

# State of the Art and Future of Research in Software Process Improvement

Miguel A. Serrano  
Center for Research in Mathematics  
masv@cimat.mx

Software Process Improvement (SPI) is a relatively new area, developed in the last twenty years. Most ideas in SPI were adopted from the theories and methodologies for quality in manufacturing systems developed in the last few decades by *Shewhart*, Deming, Crosby, and Juran [1,2,3,4]. In the last years, we have seen an explosion in the number of methodologies, models, appraisal methods, and research in SPI [5], such as the ISO/IEC 15504, CMM, CMMI, Agile Methodologies, ISO 9000, Balbridge, Six Sigma, etc. [6,7,8,9,10] to mention a few. Furthermore, each model and methodology is supported by different groups of people and research groups, which makes it difficult for practitioners, university teachers, and researchers to be able to understand, teach, adopt, and apply those best practices for the development and maintenance of software and systems.

In spite of the adoption of methodologies and models such as the CMM, CMMI, ISO 15504 by some organizations for the development and maintenance of software and systems, still the majority of the organizations worldwide are unaware or do not even have any SPI initiative. A challenge in the present time is to permeate the concepts and principles of SPI to the majority of organizations and people working in the development and maintenance of software and systems. That will not happen efficiently and effectively until we introduce those concepts and principles into the body of knowledge of university programs in computer sciences and software engineering. Furthermore, the generic concepts and principles in any quality related area (engineering, management, SPI, etc.) are all the same, and should be introduced in the regular curricula of any educational program, at all levels, in an incremental way, instead of training the workforce in a late stage to make up for those deficiencies. Another major problem facing research and evolution in SPI is the separation of work and research in industry and researchers in academia. Most SPI work and development of methodologies in the last years have been driven by the industry. Academia and university researchers have had almost no impact.

SPI is an experimental and practical field and research in this area must be driven by experiences and data. An important field to explore more in the future will be Statistical Process Control (SPC) in software and systems environments, which vary from the SPC field in manufacturing, where large populations and samples of

data exist. Research fields such as theory of sampling, measurements, design of experiments, reliability, and statistical analysis should be explored under the constraints of small amounts of data for software and systems. Another area of study will be the variability of the human factor in the development and maintenance of software and systems. In addition, areas such as teams, groups, and even psychology in individuals and groups behavior should be studied and related to the findings of SPC. Finally, a considerable amount of data and experiments under different settings and environments (e.g., size of projects, type of projects, domains, etc.) will have to be recorded and analyzed to produce studies that drive future SPI research.

## References

- [1] Shewhart, W., *Economical Control of Quality of Manufactured Product*, Van Nostrand, 1931.
- [2] Deming, E., *Out of the Crisis*, MIT Press, 1986.
- [3] Crosby, P., *Quality Is Free*, McGraw-Hill, 1979.
- [4] Juran, J., *Juran on Planning for Quality*, MacMillan, 1988.
- [5] Sheard, S., "Evolution of the Frameworks Quagmire", *IEEE Computer*, Vol. 34, No. 7, 2001, pp. 96-98.
- [6] International Organization for Standardization, "ISO 9001:2000: The International Standard System for Assuring Product and Service Quality", 2000.
- [7] International Organization for Standardization and International Electrotechnical Commission, "ISO/IEC 15504 Software Process Improvement and Capability DEtermination Model (SPICE)", 2001.
- [8] CMU-SEI CMMI Team, "Capability Maturity Model Integration (CMMI-SE/SW/IPPD/SS) Version 1.1", *CMU/SEI-2002-TR-011 and CMU/SEI-2002-TR-012*, 2002.
- [9] Tayntor, C., *Six Sigma Development Software*, CRC Press, 2003.
- [10] Cockburn, A., *Agile Software Development*, Addison Wesley, 2002.