Software Process Improvement: The New 'Silver Bullet'?

ir. Hans Sassenburg

In this article, Hans Sassenburg shows how opposite trends in the software industry have led to an increased interest for the software development process and its improvement. Also within The Netherlands the SPI concept is rapidly gaining acceptance. Based on experiences from his daily consulting practice, Sassenburg warns to not only focus on the Process, but also on People and Technology.

Introduction

From the end of the eighties onwards it became clear that the use of information technology tools in our society would expand enormously. This trend is characterized by, among other things, revolutionary developments in the software industry. But the problems experienced in the management of projects are becoming progressively greater. Budgets are substantially exceeded, delivery times are not met, the ultimate product does not satisfy expectations and, in addition, it contains many defects. In the past, numerous *silver bullet* solutions have been put forward to cope with the problems outlined. The use of advanced methods/techniques and the acquisition of certificates has often cost a great deal of time and money, but has seldom led to the desired result. Managers are often completely at a loss and ask themselves how these problems can be solved. In recent years an increasing interest in improving the software development process has been observable: Software Process Improvement. This article deals with the question of the extent to which this attention to the process alone is sufficient, together with an explanation based on a practical example.

The software crisis

Tumultuous developments are taking place in the software industry. Turnover in *embedded software* – software incorporated into products such as television, audio, telephone, medical and telecommunications equipment – will increase sharply in the coming years. A growth from two to twenty billion guilders in Europe is forecasted. Observable trends are the following.

- A substantial growth in the use and complexity of software in products and as stand-alone products.
- More demand for open systems with standardized interfaces, so that link-ups can be made to other (standard) products.
- Greater importance of hierarchical and robust architectures, aimed at future adaptations and expansions.
- Ever-larger and more highly-qualified development teams, working on a geographically scattered basis.
- The availability of progressively newer techniques.
- An increasingly higher investment level for the development of new products.
- A strong growth in subcontracting projects to specialized companies (within The Netherlands, as well as to low-wage countries).

Running counter to these trends within both companies and government organizations there is unrelenting pressure aimed at the following items.

- Shortening project lead times, so that products can be introduced faster to the market.
- Increasing productivity by operating more efficiently.

- Improving customer-mindedness by fulfilling prior agreements in which functionality, quality, costs, and delivery times are laid down as precisely as possible.
- Anchoring activities in the organization in order to search continually for and implement improvements: the self-teaching organization (TQM).

The areas of conflicting interests which have thus arisen are not new. Numerous attempts have already been made in the past to find an appropriate answer. Among other things, this was sought in the use of advanced methods and techniques. The results were disappointing, however. At the end of the eighties, excessive attention suddenly emerged for the ISO-9001 standard, together with the appertaining ISO/9000-3 directive. Many organizations have attempted to obtain certification as quickly as possible. This has often become a goal in itself and that certificate is mainly used as a commercial visiting card. As such, these certificates have made scarcely any contribution to achieving a structural improvement in the management of projects. So what is the answer?

Process approach

Even in undisciplined organizations one occasionally comes across projects which have worked extremely successfully. The success of such projects, however, is generally attributable to the heroic efforts made by a project team instead of following a disciplined procedure laid down for the organization, and therefore applied to every project. Because of the absence of a clearly established process, future results depend entirely on the availability of these same people for a subsequent project. If success depends on the availability of people, this cannot constitute the basis for long-term continuity and improvement. That can only be achieved by establishing and continually improving those processes which play a part in software development for the whole organization. This idea is beginning to be more and more widely accepted and is known as *Software Process Improvement*.

In 1986 the Software Engineering Institute (Pittsburgh, USA) – at that time headed by Watts S. Humphrey – started developing a *process maturity framework* to help organizations improve their software development processes. This was prompted by a request from the American government (Department of Defense) to supply a method for assessing suppliers with regard to their ability to implement software projects effectively. After years of experience with this framework, based on investigations carried out in many companies, this led in 1991 to the release of the *Capability Maturity Model* (CMM). The CMM distinguishes between five levels of maturity which an organization may have reached. This stratified structure is based on ideas of quality gurus such as Deming, Juran, and, particularly, Crosby (*Maturity Grid*).

SPI in The Netherlands

In our consultancy work, we increasingly come across companies which embrace the SPI concept and use the CMM as a reference framework for improving their software capability. At the start of the nineties, this was still confined to larger, internationally operating companies which were active in extensive embedded software projects. Among them were Ericsson, Holland Signaal, and Philips. Many millions of guilders were invested in extensive improvement programmes. Slowly but surely attractive results are now beginning to become visible. Do not forget: here it is a question of "invest first, earn later". Following the example of these organizations, the SPI concept gradually also found application in smaller organizations, but still in the area of embedded software. Since 1995, however, we have seen a clear change taking place. The entire banking and insurance business is paying great attention to SPI and major improvement programmes will start up in 1996. It is, of course, interesting to see that the problems in this business are identical to those in the technical field. Our experience in numerous organizations shows that the software industry in The Netherlands is in no way inferior to that in other countries. It turns out that over 85% of the

SPI Organizations

I would like to draw the reader's attention to the existence of two interesting organizations in The Netherlands where SPI/CMM regularly appears as a topic on the agenda.

SPIder
In 1995, a national network was set up for SPI on the initiative of (amongst others) ICT Automatisering in order to exchange experiences in this field. Meetings devoted to special themes are organized four times a year. Three working groups which meet on a more frequent basis are also active within the network. These working groups are: 'Introduction strategies for SPI', 'Metrics', and 'SPI in smaller organizations'. Over 150 people from various organizations are at present active within this network.

Further information can be obtained from

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ESPI Foundation
This European network, with representatives in the various countries of Europe, was formed at the end of 1995. ESPI is represented in The Netherlands by ICT Automatisering. ESPI works in close cooperation with the Software Engineering Institute (USA) and the European Software Institute (Spain). ESPI is currently organizing seminars throughout Europe (April 3rd in The Netherlands) and will also organize an international conference in Amsterdam from 24-27 June. Leading international experts will meet for four days to exchange experiences.

Further information about this network and the conference can be obtained from the author.

organizations known to us are in the bottom regions of the CMM. We only come across more mature organizations occasionally, and these are generally small development departments in small organizations.

Other possible solutions

The Software Process Improvement concept and the Capability Maturity Model as a reference framework are rapidly gaining in popularity. Numerous organizations are taking this process approach on board and regard it as the latest *silver bullet* solution. Is this euphoria justified? A comparison with a completely different discipline may possibly prove instructive: the construction world.

Control parameters
A number of control parameters can be distinguished in the construction world which may be regarded as important for the successful completion of a building project: the quality of the construction plan, including working agreements, the availability of the necessary tradesmen, and the availability of the right tools. A comparison with the software industry is given below.

Construction world	Software industry
• construction plan, incl. working agreements	• development processes
• tradesmen	• training, experience, skills
• tools	• technology

All control parameters are important, both in the construction world and in the software industry. Placing too much emphasis on only one of the parameters is too one-sided and will result in sub-optimization. After all, what good are excellent tradesmen if the construction plan displays too many defects? What is the point of the most modern tools if there are no well-trained specialists available to use them?

Proposition 1: All control parameters must be in balance with each other.

Requirements
Secondly, one may ask oneself which requirements must be met by the various control parameters. Does it make sense to impose the same requirements on the construction plan, the tradesmen and the tools for building a garage as for building a new Golden Gate Bridge? Of course not.

Proposition 2: The ultimate requirements at the level of the control parameters are determined by the characteristics of the product to be realized.

By analogy, in the software industry it may be said that aiming uncritically to achieve the highest CMM level is not useful for every organization.

Priorities
Now let's assume that the level of all the various control parameters is not in accordance with the characteristics of the product to be realized. Which control parameter should then take priority? In the software industry at present it is said that attention to the process should take priority. But is this really true? Would you give preference to a good carpenter with a bad hammer or a poor carpenter with a good hammer?

Proposition 3: People constitute the most important control parameter in every discipline.

Opting for good tradesmen will prove to be the most justified choice in every case. When it comes to making a choice in the software industry, it is therefore probably advisable to invest in recruiting and maintaining qualified staff in addition to improving the development process or buying the latest technology.

Assessments

Since the start of the nineties, we have increasingly come into contact with organizations which want to use SPI and CMM. The questions most frequently put to our consultants are the following.

- How much does a CMM assessment cost?
- How do we reach the next CMM level as quickly as possible?

On the basis of the propositions above, caution is advisable. In every organization which asks us these questions we try to show that

- In addition to attention for the dimension *Process*, attention to other control parameters is desirable: *People* and *Technology*.
- It will be necessary to identify the characteristics of the present and future products (*Product*) in order to be able to decide what requirements must be met by the various control parameters.

Only then can a sensible strength/weakness analysis of an organization be made. In every case, we have found that organizations appreciate this expansion of scope and that, in particular, the management is delighted with this. The reason for that lies in the fact that in this way an attempt is made to also find out what over-arching business objectives are eventually aimed at. Recommendations resulting from an assessment should be brought into line with each other as far as possible here.

Assessment phases

An assessment generally proceeds as follows.

1. Preparation (lead time: 2-4 weeks)
In this phase, the organization to be investigated is studied on the basis of an organization description, available manuals, and some intake interviews. Next, the scope of the research is determined in consultation with the client by selecting a number of representative projects. The persons to be interviewed during the implementation phase are then selected.

2. Implementation (lead time: 2-4 days)
The interviews are held during this phase. Before

they start, a kick-off presentation is given to all those directly involved. A crucial role is reserved for the client in convincing all those concerned with the need for the investigation by pointing out the main business objectives. Next, the interviews are held. These are strictly confidential and open in nature. For this reason, it is preferable not to allow the client to be present at the interviews unless otherwise explicitly agreed. On average an interview lasts for 1.5 hours.

3. Analysis (lead time: 2-4 days)
The information collected during the implementation phase is analyzed in this phase. Firstly, on the basis of the characteristics of the product it is decided what requirements would have to be satisfied by the control parameters *People*, *Technology*, and *Process*, both in the present situation and within three to five years. After that, the maturity level of each control parameter is determined on a scale of 1 to 5. The CMM is used as a reference for *Process*. The risks, conclusions, and recommendations are drawn up. All this information is recorded in a report. The recommendations are generally long-term in nature, varying from one to two years.

4. Reporting (lead time: 1 day)
In this phase the report is discussed with the client. First, there is a discussion with the client himself and later a presentation is given to all the persons interviewed, as well as others concerned and interested parties. Once again, a crucial role is reserved here for the client in promising everyone involved that the recommendations made will actually be followed up in practice.

5. Follow-up (lead time: 1 year)
The last phase of an assessment is also the most important phase. On the basis of the recommendations made, the client will have to decide how an improvement process can be initiated and what resources will have to be made available for this purpose.

Practical example

In 1994, we carried out an assessment in a company which specializes in automation applications in the petrochemical processing industry: depot monitoring, data acquisition, process control, and trend analyses. First, we were asked to analyze a project which had gone off the rails and to help it to get back on course as quickly as possible. By mutual agreement, however, it was decided to make an assessment covering several projects in order to try to analyze the *capability* of the entire software development department. The results are presented in Figure 1. The characteristics of the type of product mean that the control parameters must at least be at Level 3. It was found however, that the *People* and the *Process* dimensions fell short in this respect (CMM Level 1). It proved that the so-called software developers had little or no training in information technology; their backgrounds varied from biology to electrical engineering. The development process we encountered had not been laid down, which resulted in unrealistic planning, unclear working agreements, and an ad-hoc approach to work. On the basis of the recommendations made it was then decided to start three improvement processes.

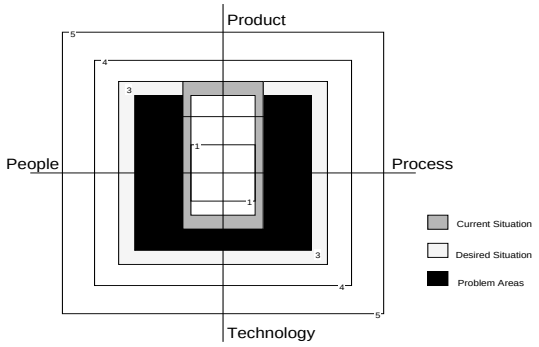

Figure 1: Maturity diagram

- Recruiting some experienced information technologists.
- Setting up a training programme for the present development engineers.
- Improving the software development process.

Despite the high investment level required for this, the company is now in a much better position to plan new projects in terms of budgeting and lead times and the quality of the end products is increasing. The number of complaints reported by customers has decreased by a factor of four, despite a doubling of the installed base.

Conclusion

This article has dealt with the increasing attention being paid to improving the software development process. In The Netherlands, we see an explosive growth in this interest, particularly in the banking and insurance business. By making an extrapolation to the construction world, however, an attempt has been made to show that attention to other control parameters is also important. Recruiting qualified and experienced staff and keeping them motivated probably deserves even higher priority and is at present an extremely difficult issue, given the tightness of the present labour market. In addition, intelligent use should be made of the available technology as a support in the development process. The challenge will lie in managing to find the correct balance between these different control parameters in relation to the type of product being developed. In that sense, SPI therefore cannot and must not be described as the *silver bullet* solution. Such solutions do not exist. □

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Short News

Internet access for XOOTIC members

Members of XOOTIC whose employers do not provide Internet access can make a request for a user account on the OOTI machines. The accounts are meant for providing basic facilities like electronic mail and World-Wide Web access. Available disk space is limited to 5 Mb per person. Please note that dial-in accounts are not provided. EUT's Compute Centre ('Rekencentrum') offers this service for the annual fee of Dfl. 300. For more information, contact dr.ir. Marloes van Lierop, tel. (040) 247 4448. □

OOTI's External Advisory Board

OOTI's External Advisory Board has been extended. The configuration at present is as follows.

prof.drs. M. Boasson, HSA, Hengelo
ir. F.J. Heerema, NLR, Emmeloord
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OOTI in numbers

The following table shows since the start of the OOTI course in 1988 how many students have started the course per year, and how many of those did or did not complete the entire course.

Generation	88	89	90	91	92	93	94	95	Total
Started	14	7	7	20	21	31	28	23	151
Dropped out	2	0	0	5	3	1	2	-	13
Graduated	12	7	7	15	18	30	-	-	89

OOTI student numbers over 1988-1995

N.B. The generation of year N contains the input between August 1 of year N and August 1 of year $N+1$. □