors in ISD. One specific description of an innovation space is ba which forms part of the SECI knowledge creation framework and is discussed next.

3 Organizational Knowledge Creation

The SECI theory of organizational knowledge creation has enjoyed "paradigmatic status" (Gourlay 2003) since first elaborated by Nonaka and Takeuchi (Nonaka and Takeuchi 1995). In the following text the major components of the theory are described, focusing particularly on the five "enabling conditions" which support an innovation space, or ba.

SECI is based on two underlying constructs. Epistemologically there exist two forms of knowledge – tacit and explicit. Ontologically, knowledge is formed by individuals and the interactions common within organizations which can develop, refine, clarify and amplify it. Using these two 'dimensions' of knowledge creation, SECI proposes a spiral model where tacit and explicit knowledge are in continuous dialogue within a ba, transforming through the four processes of socialization, externalization, combination and internalization.

Socialization represents conversion of knowledge from tacit to alternate tacit forms and can occur through shared experience (for example apprenticeship). This can rarely be achieved through abstracting knowledge into an external form, can even occur without language and therefore requires close face to face interaction. *Externalization* uses metaphors to convert tacit knowledge to explicit form – it is the articulation of knowledge. The writing of poetry could be regarded as a highly sophisticated example of this whereby complex and nuanced knowledge is transferred through metaphor to an explicit form for communication to others. *Combination* of multiple externalized knowledge sources through meetings and conversations can lead to the creation of new knowledge by bringing together existing explicit forms. Finally, *internalization* involves the conversion of explicit knowledge to a tacit form through 'action based' learning. Taken together, these transformations create, develop and disseminate knowledge within the various organizational levels from individuals to entire value chains.

SECI identifies 5 enabling conditions (Figure 2) for these processes, and the ba in which they occur. For an individual to acquire knowledge, Nonaka proposes they must be 'committed'. That is, they must have an *intention*, an action oriented concept which forms their approach to the world. The value of information, and the knowledge to which it can contribute, depends on the intention of the receiver, and not purely on the nature of the information itself. Therefore, the perception, context and prior knowledge of the individual affect the possibility and form of meaning derived from it. Additionally, *autonomy* at both individual and group level is essential to provide the freedom to absorb new knowledge – this does not need to be absolute freedom, but reflect a 'minimum critical specification' (Morgan 1986). Autonomy reflects empowerment where authority, guided by a clear understanding of intention, is delegated to where it can be most effectively exercised. Thirdly,

knowledge creation requires *fluctuation* whereby there are discontinuities in the interaction of an individual's knowledge with their perceived reality, leading to the re-evaluation of assumptions underlying their current knowledge. Such breakdowns or contradictions therefore contribute to the creation of new knowledge. Fourthly, *information redundancy* facilitates efficient knowledge flow and absorption, as well as empowerment of the team through participation of members on the basis of consensus and common understanding. This reflects the use of knowledge to facilitate the absorption of additional learning which can in turn enable innovation (Cohen and Levinthal 1990). Redundancy also creates resiliency within the team through the "principle of redundancy of potential command" (McCulloch 1965 quoted in Nonaka and Takeuchi 1995) and supports the development of trust between team members. And finally, SECI proposes Ashby's principle of '*requisite variety*' (Ashby 1957) in balancing the creation of knowledge and its effective processing. According to this principle, the diversity of knowledge at any point in the organization should match the diversity it must process.

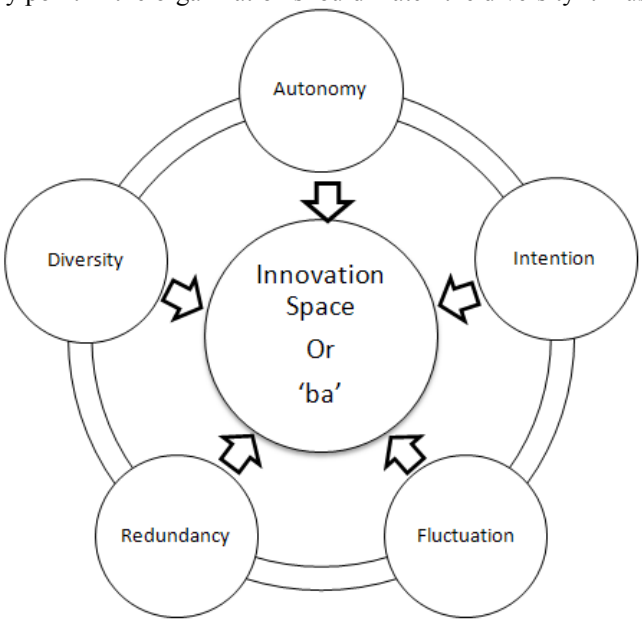

Figure 2 SECI Enabling Conditions

The SECI theory is pre-dominant in the field of knowledge creation. It provides a comprehensive framework for the evaluation of the agile practice of user stories in creating an innovation space and enabling that space for knowledge creation and innovation.

4 Agile Practice – User Stories

The concept of user stories were first introduced to software development with the publication of Kent Beck's eXtreme Programming book in 1999 (Beck 1999). User Stories represented a technique of establishing a shared understanding of software requirements using a low-overhead, user centric and flexible approach. This concept was later developed further and extended to apply to other agile methods such as scrum (Cohn 2004). Although not universally accepted as the best way to capture software requirements (Cockburn 2007) they are widely used and are therefore treated here as a common agile practice.

The user story format has three elements often articulated as Card, Conversation and Confirmation (Jeffries 2001). The *card*, so called as its often written on an index card, is a small number of sentences used to describe the intent of the story. The card serves as a token, summarizing intent and acting as a placeholder for a conversation which will elaborate on the detail closer to the time it is required. As implied by the name user story, this description should be both user centric in terms of the language used and the need expressed. It should be written in the form of a story. A format commonly used by agile teams takes the form '*As a <role> I want to <action> so that <result>*'. An example would be "*As an online customer I want to enter a product name so that I can view details of that product*". The card can also capture initial estimates of the value of the story to the customer and the cost in implementing it. The *conversation* represents a discussion between the team, customer, end users and other stakeholders, which clarifies the details of the requirement and frames the solution design to be used. The term conversation reflects the verbal nature of the interaction – negotiation around the requirement is through rich, highly interactive dialogue, using a shared vocabulary understandable by both customers and the development team, and not necessarily resulting in written specification. *Confirmation*

represents the acceptance criteria or tests which must be satisfied before the story can be considered fully implemented. Unlike the conversation, such tests are normally written down for later reference (often on the reverse of the story index card), though ideally they represent the intent agreed rather than precisely how a feature will be implemented. By ensuring these tests pass, the development team should be confident that the value of the story has been delivered to the customer.

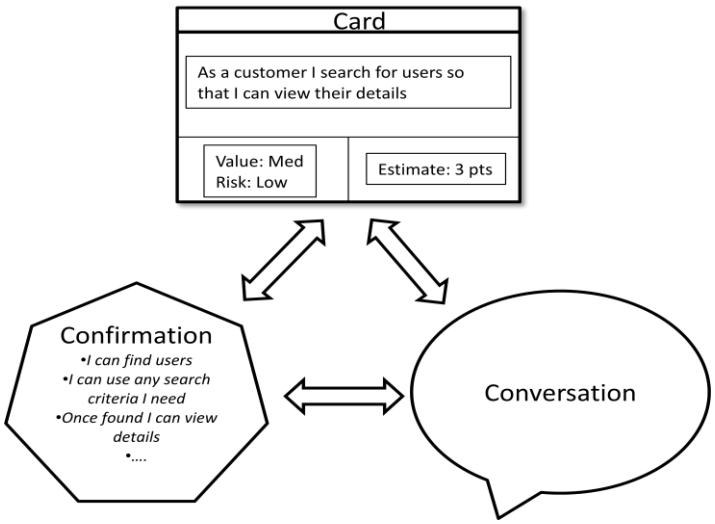

Figure 3 Elements of a User Story

The user story format is advocated in agile methods as it is lightweight, reduces design in process, encourages late commitment, facilitates iteration planning and supports a shared understanding of the business value and design of software features. The latter of these concerns knowledge creation in an innovation space and will be discussed further in terms of the effect of the user story technique on innovation.

5 Discussion

User stories support the coming together of problem and solution domain knowledge in a shared innovation space, or ba. The user story card holding a summary of the intent, and optionally, an initial estimate of effort and value, is used primarily for planning purposes – it is not intended to be sufficient for implementation. It is the conversation represented by the card which positions the 'whole team' (Beck 2005) to develop a shared mental model of the optimum solution based on a mutual understanding of the problem and solution domains. This conversation within the cross-functional team should include all perspectives and skills, including the customer, product owner, designers, developers and other stakeholders. By representing the requirement in terms of the customer's intent, a user story card maintains the ambiguity and uncertainty until the solution space can be appropriately explored – the opportunity to arrive at a novel solution is not closed down prematurely.

In evaluating the capability of the user story practice in creating new knowledge and innovation, the five enabling conditions proposed by SECI are here used as a lens.

Intention: The user story is designed to capture only the *intent* of the user at a high level – a succinct description in one or two sentences of what the user wants to achieve, and a set of criteria to help determine if the need has been satisfied. This contrasts with traditional requirement specification techniques which encourage the comprehensive specification of the *solution* by those in the problem space (usually the customer or end user), leaving little room for negotiation, learning or participative and emergent design. User stories communicate the business intent clearly to those with the technical skills to design a solution. That is, a user story expresses the *intention* of the user and is a simple mechanism to place that intention within the innovation space, where various stakeholders can interact through the conversation and arrive at a mutually agreed solution.

Autonomy: Within the conversation on a user story the design approach and exact scope can be negotiated by those that best understand the constraints and solution technologies. Autonomy supports self-organization and accountability, which in turn helps motivate individuals to work together to find better solutions (Nonaka 1991). The conversation provides the space in which this autonomy can be exercised. The accountability conferred on the team by this same autonomy can also lead to fluctuation, as a sense of responsibility for developing an effective solution motivates the team to evaluate novel approaches.

Fluctuation: With the rich interactive communication surrounding the focus of discussion – namely the user story, comes knowledge transfer and learning. As each individual learns more about the business problem being addressed, the possible ways value can be generated and the technical solutions available, they experience a changing understanding of the user story. This can lead to changing understandings and perspectives by all parties as pre-conceived ideas are abandoned or altered. This can induce a 'creative chaos' whereby participants are moved to adjust their views of the story based on input from others, leading to a state of uncertainty, ambiguity and fluctuation wherein innovation flourishes.

Information Redundancy: The rich conversation invoked by the user story format both requires and contributes to information redundancy. To communicate effectively and internalize others perspectives requires 'absorptive capacity' (Cohen and Levinthal 1990), a depth of knowledge allowing appreciation of the others point of view. Through the four SECI knowledge transformation processes active in the group conversation, new knowledge relating to different perspectives is created and disseminated across the team, thereby increasing information redundancy. In the agile literature, this has led to the term 'generalizing specialists' to describe team members who have great depth of expertise in one or more areas, but some knowledge of many other areas allowing them work effectively as part of an integrated team. In more traditional approaches lacking this conversational element, little learning occurs leading to the common 'silo' effect where past solutions are re-applied to new problems thereby limiting innovation.

Requisite Variety: The concept of cross-functional teams, often referred to as feature teams in the agile literature, bring a variety of knowledge and perspectives to the user story conversation, allowing novel solution designs to emerge (Campion, Medsker et al. 1993; Lee and Xia 2010). However, literature suggests (though it has not been empirically demonstrated) that such diversity may come at a price in terms of the efficiency of the team in exploring different possibilities, in communicating effectively and in arriving at shared decisions (Lee and Xia 2010). Therefore, diversity within the team should be balanced with the need for efficiency – it should be appropriate to handling the variety of customer needs and technical solutions likely to be encountered by the team. Assigning a high level estimate to a user story before the conversation occurs may bound the possible solutions investigated and helps achieve this balance in diversity.

6 Conclusions and Recommendations

User stories are widely used in agile methods. Their focus on small increments of functionality of short term value to the user is sympathetic with lean thinking. The card, conversation and confirmation elements of the user story format are particularly conducive to developing innovative user solutions. Sometimes described as a 'placeholder for a conversation' (Highsmith 1999) a user story can serve as a boundary object facilitating the transfer and creation of new knowledge within a shared innovation space. Through the card and confirmation elements the format of a story includes the user's intention in taking a defined action. Through the conversation element, it fosters information redundancy in the team through sharing of perspectives and leverages team diversity in exploring possible solution design. Similarly, by allowing the solution design emerge from the team conversation, the autonomy of the team is supported while fluctuation or 'creative chaos' can be encouraged by the lack of predefined solution guidelines. In the remainder of this section we describe some recommendations for maximizing the contribution of user stories to solution innovation.

By separating the business intent and value of the story from its logical and technical design, the space provided for a cross-functional team to explore and develop solutions is maximized. However, this can be constrained where the <action> of the user story is prescriptive, defining 'how' the user will achieve their objective and not confining itself to 'why'. But the <action> is important in providing context to the story – it relates under what circumstances the <result> should occur. Therefore, a careful balance of contextualizing the intent of the user while avoiding unnecessary specification of a solution by describing what the user action might be can help maintain space for novel solutions to be developed. Similarly, within the confirmation element of the user story, by specifying only acceptance rather than systems tests, the users intent can be expressed in the broadest terms possible, without constraining the solution space. The system tests should relate to the intent of the story, rather than the specific actions the user must take to achieve that intent.

The user story form has been criticized for being too granular and thereby lacking full context of the user experience in pursuing the intent of the story (Cockburn 2007). To facilitate exploration of novel solutions, understanding the wider context of interaction within which the user story exists can be key – therefore, approaches such as user story mapping (Patton 2008) are recommended. Where possible, initial user stories

should be described at a high level (sometimes referred to as epics (Cohn 2004)) and collaboratively developed into a series of user stories small enough to be elaborated, developed and tested in short iterations.

The conversation called for by the practice creates an innovation space where the stakeholders in the story can leverage the five innovation enablers proposed by SECI. Factors such as a clear intent, team autonomy in how a solution is developed, a sense of creative chaos, continuous learning and redundancy and diversity within the team all contribute to an innovative environment. In this way, the user story practice is central to the innovation capability of agile teams. However, in practice these benefits are often reduced for localized efficiency by assigning specialists within the team to design and estimate stories without collaboration (O'hEocha, Conboy et al. 2010). It is recommended that where possible the design of solutions, especially at the high levels of epics or themes, are collaborated upon by a diverse set of team members. This can help prevent past techniques being automatically applied to new problems and foster continuous questioning and novel approaches.

In summary, careful use of the practice, such as ensuring solutions are not framed before the conversation occurs, or are embodied into the confirmation criteria, are necessary to maintain space for innovation. In addition, the intent of the story, as well as the larger strategic intent of the organization, must be clearly articulated to ensure the appropriate learning takes place. Information redundancy and team diversity must be managed to ensure balance between the efficiency of converging on a solution quickly and closing down the conversation prematurely and thwarting the emergence of novel solutions.

The aim of this paper is to establish aspects of user stories that are likely to support the emergence of innovative solutions from the agile development team. It has been argued above that, if implemented appropriately, the practice is likely to significantly contribute to the development of novel solutions, and indeed to the learning and thereby innovative capability of the agile team. Further possible research will include testing these conclusions empirically.

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