

What Small Businesses and Small Organizations Say About the CMM¹

Experience Report

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Abstract

The United States Air Force sponsored research within the Department of Defense (DoD) software development community to determine the applicability of the Software Engineering Institute's (SEI) Capability Maturity Model (CMM) for Software to small businesses and small software organizations. The research found that small businesses are faced not only with a lack of resources and funds required to implement many of the practices stated in the CMM, but also with the task of basing their process improvement initiatives on practices that do not apply to a small business and small software organization. This paper discusses, from industry's perspective, why small businesses and organizations are experiencing difficulties implementing CMM-based process improvement programs and how they are tailoring their approach to the CMM to meet their quality goals.

1: Introduction

In 1987, the U.S. Department of Defense (DoD) tasked the Software Engineering Institute (SEI) to develop a means to evaluate the maturity of an organization's software development process. The SEI developed a questionnaire and a five-level model, known as the Capability Maturity Model (CMM) for Software [1][2], which serves as a guide to improving the organization's software development process through better management practices. DoD agencies have embraced the questionnaire as a means of evaluating, during contract procurement, the software development capability of their bidders, with the hope of controlling the risks long associated with software development. The method used to identify the bidder with the lowest software risk is called the Software

Capability Evaluation (SCE), which is based on the CMM and its questionnaire.

Now, six years later, not only has the model been updated, but an increasing number of procurements are requiring SCEs of bidding contractors. As a result, DoD contractors have begun viewing software process improvement as a necessary requirement for doing business with the DoD and other government agencies. Numerous complaints about the software process maturity requirements have been voiced by the DoD contractor community, especially by small businesses. Small businesses are finding themselves in the unenviable position of trying to fund costly software process improvement programs without substantially raising their overhead rates. There is a minimum cost that must be borne to initiate a software process improvement program regardless of company size, and thus the overhead rates of small businesses are affected to a greater degree than those of large businesses, which have a larger base over which to spread the overhead costs. Consequently, a small company is faced with becoming less competitive in terms of overhead rate, not only with other small companies that may not be paying for process improvement programs, but also with large companies whose overhead rates are not substantially affected by their software process improvement programs. Small companies are now frequently competing with large businesses for small contracts due to the shrinking DoD market, and they fear that their competitive advantage of lower overhead rates will be lost when paying for software process improvement programs.

Further compounding the problems of small businesses trying to implement a CMM-based process improvement program is the fact that many of the practices within the CMM are not applicable to small projects, which are prevalent in small businesses. The businesses fear that the money spent on software process

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improvement will not enable them to satisfy contract maturity requirements when faced with an SCE team that literally interprets the CMM practices and does not have the software background to recognize alternative practices of small businesses as meeting the goals of the CMM.

Most of the issues raised by small businesses were found to be pertinent also to small software organizations within a large company. When a small organization functions as a separate cost center, it looks like a small business. Moreover, as a small organization, it has many small projects, and, therefore, encounters problems similar to those of a small business in using the CMM as a basis for its process improvement program. Because of the dual applicability of the issues, the small business issues discussed in this paper will refer to both small businesses and small organizations, unless stated otherwise.

2: Research approach

In order to investigate small business CMM issues, it was necessary to gather information from a large number of small businesses and small software organizations throughout the U.S.. The subject companies needed to be familiar with the CMM and to use it as the basis for their software process improvement programs. The research was divided into a survey phase and an interview phase. In the survey phase, a questionnaire was generated and sent to companies that had the potential of fitting a profile of small businesses or organizations with process improvement programs based on the CMM. The questionnaire solicited comments on any issues encountered with, or tailoring performed on, the practices within the CMM. Based on the questionnaire responses, potential problem areas were identified as topics for further investigation in the interview phase, and companies were targeted for follow-up interviews. The details of the survey and interviews are discussed below.

2.1: Survey approach

The goal of the survey was to generate feedback on the state of process improvement programs in small businesses and small software organizations with the following qualifications:

- Knowledge of the CMM

- Active process improvement program based on the CMM
- One or more software contracts with the DoD
- Company or organization of fewer than 500 people, or consultant representing such

A total of 545 survey participants were selected to receive a questionnaire soliciting information on the following topics:

- Company background
- Process improvement program background
- Problems with applying the CMM practices, especially size-related problems
- Tailoring of CMM practices, especially size-related tailoring
- Comments on the CMM

The response rate for the questionnaire was 35% (190 responses out of 545 questionnaires), well above the expected response rate from an unsolicited survey. The distribution of the responding companies was, as follows:

- Small business: 60%
- Small organization: 29%
- Large business: 4%
- Consultant: 2%
- SEI-licensed vendor: 0.5%
- Not applicable: 4%
- Refused participation: 0.5%

2.2: Interview approach

The interviews were used to gather an in-depth understanding of the issues faced by small businesses in implementing a software process improvement program based on the CMM. The questionnaire responses produced a pool of 94 potential candidates for the interviews: 45 small businesses, 45 small software organizations, and 4 consultants. Forty-six of the candidates were selected for the interviews: 25 small businesses, 19 small organizations, and 2 consultants. The interviewee selection was based mainly on the quality of the comments the candidates made regarding problems with the CMM, tailoring of the CMM, or success with the CMM. Two consultants, who had a wide range of small business experiences from which to draw, as well as one company in the process of planning a CMM-based process improvement program, were included as interviewees to offer a different perspective on working with the CMM. Also, three interviewees whose process improvement programs are based on models other than the CMM were included to gain

insight on why the CMM was not selected as the basis for their process improvement program.

The interviews were conducted via on-site visits, telephone conferences, or spot telephone calls. The spot telephone calls focused on specific comments that were made by a company on its questionnaire response and were not intended as a broad-base informational source. The on-site visits and telephone conferences were almost equally divided between small businesses and small organizations. Small businesses were the primary target for the spot calls. The interviews averaged one-half hour for spot calls, one hour for telephone conferences, and two and a half hours for on-site visits. The interviews were conducted with senior level company personnel, typically including the company president, vice president, software manager, and/or Software Engineering Process Group (SEPG) head.

A standard set of questions in script form were generated for the topics to be covered in the on-site visits and telephone conference interviews. The extent to which all questions were satisfied in an interview depended on the process maturity of the interviewee's organization -- the more mature the organization, the more detailed the questions became. The questions focused on the company background and the success or failure of its implementation of the CMM practices as a basis for its process improvement program. The questions were phrased in a non-leading way, so as to elicit unprejudiced responses from the interviewees. The scripts solicited the following information:

- Size of company
- Company organizational structure
- Funding or staffing issues with process improvement programs
- Process improvement staff size
- Assessment/SCE experience
- Problem Key Process Areas (KPA's)
- Tailoring suggestions
- CMM policy, plan, and procedure issues
- Organizational versus project consistency
- Standard software process
- CMM-based issues related to specific KPA's

3: Survey highlights

The questionnaire responses provided a wealth of information about process improvement programs and about those companies engaged in process improvement. This information is discussed below.

3.1: Respondent profile

The following description paints a profile of the respondents by key characteristic and by percentage of respondents satisfying the characteristic.

The average respondent is a small business (60%) with an average software organization size of less than 40 people (61%), from the Middle Atlantic or Northeast region of the country (54%), and is a Government contractor (82%). Not only is the respondent familiar with the CMM (78%), but the respondent has a process improvement program (70%) that has been in place for 2 years or less (65%), and the program is based on the CMM (76%). The respondent more likely is not an SEI subscriber (57%). Furthermore, the average respondent has conducted a SPA (58%), in the form of a self-assessment (66%), but has had no experience with SCEs (74%).

With regard to CMM issues, the average respondent, having a CMM-based PI program in place, stated overwhelmingly that problems had been encountered using the CMM (76%), these problems were due to the organization's size (53%), but the organization tailored the CMM for its own use (65%).

3.2: Respondent process improvement program characteristics

Seventy percent of small business and small software organization respondents have process improvement programs (see Table 1). Only 53% of them, however, have process improvement programs based on the CMM, even though 78% of them are familiar with the CMM. Only 39% of small businesses have process improvement programs based on the CMM, as opposed to 82% of the small organizations. The statistics are equally as unbalanced if process improvement programs in general, not necessarily CMM based, are examined: 58% of small businesses have process improvement programs, while 95% of the small organizations have them.

The disparity in process improvement program existence between small business and small organization respondents was investigated further by examining the distribution of process improvement programs among different sized organizations. One of the goals of the research was to determine at what organizational size do problems with process improvement programs and CMM usage arise (i.e.,

Table 1: Respondent process improvement program profile

Description	All Respondents		SB/SO Respondents	
	Company Total	%Sample	Company Total	%Sample
Respondent sample size	190	--	169	--
Familiar with CMM	140	74%	131	78%
Have PI program	126	66%	118	70%
Have PI program & familiar with CMM	114	60%	106	63%
PI program based on CMM	98	52%	90	53%
SEI Subscribers	81	43%	74	44%

SB=small business; SO=small organization; PI=process improvement

What size is small?). In small organizations, the probability of the existence of a process improvement program in general, and of a CMM-based process improvement program in particular, increased in organizations greater than 20 people (see Table 2). It was more difficult, on the other hand, to find a similar trend within small businesses. There, the strongest showing of process improvement programs is in the 10 to 20 person organizations, with the other sized organizations widely varying until the very largest

organizations, where the statistical base is not high enough to draw any conclusions. More likely than not, the implementation of a process improvement program in a small business is a problem of resources (time, money, and personnel) rather than a problem related to organizational size.

3.3: Survey Findings

The questionnaire solicited both CMM-related

Table 2: Size of average software organization for research participants

Size of avg. sw org. in company	Small Businesses			Small Software Organizations Within Large Businesses		
	# of SBs of indicated avg. org size	% of SBs of org size with PI program	% of SBs of org size with CMM-based PI program	# of SOs of indicated avg. org size	% of SOs of org size with PI program	% of SOs of org size with CMM-based PI program
000-010	42	43%	19%	5	60%	40%
010-020	27	70%	59%	15	93%	73%
020-040	18	56%	50%	9	100%	100%
040-060	10	50%	40%	4	100%	75%
060-080	7	86%	29%	3	100%	100%
080-100	6	67%	50%	3	100%	100%
100-150	1	100%	0%	6	100%	100%
150-200	1	100%	100%	4	100%	100%
200+	1	100%	100%	6	100%	67%

SB=small business; SO=small software organization; PI=process improvement; org.=organization

Note: Over 50% of the companies with average organization size over 10 have multiple software organizations.

comments and general comments from its respondents. In order to elicit more specific information, it also prompted the respondents to describe CMM problems and CMM tailoring due to organizational size. Certain issues stood out as concerns among the respondents (see Table 3). The cost of implementing specific aspects of a process improvement program, the difficult (if not impossible) hurdle of satisfying CMM practices within a small organization, and problems with the CMM as a basic guide are the general areas where the most comments were expressed -- at least half the commenting respondents touched on specific issues in each of these areas. When examining the specific issues, there are items once again that stand out as being of primary concern to the respondents:

- The CMM's usefulness as a process improvement tool
- The cost of implementing a process improvement program
- The cost tradeoffs for process improvement versus other business pursuits
- A corporate culture which does not support process improvement
- The lack of customer support for process improvement initiatives
- CMM organizational or management structuring in conflict with company structuring
- Insufficient resources for a process improvement program prescribed by the CMM

The primary issue of concern to the respondents by far is the lack of resources within both small businesses and small software organizations to support a process improvement program modeled on the CMM practices. The availability of money, personnel, and time to apply to such a program is extremely limited within these companies. The issue was expressed as a concern almost equally by both small businesses and small organizations. Since it is such an important issue, it was further explored in the interviews.

Each issue raised by the respondents was examined in light of the size of the average software organization of the companies commenting of the issue. For the most part, no correlation was established between the type of comment and the size of the organization. However, a few interesting observations were made. One of the small organizations that voiced a concern about the CMM being geared for large companies has an average organizational size of 150-200 people. Apparently, the company felt that it needed to be much larger to apply the CMM practices effectively. A small

organization respondent with an average organization size of over 200 voiced a concern about the costs of a process improvement program, implying cost is an issue even for the larger organizations. The preponderance of companies that voiced a concern for process improvement program costs have average software organizations under 20 people. On the other hand, limited resources are an issue even for average organizations over 200 people.

4: Interview highlights

The interviews were approached enthusiastically by the interviewees, with up to six or more senior members of the company participating in both the on-site visits and telephone conference interviews. One telephone conference took place on a speaker phone with members of the company's SEPG as part of their monthly meeting. Most participants regarded the interviews very seriously, and many of them had prepared ahead of time -- some had reviewed the CMM, some had prepared questions to ask in return, and others had summarized with their staff the highlights and problems encountered in their process improvement efforts. There were companies who followed up the interviews with further suggestions or additional information. The interviews proved to be a highly successful method for discussing issues with the target companies.

4.1: Interviewee profile

The following description paints a profile of the interviewees by key characteristic and by percentage of interviewees satisfying the characteristic.

The average interviewee is a small business (54%) with an average software organization of less than 40 people (64%) from the Middle Atlantic or California area (61%) and is a Government contractor (93%). The interviewee has an established process improvement program (98%) based on the CMM (84%) that has been in place for 2 years or less (78%). The interviewee's organization has a process group (92%) consisting of part-time people (76%) whose process improvement activities are funded at least partially (81%) by the organization. The interviewee has a maturity level goal of level 3 or less (63%), has conducted a SPA (68%) via self-assessment (63%), has not experienced an SCE (75%), and is an SEI subscriber (65%).

Table 3: Respondent CMM Issues

CATEGORY	DETAILED AREAS OF CONCERN	SB	S O	C S	com- pany total	cate- gory total
Better Models	Cleanroom	1			1	8
	ISO9000	1			1	
	TQM	2	1		3	
	Others	2	1		3	
CMM Flaws	Needs more information, coverage	2	5	3	10	45
	Designed for large businesses	10	5	1	16	
	Needs to be more flexible, scaled	6			6	
	New version too proscriptive		1		1	
	Difficult to understand, interpret, use, apply	7	4	1	12	
Costly Impl- ementation	Process improvement programs in general	12	9		21	54
	Documentation	2	1		3	
	Peer reviews	2			2	
	Cost-tradeoffs necessary for ROI, competitiveness	8	4		12	
	Training	7	2		9	
	Vendor assessments	2			2	
	Tools	3	1		4	
	SEPG, working groups		1		1	
Corporate Culture	Environment not conducive to PI (attitude of personnel, historical way of doing software, diversity of sites)	3	6	1	10	10
Customer	Lack of customer support for PI	7	5		12	23
	Diverse customer base	4	3		7	
	Customer environment (type of business, customer standard used)	3	1		4	
Company Resources	Limited time, personnel, money for PI allocation	17	1		31	32
	Limited pace for PI activities	1	4		1	
Management	Management support for PI	3	5		8	8
Project Base	Project diversity (standards difficult, short cycle, small selection)	3	4		7	14
	Types of projects (R&D, prototyping, commercial, classified)	3	4		7	
Unattainable CMM Requirements	Configuration Management	2	1		3	58
	Documentation	4	3		7	
	Independence of groups (dedicated, separate organizations)	5	4		9	
	Organizational structure, management roles	12	5		17	
	Process bureaucracy, SEPG overhead	7	2		9	
	SQA	4	1		5	
	Testing		1		1	
	Training	1	2		3	
	Metrics	3			3	
	Tools, technology	1			1	
Subcontracts	Subcontract management not applicable to most small businesses	2			2	2

SB=small business; SO=small organization; CS=Consultant; PI=process improvement

4.2: Interviewee process improvement program characteristics

The process improvement programs of small organizations by and large do not benefit financially from their existence within a large corporation. Only two out of 18 small organizations are receiving full funding for process improvement initiatives from their parent corporations. Another four organizations are receiving partial funding, and the remaining organizations receive no corporate funding.

The goals of the interviewees' process improvement programs vary, but almost half the companies are aiming for level 3. Very few of them believe that they can achieve a level beyond level 3. Some (8%) of the companies stated that they are looking to improve in general, or in areas where they can derive the most benefit, and, thus, are not targeting a specific level.

4.3: Interview findings

The interviewees were asked specific questions about their perspectives on the CMM and the applicability of its practices to small organizations. The interviewee comments fell into two categories: general comments on the CMM and KPA-specific comments on the practices (see Table 4). Over a third of the interviewees offered general CMM comments, which ranged from a critique of the way the CMM was put together ("vocabulary

needs clarification", "need basic training on the CMM") to its shortcomings as a model ("favors waterfall, does not address prototyping", "does not address if you've always been a subcontractor", "lacks KPAs on reuse, customer satisfaction"). At least six interviewees commented that they would like to see more detail in the CMM in the way of examples, templates, and standard processes to help reduce the costs of generating those items within the organization. Interviewees also questioned if the CMM fits in with other quality programs, and if level 2 in a small organization means the same thing as a level 2 in a large organization.

Most of the KPA-specific comments can be directly attributed to problems that small organizations within both small businesses and large businesses have encountered using the CMM as a model for their process improvement programs. The top three issues, each one accounting for comments from over a third of the interviewees, center on the cost of training, the cost of the separate organizations specified in the CMM, and the needed tailoring of KPA practices unrelated to small organizations. The cost of implementing the training requirements scattered throughout the KPAs is seen as excessive for small companies, which state that they tend to hire senior level people who are highly educated and are already trained for the position. The training costs that must be borne by a small company cannot be amortized over a large number of projects, as can be done in a large company. One interviewee estimated

Table 4: Interviewee Key Process Area (KPA) Issues

KPA	Interviewee Issue
Software project tracking & oversight	Overkill for small project; interaction between managers and staff on an on-going basis because they often work side-by-side.
Software project planning	Proposal team part of software development not feasible -- individuals not always available two years later when award made.
Requirements management	Requirements under control of systems organization, not software organization.
Software subcontract management	Subcontracts under control of contracts organization, not software organization.
Software project planning	Cannot build history on unprecedented systems, which are common in small businesses -- new tools, process constantly changing.
Training program	Formal training a problem, informal training not a problem -- need tailored practices to reflect this.
Peer reviews	Costly to projects from which reviewers taken.
Process measurement and analysis	No depth of project base -- always new systems, new domain; cannot use metrics to generate history; metrics costly to generate, need automation.

that the company would need to be a \$2B company to be able to afford a training program satisfying all the CMM requirements. Another interviewee declared that the company would need to become a university to offer the breadth of required CMM training. Most interviewees believe that a formal in-house training program is beyond their capability to deliver as a small organization, but their tailored training practices could meet the goals of the CMM.

The issue of separate organizations, specifically for Configuration Management (CM), Software Quality Assurance (SQA), SEPG, and technology, is one that taxes the resources of a small organization. Allocating personnel to a group, such as an SEPG, according to recommended percentages [3], produces only a fraction of a person in some organizations. Since that fraction of a person is not enough to accomplish the required tasks, a much higher investment, percentage-wise, must be made by a small organization than by a larger one to form a group. Most small organizations cannot afford full-time personnel dedicated to overhead functions such as SQA and CM. These companies practice role-sharing or share personnel between multiple projects. Independence of groups is more difficult to achieve cost-wise in a project oriented organization. One company that did achieve it, however, was disappointed with the results and returned to a less independent association between groups -- small problems were being raised to too high a level in the organization, so a dotted line association with the higher level management was instituted for unresolved issues to achieve the independence.

The final major KPA issue relates to the needed tailoring of KPA practices that do not apply to small organizations. The interviewees felt that the CMM addresses practices, such as documented policies and procedures, that large organizations need because of their size, and that it further contains language referencing a management structure that is inappropriate to small organizations. Small organizations contend that their people communicate verbally on an on-going basis and the required documentation, especially on a two or three person project, would be counter-productive. One interviewee estimated that as long as the project size remains in the 10 to 15 person range, the formal documentation policies and procedures are unnecessary -- they should come into play only when the team size reaches 20 or more.

The management structure implied in the CMM identifies management positions that do not exist in the flatter management structures of small organizations. The software manager in some cases is responsible for the management of multiple software projects, or, in other cases, has technical responsibilities in addition to managerial responsibilities. Often the manager with software responsibility is an engineering manager, responsible for tasks other than software.

5: Research summary

This paper has discussed many areas in which small businesses and small software organizations have experienced difficulty when trying to implement software process improvement programs, especially process improvement programs based on the CMM. Some of the issues are not necessarily reserved exclusively for small businesses, but pertain also to large businesses. Small businesses, however, have more difficulty with these issues since they lack the resources necessary to resolve the problem areas and do not know where to turn for help.

Small organizations within large companies, in contrast, have their larger parent organizations to support them; however, that support and guidance was found to be very limited in many cases, especially for organizations which function as separate cost centers. The problems of these organizations tend to be overlooked because of their perceived association with the parent company, yet they are experiencing many of the same frustrations as the smaller companies.

Despite their stated problems with software process improvement, small businesses and small organizations realize that their "smallness" can also be an asset. Once process improvement is accepted as a course of action by the management, it is much easier to change the corporate culture and steer the organization toward improvement goals in a small company than in a large company because of less inertia and less bureaucracy in the small company. Three of the interviewees had undergone massive organizational changes to better structure themselves for their quality goals.

Small businesses and organizations also realize that the short-term project duration typical of small organizations can work to their advantage when introducing new initiatives into their process improvement programs. It becomes an easier task to introduce improvements at the inception of a project rather than midway through the project, the latter

course often being unacceptable to a customer who is happy with the way the project is progressing.

Small organizations also reap a size advantage over large businesses in terms of ease of communication within the organization. Not only do the managers in a small organization work side by side with the engineers and therefore maintain a close vigil on the project status, but also organizations outside of software, such as systems, hardware, and test are often co-located with the project team, if not part of it. Communication between these organizations occurs on a daily basis, and their differentiation becomes functional rather than organizational.

Despite the size advantages that do exist within a small business or organization, the disadvantages of being small heavily outweigh the advantages when implementing a CMM-based process improvement program. There are many CMM practices that physically cannot be accomplished by a small organization, even without considering cost implications -- there are insufficient resources in terms of personnel to support separate, independent groups or organizations (e.g., SEPG, CM, SQA, technology), an in-house training program, and a hierarchical management structure (e.g., software manager, first-line manager, mid-level manager)

When taking the cost of process improvement initiatives into account, small businesses are at an even greater disadvantage than large businesses. There is a certain level of buy-in that must be attained to even begin a viable process improvement program. For instance, a minimum amount of effort in terms of personnel is needed to accomplish results. Furthermore, the required documentation must be written regardless of the size of the organization. Even if the amount of descriptive material in some documents can be scaled back in a small organization, the basic requirements of the documentation must be met, and those basic requirements do not scale proportionately to the organization's size.

The subcontractor role that must be assumed by many small businesses places them at a disadvantage with respect to institutionalizing their process. As a subcontractor, a small business is often subjected to the prime contractor's standards and processes and, thus, cannot build a project history based on its own standards, or even common standards, since each prime contractor has different requirements and a different way of producing software. A similar problem exists for those small businesses or organizations who are prime

contractors servicing several customers. Each customer's needs and process requirements differ, so it is difficult to show standardization across projects, and therefore, across an organization. Large businesses may also have many customers, but they tend to have a greater number of projects with the same customer and can show standardization within the domain of that customer.

It seems appropriate at this point to examine the above issues in light of the role that company size plays in them. Software organizations of various sizes participated in both the survey and the interviews. They ranged in size from fewer than 10 to over 200 people -- the median size was 40 people. Very little correlation was seen between the size of the organization and the issues that were raised -- the issues seem to span all sized organizations. As a result, it was difficult to define small, though one organization of over 200 people noticed a definite change in its process improvement needs at 200 people -- the advantages of being small were no longer there, and the economy of scale transitioned into its favor at that size.

The factors that do seem to affect process improvement size issues are a combination of the project size, the organization size, and the company status as a small business versus a large business. When projects are small (especially fewer than 20 people), the project-level CMM practices (e.g., dedicated CM and SQA staff, standard process tailoring, and much of the documentation) do not seem to apply. When the software organization (both within a small business and a large business) is small, the organization-level CMM practices (e.g., independent groups and in-house training program) present a problem. When a company is small (and somewhat less so with small organizations acting as separate cost centers within a large company), the cost issues come into play -- the revenue base is not large enough for a reasonable increase in overhead rate to provide sufficient working capital to fund a viable process improvement program. Large companies can experience process improvement program implementation problems at the project and/or organization levels in small organizations, but it can use the resources of its larger organizations to offset some of those problems. Small businesses, on the other hand, experience the problems at all three levels - project, organization, and company - and do not have the resources to address them at any level.

Despite the barriers to success, there were definitely small businesses and organizations with very successful process improvement programs. Their innovative practices may not meet the letter of the CMM practices, but they certainly meet the spirit of the CMM goals. Factors contributing to their success include the following:

- Quality emphasis in the company as a whole, not necessarily restricted to software and to the SEI's view of software quality
- Customer support of process improvement efforts
- Management business decision that the company's future is in software and therefore in software quality
- Subcontracting or teaming relationship with a larger company of greater process maturity
- Membership in an outside organization providing process improvement resources for its members (e.g., training resources)

It is interesting to note that many of the interviewees stated that they are not looking beyond a CMM level 3, and, in some cases, felt as though they, as a small business, could not achieve beyond a level 3. The more successful companies described above, however, have satisfied mature practices at all CMM levels, including at levels 4 and 5, where their practices are meeting the goals of technology innovation, defect prevention, and process measurement. Their history of pursuing quality in general has given them a broad range of mature practices, though they may not satisfy all CMM level 2 practices, especially if their tailored practices are not taken into consideration. When measuring themselves against the CMM yardstick, they usually find themselves lacking in the areas of documentation and institutionalization of the process. Those areas are now the focus of their current process improvement efforts,

which are attempting to bring their programs in line with the SEI approach.

6: Conclusion

Despite the hurdles that must be crossed, small businesses are trying to improve their software process. Some of them have been involved with quality improvements for years. They want to improve, but they have concerns with being measured against a model whose requirements they cannot rigidly meet. They have been innovative in their tailoring of the model and want those innovations to be recognized as meeting the goals of the CMM. They are not looking for exemptions from process improvement requirements, but are looking for guidance with meeting those requirements, acceptance of their tailored practices, and help in the form of cost relief to meet the regressive buy-in costs of process improvement.

Small business accounts for over 80% of the jobs in the U.S. and for a large percent of its innovative technology. If small businesses can be given the means to improve their software process on terms comparable to large businesses, the U.S. government can only benefit from the access to an even larger pool of mature software developers.

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