Harmonizing Critical Success Factors in Agile ISD Projects

Completed Research Paper

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Abstract

Over time, various information systems development (ISD) approaches have emerged, principal of which are plan-driven and agile approaches. While agile ISD approaches have been promoted as replacements for plan-driven development to enhance responsiveness to changing customer needs, in practice organizations tend to use practices from both of them. This combination represents a challenge for decision-makers that utilize critical success factors (CSFs) to manage the development project because, so far, prior research has identified CSFs for either traditional or agile ISD projects, but not when an agile ISD project has elements from plan-driven development added. This paper theorizes about how CSFs change for agile ISD projects which have plan-driven practices added and empirically investigates the content of these CSFs. Through a qualitative study eight CSFs, allocated into four method dimensions, are identified to give a parsimonious number of areas that contribute to the success of an agile ISD projects.

Keywords

Agile information systems development, critical success factors, case study.

Introduction

Agile IS development (ISD) methods have received considerable attention from both academics and practitioners (see for example, Barlow et al. 2011; Conboy 2009; Maruping et al. 2009; Ramesh et al. 2012; Vidgen and Wang 2009). Proponents promote agile ISD as a “lightweight” replacement the “heavy weight” plan-driven methods (Baskerville et al. 2007). In fact, Dingsøyr et al. (2012) report that agile method are nowadays the dominate ISD method which was also confirmed in an industry survey where more than 88% of respondents said they practice agile ISD – which represents a further increase from 84% in 2012 (VersionOne 2014).

Companies, in an effort to manage their ISD projects successfully have focused on factors that impact the project outcomes: so called “critical success factors” (CSFs). The underlying assumption is that an association exists between a small number of critical areas (i.e., factors) and the project outcomes. Knowing these areas is particularly important in situations in which decision-makers lack expertise or have incomplete information to base their decisions on. Thus, CSFs alert decision-makers that activities in these areas must be performed at the highest level of excellence. Prior IS research has identified CSFs for ISD projects. Initially, research has focused on the identification of CSFs for plan-driven ISD, for example CSFs in the development of executive information systems (see for example Poon and Wagner 2001) but later, attention has been directed toward examining CSFs for agile ISD projects (see for example Chow and Cao 2008).

The CSFs identified for either traditional or agile ISD approaches are only useful and of value for decision-makers if the approach is applied consistently. Deviation from the approach such as adding practices from a different approach might lead to the ineffectiveness of the CSFs as pointers for ISD project success. Yet, it has become common in ISD projects to tailor the ISD approach by having agile as the fundamental ISD method with elements from another approach added – either from different agile approaches or from plan-driven approaches. Reasons for the combination include (1) differences in the approach used by the...
ISD team and a customer that is external, (2) prior experiences of the ISD stakeholders with plan-driven approaches (Boehm 2002; Boehm and Turner 2005; Nerur et al. 2005; Vinekar et al. 2006), and (3) to draw on agile practices from different agile methods to suit the ISD team’s development efforts (Fitzgerald et al. 2006). The practice of adding plan-driven elements into an agile ISD approach suggests that not every practice in plan-driven ISD ‘was bad’ and should be abandoned. However, the combination of diametrically opposite ISD approaches calls for identifying a set of CSFs that consider the unique nature of this development method.

Against this backdrop, our research seeks to understand the CSFs of an agile ISD projects in which the team adds practice from a different ISD method. We are particular interested in to understand the CSFs in projects where elements from plan-driven ISD are added to a fundamental agile ISD project. In an exploratory case study, semi-structured interviews in an Australian company were performed to determine the CSFs of such ISD projects.

**Background**

**Characteristics of Plan-driven and Agile ISD Approaches**

ISD research is one of the major research areas in IS (Bacon and Fitzgerald, 2001). Prior research differentiates in principal between two ISD approaches, namely the traditional, plan-driven ISD and the agile ISD (Baskerville et al. 2007). In various studies, these two approaches were analyzed and, therefore, we keep their comparison to a minimum to avoid repetition. The interested reader is referred to (Boehm 2002; Dybå and Dingsøyr 2008; Vinekar et al. 2006). Yet, understanding the nuanced differences between the two approaches might explain why elements are used from both. Table 1 summarizes the characteristics of plan-driven and agile ISD by using four method dimensions: (1) management and organizational, (2), processes (3) people, and (4) technology (Nerur et al. 2005; Vinekar et al. 2006). These dimensions highlight the main differences of the approaches. Plan-driven ISD is characterized by its highly structured and well planned processes that are managed by command and control and typically creating software in larger teams for larger firms. Conversely, agile ISD is designed for smaller teams of a self-managing nature that work collaboratively with the customer to develop software solutions through numerous short iterations allowing for flexibility and swift responses to changing requirements. While plan-driven approaches rely on explicit knowledge and formal communications, agile approaches benefit from informal communication and tacit knowledge.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Plan-driven Approaches</th>
<th>Agile Approaches</th>
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</table>
| (1) Management and Organizational | • Command and control  
• Explicit knowledge  
• Manager as planner                        | • Leadership and collaboration  
• Tacit knowledge  
• Manager as facilitator  |
| (2) Processes               | • Life-cycle development  
• Specified and preplanned  
• Late and heavy testing                            | • Evolutionary development  
• Flexible and adaptable  
• Continuous testing |
| (3) People                  | • Formal communication  
• Larger teams  
• Low (i.e., at the beginning/end ISD process) customer involvement  
• Individual work of specialists                          | • Informal communication  
• Smaller self-managing teams  
• High customer involvement  
• Collaborative work of multidisciplinary-skilled teams |
| (4) Technology              | • Standardized tools  
• Structured or object oriented                       | • Tools for iterations  
• Object oriented                                        |

Table 1. Comparison of plan-driven and agile ISD approaches (Dybå and Dingsøyr 2008; Nerur et al. 2005; Vinekar et al. 2006)
Critical Success Factors for Plan-driven and Agile ISD Projects

Critical success factors (CSFs) are for any business “the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization” (Rockhart 1979, p. 217). These are the areas in which “things must go right” because they are strongly related to the achievement of management goals (Rockhart 1979). The CSF concept is easy to understand and appealing to managers, which explains its high uptake (Rockhart 1982). Boynton and Zmud (1984) have also shown that decision-makers at different organizational levels highly appreciate the concept because it provides them with a common language about critical areas and threats to the firm.

Originally, CSFs have been established as a mechanism to define the information needs of chief executive officers (Rockhart 1979). The method was later broadened by Bullan and Rockhart (1981) as an MIS planning tool to ensure information resources and activities are available to focus on the achievement of critical success factors. CSF research is nowadays an established area and has been applied at three levels of analysis - the firm level, the industry level, and the economic social political level - resulting in a large number of different sets of success factors (Leidecker and Bruno 1984). The approach has also been used across many fields, such as project management, enterprise systems, and e-commerce (Butler and Fitzgerald 1999) provide a detailed summary of CSF research in the field of IS). The number of CSFs is an important aspect and prior research stresses that the number should be small. While there is some flexibility on the actual number, four to eight factors, is considered to be an accepted number. Having too many CSF causes the risk that they are either not really critical for the success or they are too detailed to be useful (Avison and Fitzgerald, 1995).

In the field of ISD, the identification of CSFs is particularly useful when the decision-maker has limited experiences with ISD in general or with a given ISD approach. Despite that the agile approach is the main development method in companies, only ISD teams may possess this knowledge on agile methods, but managerial decision-makers may lack it. It is important to point out that the decision-maker might have experiences in plan-driven ISD and only the agile part is new or the decision-makers have little experiences in ISD in general. Individuals trained in traditional approaches need to undertake a substantial mind shift and have to let go of a lot of techniques, habits, and work practices to be agile. Scholars in ISD have identified a number of critical success factors (Aggestam 2004; Butler and Fitzgerald 1999; Chow and Cao 2008; Misra et al. 2009; Poon and Wagner 2001; Procaccino et al. 2005) with the idea in mind that these factors are critical for the development of ISs in general or a specific type of IS (e.g. for executive information systems as demonstrated by Poon and Wagner 2001). Overall, the CSFs can serve as pin pointers for decision-makers (see Table 2).

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Plan-Driven ISD Success Factors</th>
<th>Agile ISD Success Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management and Organizational</td>
<td>• To identify and involve the stakeholders and take care of their needs (Aggestam 2004)</td>
<td>• Strong corporate culture (Misra et al. 2009)</td>
</tr>
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<td></td>
<td>• To have commitment from the top (Aggestam 2004)</td>
<td>• Favorable societal culture (Misra et al. 2009)</td>
</tr>
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<td></td>
<td>• Management of data (Poon and Wagner 2001)</td>
<td>• Agreed and performed qualitative control procedures (Misra et al. 2009)</td>
</tr>
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<td></td>
<td>• Clear link to business objectives (Poon and Wagner 2001)</td>
<td>• Team environment (Chow and Cao 2008)</td>
</tr>
<tr>
<td></td>
<td>• Management of organizational resistance and change management needs (Poon and Wagner 2001)</td>
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### Table 2. Critical Success Factors in ISD Projects

<table>
<thead>
<tr>
<th>Process</th>
<th>People</th>
<th>Technology</th>
</tr>
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<tbody>
<tr>
<td>Carefully defined information and system requirements (Poon and Wagner 2001)</td>
<td>Having a committed and informed executive sponsor (Procaccino et al. 2005), (Butler and Fitzgerald 1999), (Poon and Wagner 2001)</td>
<td>Use of prototyping techniques and CASE tools to determine and refine user requirements (Butler and Fitzgerald 1999)</td>
</tr>
<tr>
<td>Spend adequate time on end-user requirement analysis to research agreement (Butler and Fitzgerald 1999), (Procaccino et al. 2005)</td>
<td>Users make adequate time for requirements gathering (Procaccino et al. 2005)</td>
<td>Availability of structured development methods and supporting CASE tools environments (Butler and Fitzgerald 1999)</td>
</tr>
<tr>
<td>Project estimation, planning, tracking to agreed targets, co-ordination and control of project activities (Butler and Fitzgerald 1999)</td>
<td>High level of customer participation during development (Procaccino et al. 2005)</td>
<td>Agile software engineering techniques (Chow and Cao 2008)</td>
</tr>
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<td></td>
<td>Early and on-going communication among all stakeholders (Procaccino et al. 2005)</td>
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Table 2 presents an overview of prior studies on CSFs in either plan-driven or agile ISD for which we use again the four dimensions by Nerur et al. (2005). Our analysis identified a substantial large number of CSF for plan-driven and agile ISD. Although all CSF are theoretical important, these studies identified more CSF than the recommended four to eight factors and certainly too many factors to be useful in practice. However, these factors represent the diversity and breadth of the CSFs potentially relevant for ISD project. Interestingly, the number of plan-driven CSFs is larger than the number of agile ISD factors which may reflect how long the paradigm has been around and how much it is researched, rather than that fewer CSFs exist for agile ISD.

### Methodology

To explore CSFs in agile ISD projects, we undertake a qualitative case study. This research design is best suited when a contextual understanding of an existing reality is desired (Yin 2009) and to gain deeper and richer insights into the emergent phenomena (Willis et al. 2007). Building on prior research on CSFs which makes this study theory based, we seek to inductively develop theory (Eisenhardt 1989), which has been successfully done in prior IS research studies (see for example, Feller et al. 2008; Ramesh et al. 2012).
Data was collected via interviews with decision-makers from one Australian company that developed software using an agile method. The company operates in the financial service industry. The company was selected because we sought organizations that use an agile method for their ISD projects and this company is known as an industry leader in agile method use. It uses an in-house method that is based on Scrum (Schwaber and Beedle 2005) and practices from eXtreme programming (Beck 1999). It should be pointed out that these teams pre-dominantly and fundamentally use an agile ISD method for the IS development. However, as part of the explorative nature of this research project and the undertaken data analysis, we found that the teams and the company added elements into the ISD approach that are popular in plan-driven ISD methods. Consequently, we sought to understand which elements were added and how they were used in managing the ISD project. Subsequently, we went back to prior ISD research to find a theoretical motivation for this combination and re-analyzed the data in the way described below.

We interviewed individuals from different organizational levels (1 general manager, 2 executive managers, 1 program manager, 2 project managers) and members of two ISD teams (9 people). The teams developed solutions for internal customers – an HR system and an online banking application. The interviews constitute the primary source and field notes make up the background material that allow for contextual understanding. In addition, we have been given access to additional materials (status reports, financial documents, presentation slides). We used a pre-developed interview guide which contained open-ended questions to encourage interviewees to share their opinions and experiences with us (Yin 2009), but also to allow the researchers to further explore emergent themes. Each interview lasted between 45 to 90 minutes and was electronically recorded. All interviews were subsequently professionally transcribed.

To analyze the data, we utilized Strauss and Corbin’s (1998) open coding and axial coding techniques. Hence, we seek to identify codes and categories of CSF not purely from the data as Glaser (1992) would suggest, but rather based on the four method dimensions and the characteristics of the ISD approach. During open coding, we first deconceptualized data by breaking it into smaller units that were repeatedly compared, categorized and reexamined based on the four dimensions of the ISD approach. During axial coding, we then reconceptualized the data in new ways that enabled connections between categories to emerge, that is, the different categories were assembled into higher-order themes to give meaning to the CSF in the agile ISD projects (Strauss and Corbin 1998). During the entire data analyses process, we followed guidelines by Miles and Huberman (1994) regarding evaluation criteria of qualitative research (e.g., authenticity, plausibility, and transferability).

Findings

Understanding of Success of an Agile ISD Project

CSFs are directed towards areas that are imperative for the success of the project. Thus, we first sought to understand what success means in the context of our study. We found that customer satisfaction and the creation of value in form of a software artifact were seen as the ultimate measure of success. Consequently, a project would be terminated “... when it stopped adding value. That’s the true measure of success.” [Executive Manager1]. In applying this measure of success, the projects maintained flexibility to allow requirements and functionality to be added until the customer stops it.

“Success is always measured ... by customer satisfaction. If a customer feels like they’ve had a good result and they’ve got cost-effective delivery, then that’s the indicator” [Executive Manager1].

Critical Success Factors in the ISD Method Dimensions

For each of the four dimensions, we identified CSFs that if satisfactorily implemented ensure the project achieves customer satisfaction and creates value for the customer.
Management and Organizational Dimension

1. Stakeholder Engagement

The engagement of other interest groups beyond the ISD team and the customer in the project is common for plan-driven ISD approaches. But also in an agile dominated project, this practice is crucial to obtain project support or simple consult with the different interest groups to avoid them blocking the project at any stage.

“I think any project in development, stakeholders have to be there. What Agile facilitates is that the stakeholders are more tightly linked to the project than the traditional Waterfall.” [General Manager]

However, in an agile project with added plan-driven elements, stakeholder engagement is more actively performed by involving both, floor people from other areas and senior management on a regularly base. This results in better understanding of project progress and the recognition of team achievements. Hence, stakeholder engagement is proposed as a CSF.

“Showcasing to more senior stakeholders who aren't necessarily in the stand-ups every day to show the value for money that's being delivered out of the project .... the senior managers can acknowledge ... the group work that the team has done” [Executive Manager2]

2. Governance Systems

Self-managing ISD teams create the software and active customer involvement facilitates regular testing and requirements’ approval. In this process, the customer is clearly defined as the party interested in the software. Yet, lacking clearly defined accountability for who executes certain development tasks can impair the ISD project. Thus, having governance frameworks in place like those known in traditional ISD is important because of “their discipline” with non-functional aspects in the ISD [General Manager]. When the ISD project is composed of multiple teams, governance systems help to define the overall scope of the projects “and they would have helped get the [customer] to come to the party with clear accountabilities and clear deliverables.” [General Manager]. Therefore, governance systems is proposed as a CSF.

Process Dimension

3. Iterative Change Responsiveness

Different to plan-driven ISD, where the aim is to control the uncertainty of the ISD, in agile methods uncertainty is build-in the development and openly communicated: “You’ve never had certainty, Agile accepts and works with that and that’s the difference.” [Executive Manager1] With an agile project and its evolutionary nature, only high-level requirements are defined prior to beginning the project. Detailed requirements emerge throughout the development including changes to previously agreed requirements.

“... business might come with new stories, or new requirements - it's a trade off. You've started with an initial scope and a release plan, if the business wants more it's either you trade off that some of your already requested functionality needs to go or we move the end date... [Program Manager]

Any resistance from the ISD team to these business-driven changes – as common in plan-driven approaches – impairs the flexibility of an agile approach and limits its value for customers. Thus, being willing and able to constantly adapt the software artifact is proposed as another CSF important to address changing customer needs.

4. Paced and Sustainable Development

In agile, the frequent changes to the software allow for creating a product that matches closely customers’ needs. When testing indicates a requirement is not met, the ISD team must undertake changes. These changes can at times demand overwork from the ISD team. However, we found in the data that having a sustainable pace for the development is important to ensure customer value is continuously created, making pace and sustainable development another CSF.
“But we need to have a sustainable pace so if people start continually working past seven o’clock at night something is wrong. So it’s like, whoa, stop, what do we need to do here? Are we trying to do too much? Is it our iteration planning? Is it expecting more of than we are capable of?” [Program Manager]

People Dimension

5. Champion for ISD Project and Agile Method

In plan-driven ISD, the concept of a project champion is known as a person who promotes and evangelizes for the ISD project throughout the wider organization. A similar role is important in an agile project and hence, we propose it as another CSF. However, the role of a champion is broader such as that the championship is provided for the project and the agile method. Thereby, the customer can take the role of the champion when speaking highly about the progress of the project and thus, allow others making the leap of faith that investments and the committed budget will result in customer value.

“It was actually the [customer representative] on the projects talking back to their leaders saying, this is the best way that we have ever seen an IT project run, we want to run them all like this.” [Executive Manager2]

The champion role for the method enables the team to follow agile practices, particularly to have access to domain knowledge. Thus, a method champion may support the team or the project manager in getting a full-time or at least part-time customer representative – if that is not possible the project can be put on hold until the resource has been allocated.

“I know that I can stop a project because I know that I’ll be supported by my leader who understands that if you don’t have the right support [i.e. customer representative] you don’t get the work done.” [Executive Manager1]

6. Team Helping and Supportive Relationships

Already the agile manifesto highlighted the importance of social interactions among individuals. In agile, the ISD process is embedded in the team’s interactions and the quality of their relationships.

In these small agile teams, the support and assistance provided for each other allows the software to manifest. Particularly, asking for and providing help allows speeding up the development, avoids that a person gets stucked with their task and eventually, slows down iterations velocity. Thus, team helping and supportive relationships are suggested as another CSF.

Different agile practices, such as pair-programming and stand-ups, enable team members to become aware of issues and allow them to offer their help even if the other person did not request it.

“...you can see every day how the progress is going and you can go up to the person and say: do you need a hand, do you need any help, what’s going on, what’s you’re problem? [Developer]

ISD Method Dimension

7. Agile Practice Creating Proximity

Two agile practices – daily stand-ups and ISD team colocation – have been pointed out as crucial success areas of an agile ISD project. Both practices create proximity among ISD team members and the customer and thus, fostering ad-hoc communication and knowledge exchanges. The close proximity of all team members leads to more open and constructive discussions that enable team learning and project progress. Thus, we propose proximity-creating agile practices as another CSF.

“And one of the biggest things that came out of yesterday was co-location what has worked really well, energy levels and again, willing to disagree, or say no and not understand it et cetera but, then again, it’s not one person, and whether you agree as a team of what you’re doing, so it’s that team thing, and the team makes the decision it’s not one” [Program Manager]
8. ISD Method Supporting Tools

The use of technology to support the agile ISD process has become important and thus, it is proposed as another CSF. Initially, an agile team worked mainly without tool support using only physical storyboards and requirements were hand-written on note cards. However, the need arose to report development process, to have accountability for decisions, and document changes to priorities long term. These principals are well known concepts of plan-driven methods, but gained also importance for agile ISD to address potential management concerns of lacking control and predictability.

“We’ve made a number of changes so we’ve been logging [into JIRA]... I [Project Manager2] said: ”Well why have you done that?” ... that should be in on that story, not in the change log.” And he [Business Analyst2] said, ”The reason I’ve done it ..., I want to actually have a traceability of what they have agreed.” [Project Manager1]

Conclusion

Agile ISD has become the most widely used approach for modern software development. Prior research has shown that agile ISD teams apply an à la carte approach to their agile method, selecting whatever practice is deemed best for the team (Fitzgerald et al. 2006). Similarly, while a team is using a agile method, the team is also open to adding plan-driven method elements.

CSFs can be utilized to ensure an agile ISD project produces value for customers. Figure 2 illustrates the eight CSFs identified in this study. These factors represent the nature of an agile ISD project as being evolutionary, change tolerant, and customer-focused. A number of CSFs can also be found that represent the core values of plan-driven approaches suggesting that by adding and integrating the two opposite perspectives the benefits of using agile can be maintained while concerns for adopting agile (less accountability, transparency, control) are addressed. Understanding of these CSFs can help decision-makers to further improve the success rate of ISD projects.

Figure 1. Critical Success Factors in agile ISD Projects with added plan-driven Elements

1 JIRA is a tool developed by the company Atlassian to assist ISD teams in their planning, work assignments, and recording of activities. (https://www.atlassian.com/software/jira)
References


