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Adopting and Implementing a Software Development Methodology: An Organizational Perspective

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ABSTRACT

Although much has been written about better aligning Information Systems (IS) with the business, too often organizations perceive software development as though it exists in its own little cocoon. Selection of a formal software development methodology (FSDM) is usually left to the IS area which focuses on the detail component levels and features of an FSDM. The authors instead approach an FSDM evaluation from an organizational perspective. An organizational systems level (OSL) model should first be used to examine the potential impacts of a new FSDM on human resource policies and practices, organizational culture, structure and design, and work design and technology. Critical success factors (CSF) for an organizational FSDM are also discussed.

Keywords

Information Systems Development, Methodologies, System Development Process, Organizational Systems Level Model.

INTRODUCTION

Many organizations essentially have no formal software development methodology (FSDM) in place. Often, the manner of development is ad hoc, whatever fits the immediate need, and processes are determined by whoever is assigned to accomplish the tasks. This lack of any formal methodology may be largely influenced by the majority of organizations being “small shops” either in their size or in their ways of thinking. However, it should not be construed that these organizations have no ‘generally accepted’ processes for parts of the software development lifecycle (SDLC), or that there is a general lack of standards. Often some common methods, processes and standards may exist, though in a loosely understood and followed state. It may not be unusual for an organization to believe it ‘has a software development methodology’ due to the presence of such factors as standards and common practices. However, it is unlikely that such a ‘homegrown’ methodology is of a formal nature. The Software Engineering Institute describes this approach to software development by noting that “The immature software organization is reactionary, and its managers are usually focused on solving immediate crises (better known as firefighting)” (SEI, 1995, p.7).

Adoption of more formal processes, or methodology, is gaining acceptance as problems associated with home-grown approaches become more visible (Kruchten, 2004). Even organizations with a limited FSDM may wish to further broaden and evolve their processes due to changes in organizational size, structure or style, particularly given the current emphasis on certifications such as those associated with the Software Engineering Institute’s capability maturity models (CMM) (SEI, 1995).

Regardless of the reasons for adopting and implementing formal software development processes, or the anticipated benefits, much care and planning must be performed prior to such an undertaking. This paper makes a theoretical contribution to the field by proposing that an organizational perspective should be taken to the evaluation of a formal software development methodology, by reviewing relevant literature, and by discussing critical success factors for an organization-level FSDM.

Software Development in a Cocoon

Unfortunately, too often organizations perceive software development as though it exists in its own private cocoon. Despite the ever-increasing reliance on software throughout the organization, the functioning of the IS/IT department may be poorly understood. Management in other areas of the organization may be uninformed about not only the IS/IT area's functions, but also its capabilities. Management too often only knows that 'something is wrong.'

Certainly there is much written about better aligning the IS/IT area with the business as reviewed by Ward & Peppard (2002, p. 44-47). This alignment, however, must be a two-way street; it cannot be accomplished by either the IS/IT or the business area alone. Education of each area about the other must reach a level of 'understanding' so that actions by either, and their resulting impacts and effects on the other area, can be anticipated. Only through this two-way understanding can the organization achieve improved IS/IT/business alignment.

Overcoming the isolated or cocoon view of IS/IT, and specifically software development, is particularly critical at an organizational level in order to successfully adopt and implement a FSDM. As more of the organization becomes dependent on software, it is essential to recognize that increasingly of the organization will be affected by adopting a formal methodology.

The relationship(s) between software development and other company areas is demonstrated by the Organizational Systems Level (OSL) model regarding organization behavior as defined by Robbins (2003, p. 27). This model denotes four organizational interrelated components; Human resource policies and practices, Organizational culture, Organization structure and design, and Work design and technology. Robbins states,

Organizational behavior reaches its highest level of sophistication when we add formal structure to our previous knowledge of individual and group behavior. Just as groups are more than the sum of their individual members, so are organizations more than the sum of their member groups. The design of the formal organization, work processes, and jobs; the organization's human resource policies and practices...and the internal culture all have an impact on the dependent variables (p. 26).

Adoption of an FSDM represents a significant change in the work design not only for IS/IT, but also a sizeable impact on the other organizational components. Gaining a clear and detailed understanding of each component, their interrelationships and workflows, as well as, the nature of the changes resulting from an FSDM and its impact on the components and relationships is critical for the organization to implement the 'right' solution.

This thinking is supported by Leung (2001) who made a similar proposition in his study of the relationship between several organizational factors and their effect on project management and software quality management practices for software development. However, it appears that Leung's study stopped short of considering the full FSDM by focusing only on these areas.

UNDERSTANDING THE IMPACTS BROUGHT ON BY AN FSDM

It is important to treat the adoption and implementation of an FSDM as an organizational strategic initiative. Accordingly, this section discusses several key areas of impact of an FSDM at the organizational systems level (OSL).

Reason(s) for Change

Identifying the source reason(s) for an FSDM is needed not only to give clarity to the 'why' behind the change, but also the benefits that are expected. Some of the reasons for adopting or evolving an organization's methodology are:

- Failure of current processes to meet expectations.
- A desire for improved control over the software development processes yielding:
 - Improved standards.
 - Consistent communication processes.
 - More repeatable SD processes.
 - Improved ability to monitor status and increase predictability.
- Provide a framework for capturing knowledge.
- Improved software quality.
- Increase productivity of the software development area; e.g., more, better, faster, cheaper.
- Better alignment between the IS/IT area and other organizational areas.

- Sustainable competitive advantage or prevention of being competitively disadvantaged.

Which of these reasons and/or benefits, or others, have initiated the interest in adopting an FSDM? Answering each of these questions in as complete a manner as possible will bear fruit in the form of clear expectations, a heightened awareness of the breadth of impact, determining whether an FSDM truly is needed at this time, and if so, obtaining sustained senior executive commitment.

Business Impact

At times it may be better not to have an FSDM than a poorly implemented one (Beck, 2000). It may be worse to only implement an FSDM part-way. Understanding the level and extent of the probable impacts to the business of any major change is also necessary for obtaining long-term commitment that so significant a change requires.

Although hard to quantify, it would be ideal to have a complete and detailed projection of how an FSDM will affect not only the respective business areas, but also be able to develop an estimation of the associated costs and perform a return on investment analysis (ROI) for the initiative. However, this ideal is rarely achievable. Nevertheless, a clear understanding of the IS/IT and business processes is critical, as well as, clearly identifying the areas, individuals and relationships that will be impacted. Levels of impact can be anticipated, and at a minimum, relative values set using a rudimentary scale of high, medium and low.

Gaining a broad view of the business impacts of adopting and implementing an FSDM also establishes a 'mindset' for the initiative, and indeed the organization as a whole. Because an FSDM is highly process-oriented, a side benefit to introducing this mindset into the organization may yield other unanticipated benefits. By undertaking an FSDM initiative at the organizational level, introduction of such a mindset could well spur other areas within the business to become more aware of their processes and how they might be further improved.

Understanding Risk

No significant change initiative like the adoption and implementation of an FSDM should be undertaken without first recognizing the potential risks. Some of the risks associated with software-related projects (Schwalbe, 2004, p. 396-397; Royce, 1998, p. 66) are listed below. Whenever possible, 'best attempts' to understand, evaluate, and quantify each risk should be taken.

- **Management Risk:** the lack of support for the transition.
- **Education Risk:** how much new training will be required, how must it be introduced so it empowers all affected individuals.
- **Risk of Inertia:** similar to Management risk except that this more represents the possibility that the transition will be only partially implemented.
- **Technology and/or Vendor risk:** If new or additional technology will be required to fully implement the FSDM, what is the state of the technology, and what support from the vendor(s) will be required – initially and ongoing.

Culture and Strategy of the Organization

According to the Technology Adoption Life Cycle (TALC) originated by Geoffrey Moore (1991), organizations can be classified based on their cultural approach to new technology. Understanding where the firm is on the TALC scale, listed below, will help the organization recognize if it is at the proper stage in its internal evolution to implement an FSDM and its ability to do so.

- *Innovators* are technology enthusiasts. They are keen to be the first to try out a new technology, but they represent just a sliver of the model.
- *Early Adopters*, also known as visionaries, are somewhat keen to try out new technologies. They appreciate a product's potential to give their organization a competitive advantage. They represent a larger slice of the market, and they tend to have much more influence in an organization than do *Innovators*.
- The *Early Majority*, sometimes called pragmatists, represent the bulk of the market. They tend to buy in to new technologies only after they perceive solid references and safety measures that guard against potential failures. Securing the pragmatist buyer is the most important marketing challenge.
- The *Late Majority*, or conservatives, are also a very large portion of the market. They are extremely cautious when buying into a new technology. They want to see proof of results before they will accept a product's usefulness.

- *Laggards* are skeptics who would prefer to avoid new technologies altogether. They will buy only if they really must.

The key benefits gained from this type of understanding of the culture of the organization will likely be gained from anticipating movement along the organizational scale and potential changes in corporate philosophy that may result from the implementation of an FSDM. Clearly if the culture of the organization is conservative, the company may choose to wait until the value of an FSDM is proven. The culture of the organization will also likely influence the choice of which methodology to implement. It is also important to understand the organization's strategic nature.

Markides and Geroski (2003) categorize organizations as Colonizers or Consolidators in their strategic focus. Colonizers are companies whose focus is product discovery and/or invention. A colonizer's market may also be described as a 'supply-push' environment where the product demand has yet to really be developed. Recent examples of colonizers were 'first to market' Internet companies whose products were created with a perspective of 'build it and they will come'.

Consolidators on the other hand, are companies whose focus is on identifying the existence of product demand at an early stage. The expertise of consolidators lies in their ability to turn an idea into something reliable that meets the customers' need, and organizing the market. A consolidator may also (or instead) possess the capability to manufacture the product and distribute it efficiently.

Markides and Geroski (2003) point out that while colonizers may be successful, more often than not they fail to evolve into consolidators and truly reap the benefits of their efforts. They also note that with rare exception, a company cannot be both a colonizer and a consolidator.

A company that well understands its corporate strategy in the context of Markides and Geroski's (2003) definition can provide confirmation for where it fits on the five-category organizational adoption scale. The colonizer vs. consolidator perspective may also help the organization better understand the influence upon its corporate strategy that adoption of an FSDM will have.

The Balancing Act

It is important to note that organizations are not homogeneous. The types of analysis described above will identify a diversity of sub-organizations or subunits within the company, each with their own subculture and influences. Each of these units is comprised of people, processes, and tools, and as noted earlier, incorporation of an FSDM will likely affect each of these components. Successful organizations are careful to maintain a balance between the people, processes, and tools employed. Creating the types of understanding discussed previously will assist an organization in carefully maintaining or adjusting the balance between these resources throughout the adoption and implementation of an FSDM.

IMPLEMENTATION CONSIDERATIONS

The type of organizational analysis discussed in this paper increases the knowledge of the organization. At first it may only be in the form of 'tribal knowledge' among the senior executives and management. However, depending on the organization's culture and management style, the organization will likely benefit from spreading this knowledge to most all units and personnel. No trade secrets or proprietary information should be involved, so by sharing the knowledge, a greater common bond and sense of teamwork can be developed. Business areas and employees will have a better understanding of their company, how it 'does business' as an organization, as well as, employees' respective roles in the organization.

One would think that with this knowledge in hand, and assuming that a decision has been made that the organization will sufficiently benefit from a FSDM, that it is now time to proceed with its adoption and implementation. However, still more factors should be considered to understand what must first be done to truly be ready to select a methodology and begin implementation.

Budget and Time Constraints

Implementing an FSDM will be a sizeable commitment and investment of resources. Cost estimates should be developed during the organizational examination, and how the company will ensure the necessary funds, time and resources can be committed to the initiative. Depending on the 'size' of the methodology that is appropriate, how formal and agile it may be, and how large the organization, implementing an FSDM is likely to be a multi-year effort.

Not only should the company be realistic regarding the length of time required to implement the FSDM, its management should recognize that the first implementation iteration may not be quite the success hoped for. Education will be needed, and success will grow from experience gained through the repeated execution of the FSDM.

Managing the Change

Throughout this discussion we have continually referred to the **change** that will accompany adoption and implementation of a FSDM. It is important to clearly recognize that a significant amount of change will occur, and it therefore should be managed. Various resources are available which address managing organizational change and the issues that arise so no further discussion is presented here. The authors do caution against underestimating the level and impacts of change represented by an FSDM. Implementation of an FSDM is a form of business process reengineering (BPR) applied to (at least) the software development processes. As demonstrated in this paper, the ramifications of an FSDM extend well beyond the IS/IT area to most parts of the organization, and may spawn BPR in other organizational areas as well. BPR efforts are most always associated with varying degrees of discomfort and confusion as the organization transitions its processes. Accordingly the need to plan for and manage the change from introducing an FSDM will be critical.

Gaining Acceptance

Another factor associated with adoption of an FSDM relates to how well the resulting changes will be accepted. Considerable insight can be gained from the Technology Acceptance Model (Davis, Bagozzi and Warshaw, 1989), TAM2 (Venkatesh and Davis, 2000) and similar research. TAM suggests that when presented with new technology, the end-users will decide whether to adopt it based on their perceptions of its “usefulness” and “ease of use.” In other words, whether the technology is seen to be helpful in performing job-related functions and whether it is easy to use. TAM2 extends this model to include social influence processes and their effect on a user’s intention to utilize technology, the most significant being “subjective norm” which correlates technology utilization based on someone influential suggesting you should (Venkatesh and Davis, 2000, p. 195). This finding emphasizes the importance of change agents and positive peer pressure in gaining acceptance of technology implementation. Although supported in a later study by Hardgrave, Davis and Riemenschneider (2003) investigating software developers’ intentions to follow a methodology, another significant finding was that a management mandate to utilize the methodology does **not** guarantee it will be followed. Software developers need to see the value of using the methodology, it should be seen as the socially-acceptable thing to do, and it should closely align with the way they typically perform their work activities (p. 139-143).

Managing the Initiative

We have also referred to the adoption and implementation of an FSDM as an initiative. It should be recognized that in this discussion an initiative is basically equivalent to what project management disciples also call a project or a larger scale program (a collection of related projects). One approach to managing the FSDM initiative could easily be within a project management framework. However, smaller organizations introducing an FSDM may also lack project management skills. Depending on the size of the organization, a prerequisite for implementing an FSDM may be to first develop formal project management expertise within the organization (McConnell, 1996, p. 55). A skeletal or light-weight version of a formal Project Management Methodology (PMM) may initially be sufficient. Initiatives introducing a PMM and FSDM are often executed in tandem, and the discussion here regarding adopting and implementing an FSDM is also applicable to implementing a PMM. Parallel initiatives will, of course, broaden the scope of impact on the organization and level of change. More information on project management is readily available from the Project Management Institute (www.pmi.org). Another source of project management information that is more oriented towards serving the information processing community is CompTia, Ltd. (www.comptia.org). Both organizations are well-known by disciples of project management and provide certifications for the project management industry.

Toward An Organizational Level Solution

Further support for looking toward an organizational level solution for an FSDM can be gained from the recent writings of Scott Ambler. Although Ambler offers that an agile form of the Rational Unified Process/Unified Process (RUP/UP) has become a de facto industry standard as a software development methodology, he deems this methodology incomplete in his new book, *The Enterprise Unified Process* (Ambler, Nalbene and Vizdos, 2005). The new Enterprise Unified Process (EUP) is an extension of the RUP/UP. Ambler’s presentation of the EUP serves to not only further the software development community’s discussion regarding methodologies, it is also an indication that discussion has not reached a point at which a standard can be declared. While the EUP does place adoption of a FSDM at the organizational level and includes analysis of organizational goals and strategies, it does not, however, include an organizational level analysis of the process needed to adopt a FSDM.

INDICATIONS FOR FURTHER RESEARCH

Although the literature and recent industry changes are compelling, it is clear that more research is needed to understand how to successfully implement an FSDM at the organizational level. A good place to start would be to extend Leung’s (2001)

study to explore or confirm which organizational factors affect the adoption of an FSDM, then investigate if these factors vary according to where the organization resides on Markides and Geroski's (2003) scale. Other factors for investigation may be drawn from the TAM (Davis, Bagozzi and Warshaw, 1989) and TAM2 models (Venkatesh and Davis, 2000).

CONCLUSION

Considerations for adopting an FSDM at the organizational level were discussed in this paper and supported by relevant literature. Some thoughts on future research direction were also provided. However from a practical standpoint, whatever methodology is chosen, it is advisable to compare it against any existing 'methodology' present in the organization. It may be desirable to customize it to some degree for cultural 'fit' within the adopting organization. Flexibility of the methodology will yield benefits not only as it is introduced into the organization, but later as personnel become better informed and more experienced with the methodology and offer further customizations. Assuming that the organization expects to grow and evolve, is it better to first implement a light-weight methodology that may be throwaway within five years, or instead adopt a heavier, but more complete and robust methodology that has a more lasting nature? These are important questions for management.

Certainly which methodology is adopted is of major importance to the IS/IT area, and often the IS/IT area is the driver for implementing an FSDM, especially in immature organizations. However, no matter how the information industry may wish to consider the importance of the IS/IT area's role, it is still typically a support function which enables improvements to other business areas.

The ongoing permeation of IS/IT throughout the organization's business processes further demonstrates the increasing need for coordination and alignment of efforts of IS/IT and other organizational components. Adoption and implementation of an FSDM must be seen as a strategic organizational initiative. Therefore, rather than IS/IT being the driver of an FSDM initiative, it is a prerequisite to first understand the present organizational culture and subcultures, as well as, the organization's strategic objectives. This then allows the business at an organizational level to drive the FSDM initiative. It is critical to the successful implementation of a formal software development methodology that the 'path' chosen be one that will best serve the **entire** organization.

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