Software Process Technologies and the Competitiveness Challenge

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Abstract. Competitive quality is a need for the progress of the Information Technology sector. For enterprises, *process* is the starting point of all the approaches in the achievement of competitive quality. Despite these widely accepted hypotheses, we fail to demonstrate that Software Process Technologies are really adopted by enterprises. In this position paper we want to stimulate the discussion about the practical adoption of process technologies proposing two issues. First, following the demand for quality, work in the field of process technologies must be directly addressed to quality achievement. Second, if we want to "sell" process technologies, we have to propose to enterprises an incremental approach that minimises investments and promises quality results in the short term.

Introduction

Information Technology (IT) is one of the key sectors, probably the most important one, that will drive technological and economical progress in the next century. Research and practical applications will contribute to new infrastructures for social interaction, scientific research, industrial production, and business activity [1].

IT enterprises have to transform research achievements in products and services able to satisfy the needs and the expectations of the market. It is a great business opportunity, but it is also a hard challenge: enterprises have to compete keeping low prices and offering better quality.

Software Process Technologies (SPTs) collect the results of a wide research area. Up to now, many proposals for formal definition, evaluation, and partial automation of the development process, were suggested by the SPTs research community. Can such results become useful tools for the enterprises engaged in the competitiveness challenge?

Demand for Process, Product, and Project Quality

Process quality is an axiom of the Total Quality Management approach. Such imperative is explained by the natural remark that good results seldom arise from bad processes. More practically, when production has industrial dimensions a (good) process is needed to organise and control the development activities.

Process quality is the focus of many initiatives aimed to assess and improve the capabilities of the enterprises. The ISO 9000 standards define the requirements of a specific structure inside the enterprise organisation – the *quality system* – that imply the definition and the control of all the enterprise processes. The next revision of the standards, foreseen for late 2000, will be even more process-focused [2]. In the IT sector, and particularly in software production, *Software Process Assessment & Improvement* (SPA-I) methodologies were defined with a twofold goal: customers use them to assess and select their suppliers, suppliers use them to improve their organisation. From the original CMM [3] to the almost defined ISO 15504 standard [4], SPA-I methodologies are the most practical tools for the application of the TQM concepts in the software production.

However, competitiveness of enterprises is proportional to the value/cost ratio of their products – where products are both goods and services. Value/cost is the most practical way to define *product quality*. In this perspective, process quality is functional to achieve product quality. Effective processes reduce defects and improve the value of products; efficient processes decrease costs; flexible processes let the enterprise successfully face the demand for innovation and the changes in the market.

Another way to approach competitive quality is to look at *project quality*. Process quality focuses on its correct definition, on compliance to standards, on application of best practices. Such issues aim to give confidence of the enterprise capabilities. Project quality focuses on management of resources and activities, on control of costs and schedule, on result verification and risk prevention. Project quality aims to detect and timely solve the problems that may lead to a project failure.

Process, product, and project quality are different ways to approach quality as a way to be competitive. Process quality is not a silver bullet [8], however, seems to be a common factor and a needed requirement in all the perspectives. Suppliers have to show good processes to demonstrate their capabilities to customers (and this is pure process quality). Then they have to show a faultless project management, but, because projects are instantiations of the enterprise process, process quality is necessary for project quality. At last, suppliers have to deliver results fully compliant with the customer requirements; again, timely quality control requires a well defined and correctly applied process.

All these arguments lead to consider the process as the starting point in the competitiveness challenge. As TQM gurus say and European funding initiatives propose, enterprises have to invest in their processes, to understand them, to define them, to assess them, to improve them, but most of all to use them to set up sound projects and deliver better products.

SPTs Technologies and Quality Achievement

Several proposals and solutions have been developed in the field of SPTs. Description, evaluation and control are the main approached issues: using this perspective we can classify research and applicable results in three different areas:

- *process definition and enactment*; this is the software process modelling area, which general aim is to formally define the process and to provide enactment environments that execute the process program controlling development tools and delivered products;

- *process assessment and improvement*; this is the SPA-I standard and methodologies area, which main aim is to define a capability framework to assess the processes and define improvement paths;
- *project planning and management*; this is the area devoted to tools for project support, which comprehends tools for planning and tracking of activities, resource allocation, cost control, and automation of documentation management and flow.

Besides their goals and specialisation, these areas are also characterised for their typical contexts. Each of them is the result of a different path that often reached its maturity without much sharing with the other areas. Process definition and enactment has its typical context in the research community. The latest results in process assessment and improvement belong to the context of the international standardisation bodies. Project planning and control, including workflow and document management (read *version & configuration control*, when applied to software development), is a field well covered by continuously evolving commercial tools.

The idea of joining the efforts is natural and already discussed. We have to fill gaps between different areas, to develop common concepts and principles, to exploit the achievements of each others. Several good motivations to these goals were proposed in [5]. Here we want to add to the discussion a new perspective that aims to facilitate the introduction of SPTs in the enterprises.

Rather than classify SPTs from the perspective of historical evolution, we propose six *technology levels*. The idea is to propose to enterprises a defined improvement path in the adoption of available technologies. The order we propose follow the natural availability and maturity of specific SPTs and aims to maximise the return-of-investment for the enterprise. At the lower levels there are technologies that are more suitable as the first ones to be adopted in an enterprise. Higher level technologies are to be introduced later so that they can take advantage of the already established lower technologies. Table 1 defines the levels: for each technology level we identified the possible direct benefits in terms of quality achievements.

At level 0 there are the tools for activities support. Tools for basic workflow, version and configuration control, documentation management, and personal scheduling do not address the process, they just support and partially automate simple activities. However, their integration and customisation capabilities can be exploited in the process perspective. Tool customisation, often requiring not trivial programming efforts, is the first attempt of formal process definition that is a move toward level 1: adoption of languages to define, to understand, and to argue about the enterprise processes. Level 2, process measurement, has now to be seen as the marriage of the process formalisation with the assessment goal. In the new perspective, a formal assessment is not an audit performed by severe assessors, but a measure taken on a process definition. At level 3 the formal definition of the process is used to instantiate the enterprise projects giving actual values to deadlines, efforts, and resources. Level 4 introduces automatic control of project critical parameters as a valuable tool for decision support. Last, level 5 is the final goal of the SPTs area: enacting environments that completely control the process and automate manual activities.

While adopting the 0-5 mystic range, we do not refer to the classical process maturity scale. However, there is an underlying idea of increasing maturity, both in the perspective of the adopting enterprise and in the complexity of the technologies themselves.

Level	*Technology*	*Benefits*
0. support tools	tools that automate and support basic activities	• more efficiency • better control of activities
1. process languages	languages for formal process description	• better comprehension and training • more customer confidence
2. process measurement	formal measurement and assessment of the process	• better compliance to standards • more customer confidence
3. project templates	automated instantiation of processes in projects	• better planning and resource allocation • higher standardisation
4. project control	automated verification of costs and schedule	• early detection of problems • budget and schedule control
5. automated enacting	automation of manual activities	• implied correctness of performed activities • more efficiency

Table 1. Levels of Software Process Technologies

Up to now there exist technologies at all the levels, but low levels are better covered: there is a wide offer of commercial support tools – and commercial means used. Several process formalisms were defined, and, at the moment, UML is probably the best runner. Many SPA-I methodologies were proposed, and an international standard is upcoming. Some tools for project planning offer features similar to project templates. While tools for controlling costs and resource allocation do exist, enactment environments are still research prototypes.

Unfortunately, we lack, for instance, a process language useful for formal ISO 15504 assessment, that can be interpreted by personal schedulers naturally integrated in an enacting environment that exploits configuration management tools and fully supports project instantiation and control. In fact, neither the ISO standard is completely defined.

Marketing Conclusions

The challenges of the IT sector in the next years and the demand for quality seem good reasons for IT enterprises to invest in the adoption of SPTs to improve their processes. However, experience shows a completely different situation.

We directly participated in a survey about software process in the enterprises of Central Italy [6]. A similar survey was performed at European level [7]. Both surveys show enterprises that have grown as their main goal, but score low maturity levels and

display very scarce intention about SPTs investments. European funding initiatives are successful, but the absence of spontaneous investments shows that IT is a sector in which enterprises want to be subsidised for improving their organisation.

A possible reason is that customers do not push for quality: they are forced to accept the delivered quality because the IT market is still captive. Suppliers at the moment have benefits from such situation, but they have to face the risk of a quick change – as already happened in other sectors – with strong customers and new smart competitors.

Technologies have to follow the demand for quality: we must be very conscious of this issue and accordingly direct the research if we want to "sell" our SPTs. Moreover, we have to propose the application in the enterprises following an incremental approach that requires affordable investments and promises quality results in the short term.

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