A Case Study of Life at Level 5:

Does Your Lung Capacity Really Increase from Breathing the Thin Air Higher Up?

By

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Abstract

It is widely believed that companies that gain success in process improvement have an obligation to share with their community the non-proprietary aspects of their achievement. Doug Englebart, the visionary who mooted the idea for the computer mouse, as well as for cooperative computing, as early as the 1950s, makes the point that such sharing will result in a community of organizations much more capable of improving their work processes quickly and efficiently.

The authors of this paper share that belief. Accordingly, we describe, for other companies to consider in their own situation, the essential information about one company's journey to the top of the SEI's SW-CMM scale.

The Data Warehouse Center of Excellence (DW CoE) located in Bangalore, India, is a division of i-flex solutions limited (i-flex), earlier known as Citicorp Information Technology Industries Limited (CITIL). i-flex is an Indian affiliate of Citigroup, and it develops, sells, and supports banking and financial application solutions worldwide. In November 1999, the DW CoE, established just 2 years before, was assessed at CMM Level 5.

Data Warehousing is a market where technology changes at a frequency of web-months, and suppliers must be able to stay ahead of the technology curve to maintain and grow their share of the market. Therefore, not only must the underlying software and management processes be able to deliver productively and on time, success requires that processes must also be able to change rapidly and systematically.

In 1995 i-flex had approximately 280 staff at two sites, in Mumbai and Bangalore, and was assessed at CMM level 4. Both sites had identical software processes as shown by results from the intense scrutiny of two separate CBA IPIs by the same team within the same month. The DW CoE did not exist at the time. Since then, i-flex has grown to be a 1000-person company. Within a fast-growing company, the young DW CoE has enjoyed even faster growth.

At Level 4 i-flex was making use of the extensive quantitative understanding of process parameters expected by the CMM. Its ability to smoothly roll out new technology and processes had impressed the CBA IPI Lead Assessors even in 1995, nearly satisfying two key process areas (KPAs) at Level 5: Technology Change Management and Process Change Management. However, essential activities of the third Level 5 KPA, Defect Prevention, were absent. This

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history is important for a case study because in the 4 years since the 1995 assessments, the company not only entered a new market and founded a completely new business unit but also re-oriented its process base to focus on defect prevention. We describe briefly how the three Level 5 KPAs are implemented at the DW COE to serve its business strategy – to yield maximum benefit process improvement following the CMM should be driven by business goals.

We believe that one of the features of Level 5 companies is the exercise of emergent properties from highest maturity practices. We use the term "emergent property" in the same sense as in biological evolution: that new and unpredicted features appear as a result of an evolutionary process. The CMM posits an evolutionary path for processes in an organization that systematically improves its software practices. We claim that emergent properties are those that are identifiable as a result of following the CMM, but not predicted by it, and which appear to go beyond the CMM. In other words, emergent properties were not thought of by the authors of the CMM but clearly result from following it.

In the case we present, one such emergent property is the ability to design a methodology with features required by business strategy and to apply it successfully. Another is the banishing of the "mythical man-month" effect of making an already late software project later by adding more staff. At Level 5 processes are so well understood by everyone, even new hires, that people trained for their tasks are interchangeable in their assigned roles. We conclude this paper by taking a brief look at these, and some other such, emergent properties, which we observed at i-flex.

1.0 The Background

1.1 About i-flex

i-flex solutions limited (i-flex), earlier known as Citicorp Information Technology Industries Limited (CITIL), was founded with the mission to enable financial institutions worldwide achieve excellence and competitive edge through effective use of information technology. Established in 1989, this Indian affiliate of Citigroup specializes in providing state-of-the-art information technology solutions to the banking and financial services industry across the globe. It provides a wide range of sophisticated and integrated solutions for retail banking, corporate banking, investment banking, and mutual funds, using current technologies such as Data Warehousing and the world-wide web. i-flex is a global player with over 230 financial institutions as its customers, spanning 67 countries in the Americas, Europe, Middle East, Africa and Asia-Pacific.

i-flex is one of the high maturity organizations as per the principles of the Capability Maturity Model (CMM) developed by the Software Engineering Institute (SEI). It was the first banking and financial software company in the world to be assessed at Level 4 as early as 1995. In what can most certainly be considered a significant achievement, a division of i-flex, the DW CoE, was assessed at Level 5, using the CMM-Based Appraisal for Internal Process Improvement (CBA IPI) method, in October 1999. This was possible because of the organization's strong emphasis on software engineering processes and its commitment to quality.

1.2 The History

i-flex has a long Software Process Improvement (SPI) history. Years before its decision to implement the CMM, i-flex had prepared Standards and Procedures (S&P) manuals based on the experience of its own professionals and the best practices in the industry. Thus the principle of developing software based on well-defined processes was established at an early stage. As a part of the business need, software developers were also required to fill out [KD1]time sheets and account for all their activities. The Software Quality Assurance (SQA) group was established and was responsible for conducting process audits for all the groups in the organization, and was not restricted to software alone.

The early years of i-flex thus provided the perfect setting for the implementation of a formal model for process and quality. In 1994, the Software Engineering Process Group (SEPG) of i-flex compared various software quality models in vogue in the industry, and decided to adopt the CMM. This decision was based mainly on the applicability of the CMM to the core business of software development in i-flex. The senior management of i-flex had set goals such as improvement in productivity and reduction in defect density with obvious business implications. These goals were directly linked to the process improvement goals, as the management believed in the nexus between good process and software quality, which in effect contributed to the business goals.

After having decided that the CMM was the preferred path for i-flex's own process improvement journey, the SEPG mapped the current internal practices to the CMM Key Process Areas (KPA). Based on the practices at that time, it was found that strong management control and estimation techniques satisfied most of the requirements of Requirements Management, Software Project Planning, Software Configuration Management and Software Quality Assurance. The early setting up of a dedicated SEPG function, and the S&Ps, helped institutionalize Organization Process Focus, Organization Process Definition, and Software Product Engineering. i-flex had

traditionally been strong on training and inter-group processes. All these factors collectively led to a natural goal of CMM Level 3, as the bulk of the requirements were already satisfied and what was required was really a combination of change of terminology, introduction of additional checkpoints and in a very few cases, introduction of completely new processes.

1.3 The Level 3 and Level 4 Journey

i-flex always looked at Level 5 as the final objective and Level 3 or Level 4 were considered as intermediate steps. There were some Level 5 characteristics exhibited within the organization even when the CMM Level 3 goal was just getting formalized. As seen later in the first formal assessment of i-flex, the Technology and Process Change Management areas were developed to a significant degree of maturity. Also, the i-flex experience was that certain initiatives would span across KPAs at different levels of the CMM. It was best in such cases to take full advantage of these initiatives by allowing some Level 4 and Level 5 issues to be addressed even while preparing for Level 3. In other words, i-flex deliberately went beyond Level 3 requirements while planning for the Level 3 goal.

Some of the unique initiatives of i-flex may be used to illustrate the point. i-flex is a young organization, with an average age of 27 years. Young professionals like the usage of technology and automation. Process compliance for them is therefore easier when supported and streamlined by process automation. i-flex internally developed a suite of process automation tools, which included QuBase and Promotr. QuBase as it existed in 1995, was the on-line repository of standards, procedures, templates, guides, tutorials, project data, organizational baseline and an ever-growing library of useful information. The software envelope around this information provided a semi-automated process environment and enabled version control of organization-level documents and templates. The process definition, data and analysis in QuBase encompassed all the levels of the CMM, apart from meeting the requirements of the Organization Process Definition KPA. Promotr, the other automation component, was designed primarily as an aid to effective project tracking. As explained earlier, Promotr was designed to be wider in scope than the Software Project Tracking and Oversight KPA required it to be. It allowed metrics collection in the background, and covered some of the aspects of Level 3 and Level 4. In fact, Promotr along with a comprehensive Metrics Action Program, provided a solid foundation for Level 4.

Based on the internal assessments and mini-assessments conducted by external consultants, there was a realization some time in the middle of 1995 that the process improvement activities aimed at Level 3 were actually going far beyond the original scope. It was also observed ~~in~~ that aggressive but tangible goals resulted in higher levels of organizational achievements. This prompted i-flex to change the process improvement goal to Level 4 as that appeared to be the most logical thing to do.

1.4 Unique Initiatives – An Example

The CMM describes “what” is required to achieve a certain level of maturity and individual organizations are free to interpret the same and decide “how” they want to implement it. i-flex did have some unique initiatives based on such an interpretation.

While training is one of the well-understood and commonly accepted requirements of the CMM, i-flex started the training at the top. The process improvement program was launched with a half-day training program for the Chief Executive Officer (CEO) and his team of senior managers. These were the people who would play a crucial role in the implementation of the CMM. Their understanding and their commitment were vital to the success of the process improvement

initiative. As highlighted by the external assessor at that time, a highly committed and knowledgeable senior management was one of the key strengths of i-flex directly contributing to the process improvement exercise. This was followed by an extensive training program covering process concepts, QuBase, and various elements of software engineering.

2.0 Moving To Level 5

2.1 What We Have Achieved

Organizations, even some high maturity ones, are known to struggle with attempts to quantify the achievements of their SPI programs. At i-flex, the framework for measuring the benefits of the SPI program has been in place right from the time that the CMM based program was initiated. While the organization believes that SPI programs, if well implemented and backed up by commitment from the organization, repay themselves several times over, it still engages in periodic quantification and review of these benefits.

We would like to share some important data pertaining to process improvements at i-flex:

The mean annual growth in productivity has been 10 per cent.
The mean annual reduction in defect density has been 20 per cent.
The percentage of rework effort on projects has been halved in 5 years.
The price of non-conformance (as measured by (testing effort + rework effort) / (total effort on the project)) is down by 33 per cent in 5 years.
There has been a Return on Investment (ROI), on SPI investments, of 100 per cent in the first year, progressively going up to 300 per cent in the fifth year.
The SEPG staff strength, as a percentage of the overall organizational staff strength, has halved between 1995 and 1999. As indicated by the above data, this reduction in SEPG manpower does not affect the organization's process improvement initiatives.

The above indicators point to a healthy SPI program, with increasing benefits and reducing costs.

2.2 Defect Prevention Focus

The CBA IPI assessment of i-flex in 1995 had revealed a fact that startled most people in the organization at that time: that while most elements of the Process Change Management and Technology Change Management KPAs of Level 5 seemed to be institutionalized, there were gaps in essential activities related to the third Level 5 KPA, Defect Prevention (DP). So when the organization decided to address the findings of that assessment, it was natural that the focus of the SPI program would be heavily tilted towards DP.

The organization started with a recognition of the fact that business strategy and success includes a total focus on preventing defects, on driving the defect rate in products and processes ever lower. This led to the definition of an elaborate process for defect prevention, the corner stone of which was that defect prevention activities on projects, as well as for the organization, must be planned, and they must be performed in accordance with these plans. A new role, Defect Prevention Champion (DPC), was identified on each project, with one or more members of the project team performing this role. The DPCs are the drivers of DP activities on their respective projects, driving task and phase kick-off meetings, causal analysis meetings, and as the name suggests, championing the cause of defect prevention on projects. The technique chosen for causal analysis was the Root Cause Analysis (RCA) technique of Ishikawa. The DPCs are, in turn, members of an organizational body called the Defect Prevention Board (DPB), which is

convened by a member of the SEPG. The DPB is a forum where the DPCs share the results of RCA on their projects. It uses this data to develop and track organization level action proposals for preventing defects across projects.

An important element in the defect prevention process at i-flex is the link between the quantitative product quality goals of projects and the DP activities on the projects. These activities are directly aimed at the project meeting, and in most cases clearly surpassing, the goals for product quality that have been set using the data from the organization's process capability baseline.

2.3 Management of Process and Technology Changes

Process and technology changes in i-flex are handled in accordance with the principles of the CMM, not because the CMM wants it that way, but because these principles make very good business sense to the organization. So you have the standard pilot-evaluate-propagate path for new processes, and the evaluate-pilot-assess benefits-propagate route for new tools and technologies. The evaluation guidelines are clearly enunciated in QuBase, the organization's standard software process (OSSP), and are consistently applied for all evaluations.

An organization-level body, the Process Change Control Board (PCCB), controls all changes to QuBase. The PCCB comprises members from project teams, the SQA group, and the SEPG. The head of the SEPG is its ex-officio convenor. It deliberates on process change requests that come from members of the organization or can be identified by members of the PCCB themselves. Each request is deliberated upon at length, with members of the organization outside the PCCB if necessary, and an approve-or-reject decision is taken. This broad-based approach to process change management results in two significant spin-off benefits:

- there is a systematic mechanism for the experience in implementing processes to enter the decision making process, and
- implementation of process changes approved by the PCCB is facilitated by having champions from within project groups (who in their capacity as members of the PCCB have approved these changes).

A good example of the business focus of the process management function in i-flex is the manner in which the Iterative Application Development (IAD) methodology was defined for a product line in the DW CoE. This is described in detail in section 3.2.

Changes to tools and technologies are coordinated across the organization by a dedicated team of professionals within SEPG. The "automation champions" in SEPG scout the market for available tools, make this information available to members of the organization, evaluate new tools and technologies before they can be piloted, identify candidate projects for pilot efforts, participate in these efforts, and assess the benefits as demonstrated in the pilot. They then make recommendations on the usage of these tools and technologies, which project teams use to decide what is good for their projects.

Efforts in the direction of induction and propagation of new tools and technologies are guided predominantly by the process improvement goals that the organization sets for itself at the beginning of each year. So, for example, if the primary process improvement goal for a particular year is to drastically improve the productivity on projects, the focus will be on automating those engineering activities that take up the largest chunk of the effort spent by the project teams.

2.4 Outreach to the Organization

One of the factors that we at i-flex believe contributes very significantly to the success of our process improvement initiatives is the participation of large numbers of people from the organization in these initiatives. This participation is through different mechanisms, which are very often flexible enough to enable such participation. For example, members of project teams serve on the PCCB, which is described above. These PCCB members are not senior managers who lay down the rules to be followed by lesser mortals; they are the "lesser mortals" themselves, who are directly involved in implementing the processes, and are therefore aware of the benefits and shortcomings of these processes. Another example of organizational participation in process improvement activities is the role of the DPCs, described earlier. They are members of project teams, and drive DP activities on their projects. In fact, meetings of the DPB are usually convened by a DPC, by rotation.

There are other ways in which the entire organization participates in process improvement activities. The company intranet is used extensively as a vehicle for communicating process improvement activities and results. Some examples of the kind of information that is regularly reported to the organization by the SEPG through the intranet are:

- changes made to QuBase every month,
- minutes of the fortnightly PCCB meetings,
- status of process suggestions that have been received by SEPG,
- minutes of the fortnightly DPB meetings,
- status of DP action proposals,
- a list of process training courses offered, along with the material for each course,
- a list of engineering tools being used in the organization, along with information on where each tool is being used,
- a glimpse of the market for engineering tools,
- evaluation reports for tools, technologies, and processes,
- reports documenting the experiences in using new tools and technologies, and
- a data sheet highlighting some key data on SEPG activities.

This reporting to the organization calls for a significant investment of time and effort from SEPG; however, our experience tells us that each hour invested in this activity is more than well-spent. The "dispersion" of the SEPG role is one of the key success factors in our SPI program. It ensures that it is not "we" who formulate processes, and "they" who follow them; "we" do this for ourselves.

2.5 The Assessment Strategy

As explained above, i-flex (in its earlier incarnation as CITIL) had shown strong signs of "Level 5-ness" even in the CBA IPIs conducted in December 1995. The processes for the Level 5 KPAs, viz., Defect Prevention, Technology Change Management, and Process Change Management, were enhanced, formalized, and implemented soon after this. However, the process management function at i-flex decided to focus on implementing these processes, and strengthening them through periodic internal reviews and assessments, rather than on another formal assessment. A CBA IPI assessment has a cost attached to it, and the management at i-flex, which could already see the benefits of the Level 5 processes, was not convinced that a formal assessment would result in any significant additional benefits.

This thinking underwent a change in late 1998. The trigger for this change was the setting up of a Data Warehouse Center of Excellence (DW CoE) as a division in the organization earlier that

year. Data Warehousing is a cutting-edge technology, and an organization must outpace its [KD2]competitors in assimilating and integrating new processes, tools, and technologies, if it is to remain in business. This business need resulted in a decision to pilot a Level 5 CBA IPI assessment in the DW CoE. Apart from establishing a benchmark for the organization, the pilot would also serve as a catalyst for process and technology changes in the DW CoE. We were, in a sense, applying a basic Level 5 principle – pilot before you propagate – to our Level 5 assessment itself.

Another reason for the DW CoE to be taken up as a pilot assessment was the fact that the growth of this business was more than the average annual growth of i-flex's business. The management of i-flex firmly believed that one of the best strategies to manage the high rate of growth of the organization was "growth through process maturity". Institutionalized mechanisms to deploy this strategy were already implemented across the organization. The DW CoE assessment was to test the efficacy of this strategy: if it could work for the DW CoE, it was definitely working for the other divisions in the organization where the rate of growth was lower. In fact, this was the greatest benefit that accrued to us from the Level 5 assessment of the DW CoE: it reinforced the belief of the entire organization – senior management, SEPG, project teams, the SQA group, and all others – in the fact that we would be able to effectively manage our growth by continuously focusing on the "growth through process maturity" strategy. The process infrastructure at i-flex has the capacity to withstand the "stress testing" which rapid growth is known to subject such infrastructure to.

3.0 Emergent Properties of Highest Maturity Processes

3.1 What Are Emergent Properties?

High process maturity organizations exhibit characteristics that astound even experts in process. We call these characteristics emergent properties and define them, for a software organization following the CMM (or any standard and widely used model of process evolution), as observable characteristics that are recognizably beneficial but not specified in the standard. Such characteristics are surprising and presumably were not foreseen by the standard's compilers and authors. These properties are unintended and desirable side effects, bonuses of very high process maturity.

Emergent properties of such organizations convey the "look and feel" of the CMM. These "look and feel" features result from implementing the CMM key practices so as to enhance quality of deliverables, productivity of effort, and timeliness of output, three main goals for any production or service business. To an impartial observer (such as an assessment team), the "look and feel" features confirm that the practices of the evolutionary model are implemented effectively for the organization's purpose. But the CMM can also be implemented in a checklist manner satisfying the letter of the CMM but not adding value for the organization. Checklist implementations are usually seen as bureaucratic by working Level people, but beneficial "look and feel" features are a sign that process improvement is streamlining practices. The streamlining effect results from reinforcement among similar practices from different process areas. By contrast, checklist implementations often seem a collection of redundant practices instead of an organic whole of mutually reinforcing processes.

We present in the following sections some examples of emergent properties that go beyond the CMM as observed in our case study company.

3.2 Designing a New Methodology

At Level 5 a company would be expected to change its process pro-actively and for strategic business reasons such as outpacing competitors in productivity or quality. But the CMM gives no hint that a highest maturity company would set out to design a standard process intended to place its products as market leaders. This activity is not the same as reverse engineering a competitor's product in order to see how to build a superior one. At Level 5 this emergent property is a complex process. It involves:

- understanding correctly the success factors in an emerging market,
- determining the technical approach favoring those factors,
- predicting the productivity, defect yield and other characteristics of the approach,
- crafting the methodology or life cycle to emphasize the success factors, and
- designing and conducting a controlled pilot experiment to implement the candidate methodology.

After accomplishing the above steps, a Level 5 company will manage the pilot production process to meet or exceed quantitative organization baseline goals for quality (defect density), productivity (function points per person-hour), and timeliness (percent of slippage) and at the same time deliver a successful product for a client. In addition, it will run successive iterations that incorporate lessons learned from earlier phases.

Further, the innovative life cycle iterations will occur in an organization in which all projects are held to the same quantitative merit goals in addition to the usual one of producing products at a profit. A company that is able to implement, as described, its own innovative methodology, has made process improvement a routine, value-added business practice similar to the more common functions such as finance, marketing, and order fulfillment.

i-flex calls this innovative life cycle the Iterative Application Development (IAD) methodology (please see Figure 1). Notice that it is a “meta” version of a disciplined software production life cycle. The software production process, mastered so well at lower maturity levels to generate products, has been generalized at Level 5 to apply to strategic management of a business. For example, the requirements were gathered for a process (not just a product) to excel in a market.

A high maturity company does not have to invent a new life cycle out of the blue, but will use its standard approaches to software production as a library of components. According to the CMM, companies at Level 3 and above will have an OSSP. At i-flex, QuBase, the OSSP, consists of core processes or activities built into the ready-made life cycles from which projects may choose. Because all projects use one of the pre-defined life cycles, and because improvements in life cycles are coordinated by an organization-wide SEPG function, revisions in QuBase become known and used by other projects quickly. This kind of rapid dissemination of lessons learned is one aspect of knowledge creation and is itself a “look and feel” feature of highest process maturity.

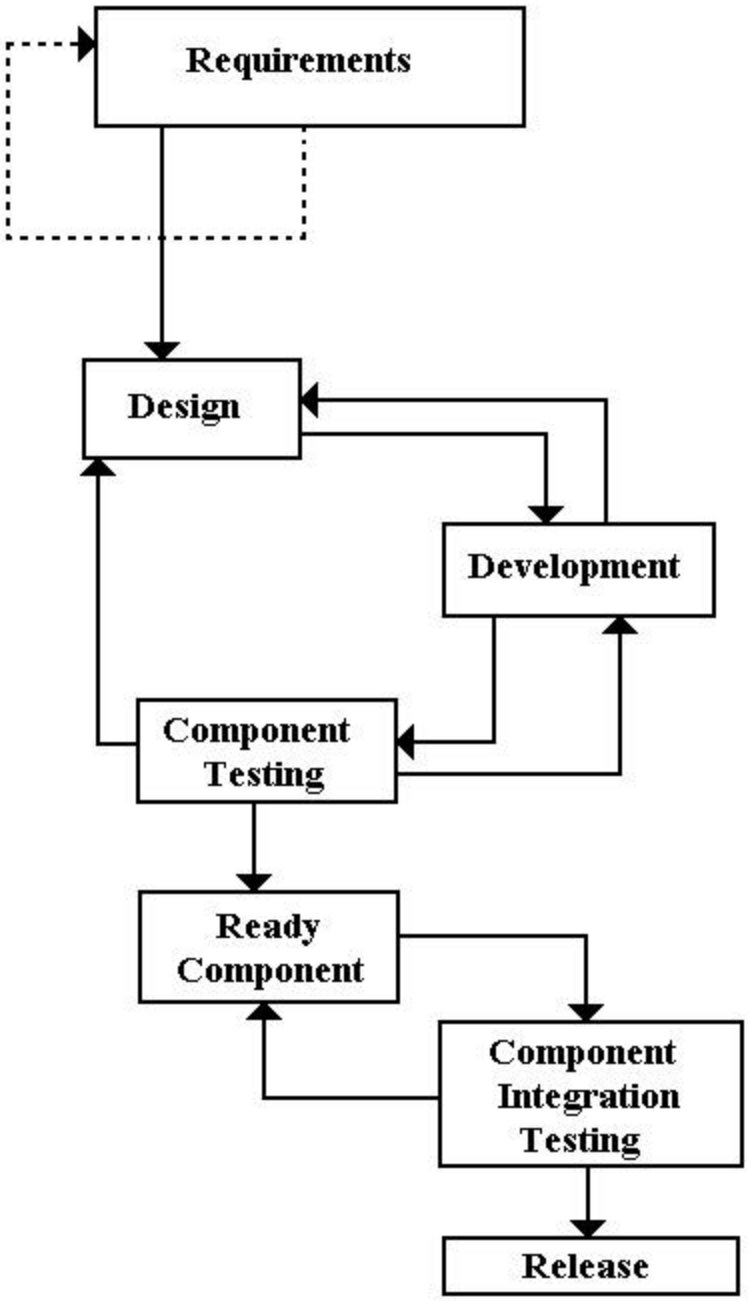

Figure 1: The Iterative Application development (IAD) Lifecycle

For constructing the IAD methodology, QuBase served as a warehouse of tried and proven core components that were woven together with new components into the pilot process. There are some similarities here to the “skunk works” approach to developing innovative products. (The "skunk works" consists of a team of a company's reputed best performers assembled to create a cutting edge technology product, beyond industry experience. The concept arose in the aerospace industry. [i]). But the skunk works is isolated from the "bureaucratic" practices of the rest of the organization, which carries on business as usual. The skunk works is like a training camp for Olympic athletes to which only elite performers are allowed entry. But in a Level 5 case, skunk

works projects are routine pilot projects. And the lessons learned from innovative projects are communicated in near real time to ongoing projects and incorporated into future projects. At Level 5, all workers, management and individuals, share best practices; everyone attends the Olympic camp.

3.3 Banishing the Mythical Man-Month

There is a commonly accepted maxim in software engineering that adding workers to an already late project usually makes the project even later; thus the added "man-months" often have the unintended opposite effect of lengthening, not shortening, the schedule [ii]. The reason is that new staff are unfamiliar with the project details and current staff must take time budgeted for production to train or otherwise accommodate the newcomers.

One of the emergent properties of Level 5 processes is that workers can be shifted from current tasks, assigned to a project slipping its schedule, and help to bring that project in on time, while schedules on their home projects are adjusted to remain on track. Thus the CEO of such a company enjoys an added and unforeseen benefit of highest process maturity [iii]. Mythical man-months become real in a Level 5 company because of its process infrastructure. The OSSP consists of core processes that are robust and well understood from previous use, and updated via the rapid spreading of lessons learned on their use and continual improvement by the SEPG. Also, employees are trained in the details of core processes for their current assignments as well as given orientation in other processes followed in the company. (In the CMM, training is enough instruction to perform a task, while orientation is enough to understand a task without being able to perform it.) All workers and managers understand not only the core production processes like requirements management, software construction, configuration management, etc., but also the core meta-processes like defect prevention, software quality assurance, analysis of data and its use to control processes, and process improvement itself. It is the combination of effective training, routine and expert use of best practices, quantitative insight into project status by means of current performance data, and the known effect on performance of adjusting resources that banishes the mythical man-month.

3.4 A "Beyond-Training" Training Program

The training program in a Level 5 company also has beneficial side effects. In i-flex, the training program is effective for its own sake in developing or enhancing the skills of people for their functional, technical, managerial, and behavioral roles. There is a small professional training staff of five people out of a work force of more than a thousand. But training courses in QuBase are developed with inputs from users of the process, and many courses are delivered by practitioners. The company benefits not only from the new skills given to trainees, but accomplishes technology transition by spreading the knowledge assets of expert process users. In lower maturity organizations the technology transfer may happen informally by "walking around" or by assigning veterans and newcomers to the same team. At very high maturity levels the technology transfer is planned, and occurs according to the delivery schedule of a formal training program. Further, the expert practitioner can be spared from a revenue-producing project to train others because the standard lifecycles of QuBase are managed quantitatively, with measurement data, much like an automated manufacturing process. The ROI from using expert practitioners as trainers is known and controlled optimally.

3.5 Built-in Intergroup Coordination

One of the "key," or important, process areas of CMM Level 3 is Intergroup Coordination. When implemented effectively, all the various company functions or groups involved in a project – technical, managerial, financial, marketing, delivery, etc. – interface smoothly to deliver a quality product at acceptable cost. At low process maturity levels, such cooperation is often missing, with the various functions operating independently and often counter-productively.

One of the fears often expressed by people in companies implementing the CMM as a checklist is that it will create extra paperwork and obstructive bureaucracy. This fear may come from the description of the Intergroup Coordination key process area in the CMM, which recommends, among other practices, an intergroup coordination plan [iv], a document that strikes many people as unnecessary.

But intergroup coordination in i-flex enjoys the emergent property of being entirely transparent: coordination among groups happens naturally by following the usual core processes for executing a project. An example is the project initiation process itself. In the early stages of a project, while information is gathered for the company decision whether to fund the project, the intended project leader estimates the various resources needed. Factors like effort (in person-hours); skill levels of staff; physical office space, computers and software tools; funding for travel and other expenses; support from SQA, configuration management, documentation specialists, and field support are estimated roughly and entered into a planning template. When the estimates are complete, e-mail messages are generated automatically by the process environment, available on every person's desktop computer, and sent to appropriate destinations.

The heads of the various groups that must supply needs to a new project receive their e-mail messages: Facilities Management for office space, telecommunications bandwidth, and computers; Finance Department for funding; Training Department for skill needs; Human Resources for staff availability; the Quality Manager (who is also responsible for the SEPG function) for quality assurance and process support. These managers in turn prepare the estimates of their own needs in order to satisfy the potential project. At a scheduled negotiation session, the various managers meet to adjust their available and potential resources against project needs. When all the managers are satisfied that they can provide the project with needed resources, the project receives a project id. The project id signals the commitment of the company to implement the project, enables the project to appear in the various tracking mechanisms of managers and workers, and kicks off the various groups to supply their resources – trained staff, money, physical space, hardware – at the proper time. During the project's life cycle these commitments are tracked at formal reviews similar to the kick-off.

Thus a seemingly bureaucratic document like an intergroup coordination plan is seamlessly woven into the usual steps for initiating and managing a project. Coordination among groups is a nearly invisible background activity on every project. The standard process, the easiest and most efficient way to work, is the very anti-thesis of bureaucracy because high maturity processes are streamlined.

4.0 Conclusion

Participating on a CBA IPI assessment team can be a grueling experience, with long days of intense work. One of the joys of assessments, especially in a very high maturity environment, is observing the emergent properties and "look and feel" features that the CMM doesn't mention. One of the lessons one learns is that effective process improvement is innovative, going beyond the literal interpretation of the CMM. Perhaps the most noteworthy emergent property is one that summarizes the look and feel of true process maturity as a permanent business practice: an unstoppable momentum for continual improvement not dependent on individuals. This characteristic is what the CMM was designed to achieve and the CBA IPI to measure: the institutionalized ability to produce superior software routinely.

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