

Motivating Small-to-Medium-Sized Enterprises to Adopt Software Process

Author-Approved Version 1.0

19 October 2004

by

F.G.Wilkie
R.Jeffery

D.Rombach
M.A.Herndon

M.L.Penn
M.Konrad

Abstract

This paper elaborates the topics identified by the open space working group that considered the issues and challenges associated with getting small-to-medium-sized enterprises (SMEs) to adopt software process culture. This group met during the first IPRC meeting in August 2004. The issues have been organised into four topics, namely: (i) problems; (ii) benefits; (iii) ideas, and (iv) actions. These issues are then represented using the roadmap template proposed by Herbsleb [IPRC Workshop 1].

1.0 Introduction

This open space working group comprised six members. Three of these members, George Wilkie, Dieter Rombach, and Ross Jeffery, represent research centres in geographical regions where there is a predominance of SMEs engaged in the engineering of software. Two of the members, Mary Lynn Penn and Mary Anne Herndon, represent large corporations in which, at first glance, issues associated with SMEs might be considered less relevant. However, both Lynn and Mary Anne suggested that large companies often sub-contract work to and team with smaller businesses and hence this topic is also important in their respective organisations.

Additionally, large companies typically perform acquisitions from organizations in which there may be a striking difference in process maturity levels. Implementing process improvement outreach programs with SMEs is an ongoing challenge for larger organizations. The sixth member of the group, Mike Konrad, is one of the principal authors of CMMI. As such, he acknowledges that whilst CMMI was developed primarily by contributions from large product development organisations, best practice from this model must be promoted through to SMEs if CMMI is to influence a wide cross-section and significant proportion of the global software engineering community.

1.1 Definition

The large majority of small-to-medium-sized enterprises (SMEs) employ between 5 and 25 engineers. Staff members in such organisations typically have multiple roles. For example, one person may have responsibility for both configuration management and quality assurance. Furthermore, it is often the case that a single work product will consolidate the multiple outputs of multiple CMMI specific practices. In other words, many SMEs are very economical with documentation. One document may, for example, contain fragments of requirements, design, test plans, and possibly release notes.

1.2 Problems

It is interesting to plot the origins of many SMEs. Typically, entrepreneurial types start them: business people, often with little background in software engineering. After all, “anyone can turn their hand to a bit of programming.” The catalyst for starting a company is a business idea—a gap in the market. Domain knowledge is the most fundamental ingredient to get things started. As a result, the engineering or process culture is not necessarily introduced early in the company’s history. A culture of slack engineering procedures reigns, and as the company grows, so does this culture prevail, up to a certain size, beyond which the staff members begin to realise that a more disciplined way of working is required for survival. However, by this time it can be difficult to change old habits. The key is to talk to the CEOs while the companies are still small and talk about business goals. Since business goals are associated with “strategic” planning and revenue, company plans made while still small can affect the culture of the organization as it grows.

Perhaps one of the greatest impediments to creating a software process culture in many SMEs is the perceived “tax,” or high overhead, associated with such a regime. There may also be a “cart before the horse” misconception that the model drives the business goals, as opposed to the more correct interpretation of the business goals driving the implementation of CMMI practices. Another misconception is that process culture will reduce productivity and creativity and hinder the company’s ability to meet windows of opportunity—in other words, process culture will make the company less competitive.

Some process areas in CMMI might certainly be perceived as overkill for SMEs. Many SMEs will not implement all practices in a given process area. But they have difficulty knowing which practices add the most value. Defining “alternative” practices versus implementing the CMMI documented practice is also difficult. SMEs may confuse the concept of goal satisfaction with rote implementation of model practices. Clearly, the cost of introducing each practice is not the same. Organisations have difficulty understanding the relative costs associated with introducing each practice. These cost concerns often lead to suspicion and impedes process improvement. The question is, “How can CMMI be boiled down for SMEs so that they benefit from needed management and engineering practices?”

For many SMEs, most engineering resources are dedicated to specific project work. There are normally few “spare” resources for infrastructural concerns such as network management, quality assurance, or research and development. Instead, this work becomes absorbed as part-time roles for project staff and is often neglected or at least given secondary importance until something goes seriously wrong. As a consequence, attempting to instill a process culture in such organisations is likely to meet with varying degrees of success depending on precisely when the attempt is made.

Accentuating the positive uses of CMMI tools, instead of forecasting a negative scenario, such as a disaster, can provide a positive motivator. Most entrepreneurs are conscious of the “race against time” to grow their business and understand growth goals as revenue and profit. Perhaps an opportune time to coordinate with a CEO is during initial planning activities. Integrating CMMI model practices into planning is an excellent way to smooth the implementation of three-year business goals. Universities or private foundations might offer a planning package to consortiums of entrepreneurial SMEs. Another opportunity to get the CEOs’ attention is immediately after a major disaster. The benefit of introducing process improvement after a disaster is that it can demonstrate a success rather quickly, thus selling process as a deterrent to another disaster.

Deciding to introduce a new idea into an organisation can happen in two ways. First it can happen through an “act of faith” that the new idea will lead to a better way to work—more efficient, or better accuracy for example. Second, it can happen through some form of a cost-benefit-analysis. The latter approach is more likely to gain approval from the financial authority within the organisation—people are less likely to argue with figures, and conclusions are more easily drawn after such an analysis. SMEs typically focus on collection and analysis of business performance measures, such as revenue and profit. Revenue and profit measures provide a basis for quantifying improvements to cost and schedule performance. These two measures, which are collected, analysed and reported as part of U.S. government requirements, are usually the first indicators used to evaluate how effectively model practices were implemented. A cost benefit analysis is usually available, although it is not commonly recognized. Leveraging on existing measures helps organizations understand the value of the IDEAL cycle for process improvement.

The most likely starting point for most SMEs should be using the Class C type of process appraisal and focusing on process areas that are relevant to their existing management practices. This approach is relatively quick and inexpensive as a set of process areas tailored to the SME are targeted. However, from a psychological standpoint, any form of appraisal will be treated as a kind of examination. From early childhood we are all programmed to prepare for examinations. Initial Class C appraisals are intended to be “unfreezing” appraisals focusing on capturing the current state of the SME’s processes, not requiring preparation to pass the test. These appraisals are intended as an aid to identify and prioritise areas for improvement. Unfortunately, many SMEs view any form of appraisal as something for which they need to prepare. Perhaps they believe they are so bad that an initial appraisal would be embarrassing? Whatever the reason, such preparation may act as a further impediment to getting started with CMMI adoption.

1.3 Benefits

The benefits of creating a process culture in an SME are as follows.

Fundamentally, processes must deliver competitive advantage with respect to performance, quality, and improved visibility to the customer. The challenge here is to have good quantitative evidence to support these points and the evidence must come from SMEs, not from large multinational corporations.

SMEs tend to rely on a small core of perhaps 1 or 2 key people who are responsible for achieving profit and revenue goals. These people include the business person who has all the contacts, or the chief architect of the company's main product who has the overall design in his or her head. Other staff members tend to simply follow orders. Process culture helps reduce a company's reliance on key individuals—something that boards of directors tend to appreciate.

Too often we see the “fire-fighting” approach to day-to-day management of SMEs wherein many staff go home at the end of the (long) day having worked on a completely different set of tasks than what they had planned to do that day. When staff members work long hours on an ongoing basis, the effect demoralises and degrades staff performance. Process improvement should be sold as a set of management tools to reduce rework (i.e., defects) and to transition from a tiresome daily tactical execution to strategic execution of a plan for obtaining defined strategic performance goals. The benefits of a process approach include reducing the unpredictability of the work place that leads to a reduced need to work overtime. But how much of this benefit is reality? We need solid quantitative evidence that this cause and effect works in SMEs.

SMEs often have only one main product or one main client. A major disaster under such circumstances will almost certainly signal the end of the company, so SMEs must guard against such eventualities. Process helps reduce the risk of such a disaster.

We see the trend of large companies contracting out more and more of their software development effort to smaller companies. Larger companies may tend more towards the role of systems integrators. In doing so, the large client is increasing its risk. Such large clients increasingly wish to ensure that their subcontractors are capable of delivering on time and to the required level of quality. Process helps identify these capabilities and so becomes an important consideration during the contract tender and award stages. Furthermore, with the trend for many more SMEs to be in the “small” category in future, in a drive to increase flexibility and reduce risk, there will be an increasing need for very small SMEs to group together into consortia for specific projects. Consortia will be created and dissolved through market demands. It is unlikely that a company of 10 people could do anything useful for a company of 5,000 people. However, a consortium of perhaps 15 companies of 10 people each could conceivably deliver a more useful service to a large client. Process becomes absolutely essential for such consortia to be effective. So whilst the 10 person company may not see the need for much process when acting on its own, it will need a culture of process to become a successful member of an effective consortium. The challenges are to understand what level of process culture and which processes make for the best consortia and to understand how to evaluate the potential of an SME to be

a good consortium member. Also, we need to understand issues of process compatibility so that different companies can use different processes that nevertheless can integrate with one another and be compatible. We also need to understand the risks associated with a consortium that is particularly lacking in one or more processes as well as ones that can't adopt process.

1.4 Ideas

Large organisations have similar challenges to SMEs with respect to using process on their smaller projects and in reducing acquisition risks. SMEs have unique challenges. Large organisations have better infrastructures for process that smaller projects can use, whereas in SMEs there is often little infrastructure and the direct link to achieving critical profit and revenue goals may not be well understood.

The key for SMEs is to have highly tailorable processes that allow flexibility. Demonstrable evidence of benefits from processes for large organizations or projects that have been successfully tailored to the needs of small projects is needed. We also need examples of managed process evolution, since there is some concern that the solution to better processes is not always through tailoring, but through evolution. How do processes evolve? We need to answer this question and better understand the process lifecycle.

SMEs need example processes as a starting point. Perhaps we need to start with generic light-weight processes and observe how these evolve with use in a group of SMEs over time.

We need to determine how important an appraisal is to the SME. Many SMEs will not pay for even Class C type appraisals. Often, the most they will do is set aside some staff time to participate in interview sessions during the appraisal process. Could we start by simply introducing SMEs to some light-weight processes (identified through their business goals), perhaps for project planning, project monitoring and control, and configuration management?

The reasons why SMEs approach research organisations for help are many fold. Sometimes SMEs want some research and development undertaken on their behalf, only to discover later that what they really needed were better processes. We need to better understand the reasons why SMEs approach research organisations if we are to determine how best to motivate these companies to embrace a process improvement culture. We need to introduce SMEs to CMMI by way of the company's business goals and avoid CMMI jargon.

1.5 Actions

The timing of when to introduce process improvement to SMEs is of paramount importance. They must be appropriately motivated by timing the introduction to be during the planning of business goals such as revenue and profit, when their product is ripe for exploitation, when they are entering a critical development stage, or when a

critical customer relationship is formed. Another appropriate time is just after something major has gone wrong, or just in advance of a major expansion drive.

Introducing process improvement culture into SMEs must be at least partially subsidised, either by government or a key client.

We need to ensure that process improvement is goal driven within SMEs. Clear justification is essential at all stages.

To be pragmatic, given the sheer number of SMEs in each geographical region, we need to cluster the SMEs by problem/needs type such as those who have common issues related to testing. We need to develop generic solutions for each cluster and make these available to SMEs then follow up with minor tailoring and some evolving of the solution in each separate company.

The motivations for process improvement need to be targeted at the investor level as well as the company financial control level to ensure sustained effort. As work with SMEs proceeds, it is also important to look for quick wins (i.e., “low-hanging fruit”) that demonstrate success and thereby encourage sustained effort.

Case studies relevant to SMEs are needed. These studies must be conducted at SMEs and include quantitative as well as qualitative assessments. SMEs need to know which CMMI process areas and specific practices are most valuable to them. They need to understand or have some appreciation of the relative costs involved in introducing and using each specific practice and its likely return so they can better judge which practices are most valuable to them. Providing such information could also help with the quick win, whenever they may decide to start with some of the “easier” practices just to see progress and come to terms with the best deployment strategy for their organisation. Guidance should focus on where the “perceived value” is. SMEs also need to understand that the specific goals are most important and that meeting those goals may not necessarily require them to conduct all the suggested practices to the same extent.

Universities have an important responsibility in setting the level of creativity, professionalism, awareness, and appreciation of “doing things the right way.” We need to influence them by increasing their awareness of what can be achieved using process improvement.

We need to know what the current level of process improvement is in each region and which organizations are involved to determine who could provide sources of case study material. One strategy is to capture learning from innovator SMEs and create case studies that will then support process improvement for the others. The target should be to impact at least 50% of SMEs in each region (over time) if the process improvement culture is to become ingrained.

We need good examples of process assets, with demonstrable levels of tailoring. We also need to develop a controlled database to assist SMEs with process startups and collect information that will provide visibility into demonstrated successes.

2.0 Mapping to the IPRC Roadmap Template

This section gathers the aforementioned challenges and issues into the format of the roadmap via (i) Technical & Business Trends; (ii) Critical Process Needs; (iii) Process Capabilities, and (iv) Research Themes.

2.1 Technical & Business Trends

- Large companies are becoming larger through mergers and acquisitions.
- Many SMEs, particular small ones (typically with less than 10 staff members) wish to maintain flexibility and speed of response.
- The geographical distribution of software development is based on a mixture of political, technical, and resourcing issues.
- There is persistent conflict between systems integrators and software developers.
- Consortia of SMEs tend to deliver to larger clients.
- Multi-year business plans describe the path to achieve revenue and profit goals.

2.2 Critical Process Needs

- Processes for the cooperation of SMEs in consortia
- Light-weight processes to respond to reduced overheads
- Suitable methods of appraising the processes of SMEs for appropriate compatibility with each other and with consortia process needs
- Exemplar processes for key areas (with tailorability)
- Process performance data
- Case studies involving SMEs

2.3 Process Capabilities

- Project management and quality assurance
- Requirements engineering, design, implementation, and testing
- Risk management
- Process performance techniques

2.4 Research Themes

- Determine the circumstances under which process compatibility is important between two SMEs that need to work together

- Develop cost-benefit studies for each CMMI process area
- Develop processes for consortia of SMEs
- Create case studies of SMEs
- Develop a process startup checklist (instead of Class C appraisals)
- Document entrepreneurial techniques for successful SME software services and products

3.0 Change Log

Versions 0.1, 0.2, 0.3 and 0.4 created during revision by authors in the period 31 August – 8 October 2004.

Version 1.0 created 19 October 2004 as “Author-Approved” without modification from version 0.4, and submitted to IPRC for general circulation.