UPGRADE is the European Journal for the Informatics Professional, published bimonthly at <http://www.upgrade-cepis.org/>

Publisher
UPGRADE is published on behalf of CEPIS (Council of European Professional Informatics Societies, <http://www.cepis.org/>) by Novática <http://www.ati.es/novatica/>, journal of the Spanish CEPIS society ATI (*Asociación de Técnicos de Informática*, <http://www.ati.es/>)

UPGRADE monographs are also published in Spanish (full version printed; summary, abstracts and some articles online) by Novática

UPGRADE was created in October 2000 by CEPIS and was first published by Novática and INFORMATIK/INFORMATIQUE, bimonthly journal of SVI/FSI (Swiss Federation of Professional Informatics Societies, <http://www.svifsi.ch/>)

UPGRADE is the anchor point for UPENET (UPGRADE European NETwork), the network of CEPIS member societies' publications, that currently includes the following ones:
- Informatica, journal from the Slovenian CEPIS society SDI
- Informatik-Spektrum, journal published by Springer Verlag on behalf of the CEPIS societies GI, Germany, and SI, Switzerland
- ITNOW, magazine published by Oxford University Press on behalf of the British CEPIS society BCS
- Mondo Digitale, digital journal from the Italian CEPIS society AICA
- Novática, journal from the Spanish CEPIS society ATI
- OCG Journal, journal from the Austrian CEPIS society OCG
- Pliroforiki, journal from the Cyprus CEPIS society CCS
- Tölvumál, journal from the Icelandic CEPIS society ISIP

Cover page designed by Concha Arias-Pérez
"Full Steam Ahead" / © CEPIS 2009
Layout Design: François Louis Nicolet
Composition: Jorge Llácer-Gil de Ramales

Editorial correspondence: Llorenç Pagés-Casas <pages@ati.es>
Advertising correspondence: <novatica@ati.es>

UPGRADE Newslist available at
<http://www.upgrade-cepis.org/pages/editinfo.html#newslist>

ISSN 1684-5285

Monograph of next issue (December 2009)

"Privacy and Identity Management"

(The full schedule of **UP**GRADE is available at our website)

CEPIS UPGRADE
The European Journal for the Informatics Professional
http://www.upgrade-cepis.org

Vol. X, issue No. 5, October 2009

Monograph: Experiences and Advances in Software Quality
(published jointly with Novática*)
Guest Editors: *Darren Dalcher and Luis Fernández-Sanz*

UPENET (UPGRADE European NETwork)

CEPIS NEWS

* This monograph will be also published in Spanish (full version printed; summary, abstracts, and some articles online) by **Novática**, journal of the Spanish CEPIS society ATI (*Asociación de Técnicos de Informática*) at <http://www.ati.es/novatica/>.

The Software Process Improvement Hype Cycle

Miklós Biró

This paper provides a historical perspective on the state of the field of software process improvement (SPI). Just as process improvement itself, the development of our expectations regarding process improvement can be viewed following a staged model which is analogous to the popular Gartner Hype Cycle for innovation. The stages highlighted in this survey are characterized by the issues in their primary focus which are mostly not forgotten at all in later stages but rather further expanded and becoming more mature. The characteristics of the identified stages are: awareness of process capability weaknesses triggered by the software crisis and CMM, SPI and ISO9000 expectations, bridging the trough of disillusionment, enlightenment leading to further recognition of the importance of business goals, plateau of spreading to other disciplines and models, trough of doubts and new triggers, plateau of reconciliation and industrial adoption. The hype cycle view of historical development can contribute to the appreciation of the role of various approaches to software process improvement, as well as to the better comprehension of the way their combination can benefit the industry.

Keywords: Agile Development, Bootstrap, Business, CMM, CMMI, Hype Cycle, ISO 9000, ISO/IEC 15504, Manifesto, Maturity, Process Capability, Quality, SPI, SPICE.

1 Introduction

Early software quality initiatives concentrated on the measurement of the quality of the software product. Boehm and McCall worked out their software quality models at the end of the 1970's [1][2]. The recognition of the fact that the software development process itself is the factor having the most significant impact on software quality dates back to the end of the 1980's and leads to the innovation embodied in the Capability Maturity Model for Software (also known as the CMM and SW-CMM) that emerged from work done primarily by Watts Humphrey [3] grounded in the tradition of Total Quality Management (TQM). The CMM was a real innovation expected to have a significant impact in overcoming the software crisis which has occupied our attention for a long time.

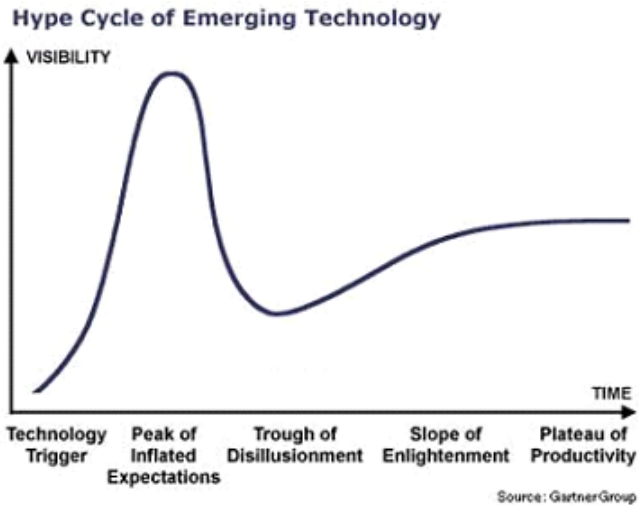

Figure 1: Hype Cycle Phases Applicable to any Innovation.

Author

Miklós Biró is associate professor with habilitation at Corvinus University of Budapest with over three decades of software engineering, university teaching (including professorship in the USA), and management experience. He has a Ph.D. in mathematics (operations research) from the Loránd Eötvös University in Budapest, an Executive MBA degree from ESC Rouen, France, and a Master of Science in Management degree from Purdue University, USA. He is fluent in Hungarian, English, and French. He has initiated and managed the Hungarian participation and consulting activities in numerous European projects and organizations. He is the author, co-author of Hungarian and English language books and numerous international publications in the fields of Software Engineering Management, Decision and Negotiation Support Systems, Combinatorial Optimization, etc. He is member of the Editorial board of the journal *Software Process Improvement and Practice* published by John Wiley & Sons, member of the Hungarian Doctoral Council and of the Public Body of the Hungarian Academy of Science. He is founding president of the professional division for Software Quality Management of the John von Neumann Computer Society, the Hungarian national representative in Technical Committee 2 (TC-2) Software: Theory and practice of the International Federation for Information Processing (IFIP) where he is coordinator of the Manfred Paul Award. <miklos.biro@uni-corvinus.hu>.

It is a characteristic of human nature in uncertainty-tolerant cultures [4], that innovation triggers significant interest followed by inflated expectations which are naturally not fully met. The resulting disillusionment may be followed by a deeper understanding and sober adoption of the innovation which will have matured by then. This is the idea of the popular concept of Hype Cycle coined in 1995 at the Gartner information technology research and advisory company based in the U.S.A. Referring to the complete analysis of the subject [5], the phases of this hype cycle (see Figure 1), originally applied to emerging technologies but applicable in fact to any innovation, are:

1. *"Technology Trigger"*
2. *"Peak of Inflated Expectations"*

3. *"Trough of Disillusionment"*
4. *"Slope of Enlightenment"*
5. *"Plateau of Productivity"*

The software process improvement movement started with the CMM being a significant innovation. The hype cycle was triggered at the end of the 1980's and went through phases which do not entirely follow the one promoted by Gartner. The reason for the difference is the support and acceptance of the model by the U.S. Department of Defense which helped the CMM avoid the full trough of disillusionment by supporting continuous innovation in the form of the Capability Maturity Model Integration (CMMI) for example. CMMI is both the result and the further catalyst of the spreading of process maturity models to disciplines other than software development. This plateau of spreading to other disciplines and models is followed by the trough of doubts and new triggers like agile software development with a new hype cycle starting with new expectations. Feelings are still high, however the light of reconciliation on a new plateau of industrial adoption is already visible.

This paper gives an overview of the progress of software process improvement along the phases of the altered hype cycle:

1. Awareness of process capability weaknesses triggered by the software crisis and CMM.
2. SPI and ISO9000 expectations.
3. Bridging the trough of disillusionment.
4. Enlightenment leading to further recognition of the importance of business goals.
5. Plateau of spreading to other disciplines and models.
6. Trough of doubts and new triggers.
7. Plateau of reconciliation and industrial adoption.

The particularity of this software process improvement hype cycle is exactly the bridging of the trough of disillusionment by the supported continuous innovation of the CMM which led to version 1.0 of the CMMI in the year 2000 followed by new high expectations, a plateau of spreading to other disciplines, another trough of doubts, and the current new plateau of reconciliation and industrial adoption.

While this phasing may generate controversy due to overlaps in the case of various approaches, as well as to the breadth of opinions reflected in the vast literature of the field, it allows the structuring of results which are impossible to fully list in this paper. The exact phrase "software process improvement" gave 245,000 results in Google and 12,400 in Google Scholar on 15/07/2009.

2 Awareness of Process Capability Weaknesses Triggered by the Software Crisis and CMM

There is no need today to highlight the significance of software in our everyday life from the provision and consumption of services to the management of business processes. It is a commonplace consequence that the timely and cost effective development of good quality software is crucial for both software consumers and software developer organizations which coexist in an increasing number of businesses. It was already estimated in the 1990's, that in Europe, 70% of software development was carried out by organisations whose core activity was not software [6].

On the other hand, software is a special product whose development requires technical and management skills which lie outside the culture and resources of most enterprises. Let's see just a few characteristics of software which make it special among industrial products.

- Mass production of software does not require any special consideration at design time, contrary to most industrial products.
- Wear and tear of software is not due to the physical impact of the environment, but mostly to obsolescence.
- The testing of software is both practically and theoretically far more complex than that of other products.

These are fundamental reasons for the software crisis which led to the recognition of the significance of process capability and organizational maturity by the end of the 1980's.

One of the most cited proofs of the software crisis is the Standish Group Chaos Report which has been regularly published since 1994. Even the recently published 2009 results show that only 32% of all projects were succeeding (i.e. delivered on time, on budget, with required features and functions), "*44% were challenged (i.e. late, over budget, and/or with fewer than the required features and functions) and 24% failed (i.e. cancelled prior to completion or delivered and never used.)*" [7].

As mentioned in the introduction, the process improvement movement, intended to overcome the software crisis, was initiated by the SW-CMM developed under the leadership of Watts Humphrey at the Software Engineering Institute (SEI) [Humphrey, Sweet 1987]. Its fundamental recognition was that the quality of the process determines the quality of the product. This slogan became more and more accepted in industrial production in general and in the software industry in particular [8].

The supported continuous innovation of the CMM professionally bridging the trough of disillusionment of the generic innovation hype cycle, naturally following the peak of SPI expectations discussed in the next section, is illustrated by the following fact:

"*The SW-CMM was retired on December 31, 2005.*

- *All SW-CMM appraisal results from CBA IPI and SCE appraisals will expire on December 31, 2007.*
- *After December 31, 2007, all SW-CMM ratings will be considered invalid and should not be advertised.*" [9].

Nevertheless, despite the innovations introduced by the later discussed Capability Maturity Model Integration (CMMI) and ISO/IEC 15504, the original SW-CMM maturity levels depicted in Figure 2 continue to determine the cognitive schemes of professionals.

3 SPI and ISO9000 Expectations

An important milestone of the software process movement in Europe was the establishment of the Bootstrap Institute in 1994. The significance of this step is described

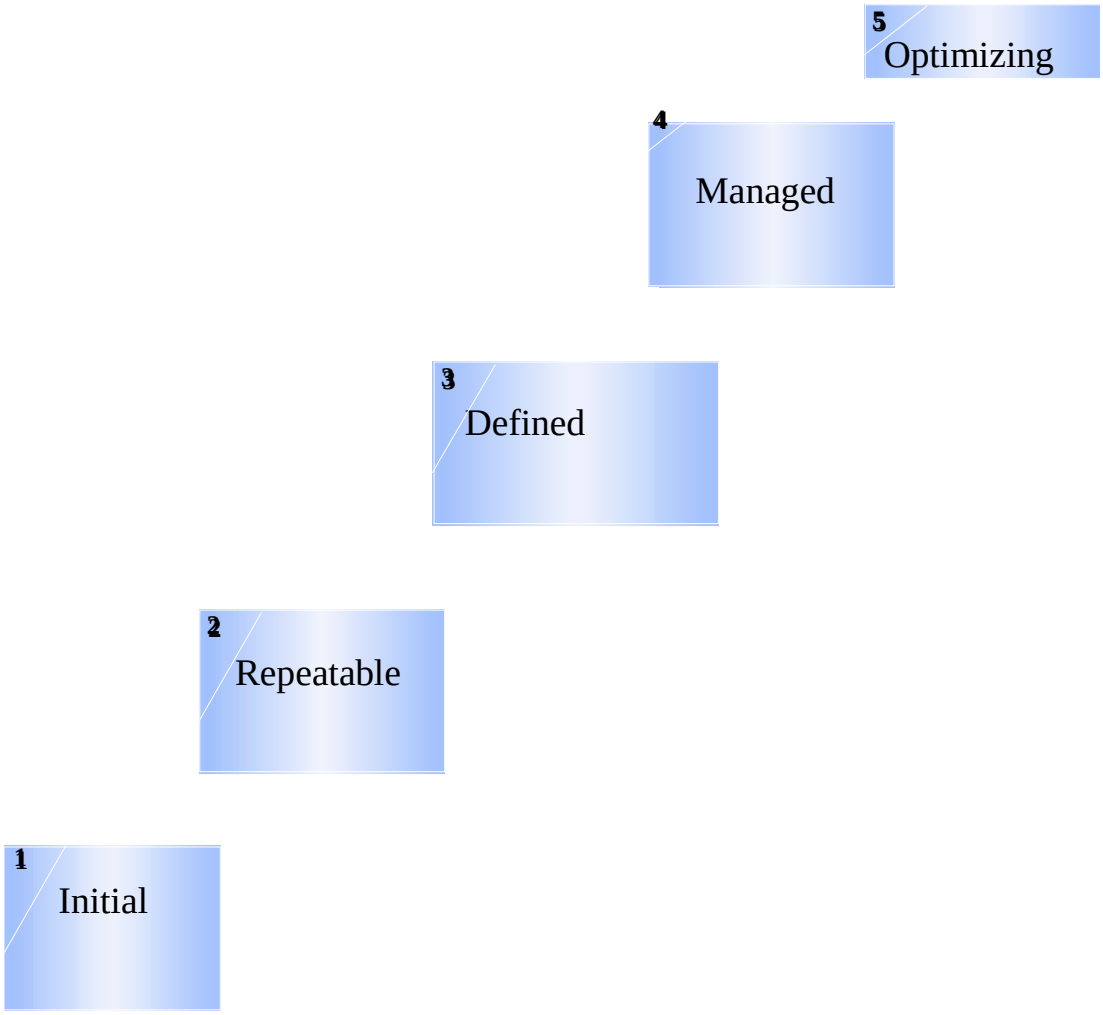

Figure 2: The Original SW-CMM Maturity Levels.

among others in the publication [10] on the the European Software Quality Network. The BOOTSTRAP methodology was developed in the framework of the EU ESPRIT programme and combined the following approaches: Software CMM, ISO 9001/9000-3, European Space Agency Software Engineering Standard PSS-05-0, and DoD-STD-2167A.

A parallel movement also rooted in Total Quality Management (TQM) and taken into account in Bootstrap was the ISO 9000 series of standards first published in 1987 followed by the ISO 9000-3 Guidelines to the Development, Supply, and Maintenance of Software in 1990. ISO 9001:1987 focused on quality control via retroactive checking and corrective actions, ISO 9001:1994 emphasised quality assurance via preventive actions, while ISO 9001:2000 (as well as ISO 9001:2008) made expectations of continuous process improvement and tracking customer satisfaction explicit. It is returning to the common TQM roots and converging to CMM [11]. This convergence is particularly apparent in the ISO 9004:2000 Guidelines for performance improvements where a CMM-like staged model is presented.

In addition to the ISO 9000-3 guidelines, there exist other types of international software quality standards whose relationship to the ISO 9000 series is enlightening. It was already described in the introduction, that the evaluation of the quality of a software product is one of the basic issues in information technology. A system of product quality criteria was summarized in the ISO/IEC 9126 standard which is evolving today into the ISO/IEC 25000 series. The first level of the criterion hierarchy contains the following six elements: functionality, reliability, usability, maintainability, portability and efficiency. The business decisions that are supported by this standard are as follows:

- Does the software requirements specification adequately reflect the user requirements?
- Does the developed software satisfy the user requirements?

Biro and Turchanyi [8] highlight however fundamental business decisions which are not supported by systems of product quality criteria and which justify the existence of the ISO 9000 series of standards as well as that of software process assessment and improvement approaches which go beyond ISO 9000. These decision problems are:

- The customer's decision problem: Is the supplier able

to sustain the reliability of its production?

- The supplier's decision problem: How can we improve the reliability of the production?

ISO 9000 certification is intended to support the customer's decision by focusing on the process rather than on the product. Nevertheless, certification is a yes/no decision which provides little support for the supplier's decision problem. It is precisely software process assessment and the corresponding improvement action plan which serve the fulfillment of the supplier's need.

4 Bridging the Trough of Disillusionment

One of the major criticisms of ISO 9000:1994 was that its introduction became a burden with the overwhelming "ISO bureaucracy" which was only meant to control the production and was not ready to adapt to the permanent change of processes, technology and customer demands. This problem led to heavy disillusionment in ISO 9000 during the 1990's which is keeping up today as well despite the new 2000 versions which are theoretically much more flexible. The blame for the continuing criticism rests with the consultants and auditors as well, who are rarely open to new paperless approaches otherwise permitted by the standard which can even be combined with model based process improvement like CMMI and the emerging ISO/IEC 15504 international standard.

One of the experiences successfully combining model-based process improvement with the achievement of ISO 9000 certification is described in [12]. The main lessons derived from this experiment are the following:

- The approach of considering the improvement of the maturity level as the principal objective and the achievement of ISO 9001 certification as a side-effect is valid from the efficiency point of view.
- Even if ISO 9001 certification is not the principal objective of process improvement, it is worth capitalizing on its high recognition by allocating appropriate resources to its achievement.
- According to international experiences, there is usually a significant decline of attention towards the quality system after the ISO 9001 certificate is granted. The approach of considering certification as a side-effect of overall process improvement helps avoiding this trap.

Disillusionment regarding the CMM can be accurately detected in the literature. Goldenson and Herbsleb [13] write: "*Still, we detect more than a little discouragement about the pace of process improvement. About a quarter of our respondents say that 'nothing much has changed' since the appraisal. Almost half say there 'has been a lot of disillusionment over the lack of improvement.' Over 40 percent say that process improvement has been overcome by events and crises and that other things have taken priority. Almost three-quarters tell us that process 'improvement has often suffered due to time and resource limitations'; over three-quarters say that process improvement has taken longer than they expected; over two-thirds say that it has cost more than they expected.*"

The SEI conducts however systematic research to measurably identify success factors and to uncover myths, and also to publish these results. This fact is well illustrated by the following quotation from [14]: "*In our survey, we were able to compare success rates of organizations of various sizes operating in different sectors in order to see if these factors played a major role in determining success. Most organizations in the survey were in the commercial (23), government contractor (19), or government (12) sectors, and our results show no systematic differences in the success rates among these sectors.*"

These measurable and well published research results, together with considerable work invested into the development of the also well publicized Capability Maturity Model Integration in the year 2000, contributed to bridging the trough of disillusionment of the CMM hype cycle.

There was however another earlier mentioned SPI initiative, Bootstrap, whose life-cycle ended in 2003. Bootstrap and actually the CMM itself were on the other hand precursors of the international standardization initiative called *Software Process Improvement and Capability dEtermination* (SPICE) which went through a long and turbulent trial phase during the 1990's. SPICE survived the trough of disillusionment due to a complete rework including generalization to all processes not restricted to those related to software.

The finally published standard is ISO/IEC 15504 whose new parts are still appearing nowadays. According to the decision of ISO in May 2009, 15504 will be replaced with the 31001 series of standards.

5 Enlightenment Leading to further Recognition of the Importance of Business Goals

ISO bureaucracy has already been mentioned as a burden preventing the achievement of business goals including flexible adaptation to the continual change of processes, technology and customer demands. After signs of disillusionment, other SPI approaches were also rediscovered in the context of their potential contribution to business success. And this is actually one of the gateways to level 4 in the reworked and published ISO/IEC 15504 standard as well.

This issue is systematically discussed among others in the chapter on "*The Software Process in the Context of Business Goals and Performance*" of the book written by Biró and Tully [6] still quoted by business consulting experts [15], as well as the paper by Biró, and Messnarz [16] which analyse the ways in which software process improvement can provide leverage for a firm from the financial, operating, production, marketing, and human behavioural perspectives.

A further issue, which becomes highly relevant to the rising globalization of business operations, is the consideration of the differences in cultural value systems when introducing new management processes. This issue is discussed in the context of SPI in [4] and [7].

6 Plateau of Spreading to other Disciplines and Models

As already discussed, the continuous innovation of the CMM resulted in the publication of the CMMI in the year 2000 which was an answer to the need best expressed by a quotation from the publicly available [18] document itself :

"*Since 1991, CMMs have been developed for myriad disciplines. Some of the most notable include models for systems engineering, software engineering, software acquisition, workforce management and development, and integrated product and process development (IPPD).*

Although these models have proven useful to many organizations in different industries, the use of multiple models has been problematic."

The most recent model integrated into the CMMI Framework is CMMI® for Services 2009 [19] which "*draws on concepts and practices from CMMI and other service-focused standards and models, including:*

- *Information Technology Infrastructure Library (ITIL)*
- *ISO/IEC 20000: Information Technology—Service Management*
- *Control Objects for Information and related Technology (CobiT)*
- *Information Technology Services Capability Maturity Model (ITSCMM)*"

The interaction of CMMI is however mutual with these and other standards and models whose most recent versions themselves refer to the popular process capability and organizational maturity framework.

As already mentioned, one of the innovations of the published ISO/IEC 15504 international standard (Information technology - Process assessment**)** is precisely its generalization to all processes not restricted any more to those related to software. This feature resulted in the development of a number of business domain-specific models like Automotive SPICE and SPICE 4 SPACE.

New models are being developed like Enterprise SPICE which "*will integrate and harmonize existing standards as determined by the stakeholders to provide a single process reference model and process assessment model that addresses broad enterprise processes. It will provide an efficient and effective mechanism for assessing and improving processes deployed across an enterprise*" [20].

It must be highlighted that while CMMI, ISO/IEC 15504, as well as ISO 9000 are apparently developed independently, they have a natural and intended mutual influence on each other. On the one hand, the "*SEI continues to work with industry and government to align the CMMI Product Suite closely with ISO/IEC 15504*", on the other hand it "*is also working with the international standards community to influence the continued development of 15504 along with key process reference models such as those for ISO 9001, ISO/IEC 12207, and ISO/IEC 15288*" [21].

7 Trough of Doubts and New Triggers

Doubts in the effectiveness of approaches, which were summarily characterized as "heavyweight", culminated in the Agile Manifesto whose essence is well expressed by the following paragraph:

"On February 11-13, 2001, at The Lodge at Snowbird ski resort in the Wasatch mountains of Utah, seventeen people met to talk, ski, relax, and try to find common ground and of course, to eat. What emerged was the Agile Software Development Manifesto. Representatives from Extreme Programming, SCRUM, DSDM, Adaptive Software Development, Crystal, Feature-Driven Development, Pragmatic Programming, and others sympathetic to the need for an alternative to documentation driven, heavyweight software development processes convened" [22].

The Agile Manifesto highlights the imminent sources of disillusionment by pointing out the higher value it attributes to:

- *individuals and interactions over processes and tools,*
- *working software over comprehensive documentation,*
- *customer collaboration over contract negotiation,*
- *responding to change over following a plan.*

And there is an important additional sentence which opens the way to the following phase of the hype cycle: "*That is, while there is value in the items on the right, we value the items on the left more.*"

In fact, agile methods have roots dating far earlier than the manifesto. Two of the most prominent representatives of the direct roots are Barry Boehm with the spiral model for software development [23], and Tom Gilb who was the first to argue for very similar principles in his evolutionary method for software engineering management already in the 1970's, and who published the recognized book [24] before the wide appearance of the CMM.

A clear effect of the agile movement is that it triggered a new hype cycle where it may itself approach the trough of disillusionment which has even received a rotund name: "death of agile", which may on the other hand be no more than the result of malpractice in many cases.

8 Plateau of Reconciliation and Industrial Adoption

There are numerous signs of reconciliation between the "heavyweight" and agile worlds starting with the CMMI itself, which recognizes both the spiral and the evolutionary development lifecycles, through the mentioned additional sentence of the Agile Manifesto, to the message of the book entitled "*Balancing Agility and Discipline: A Guide for the Perplexed*." [25].

A recent technical note published at the SEI [26] further recognizes that: "*CMMI and Agile can complement each other by creating synergies that benefit the organization using them. Agile methods provide software development how-to's that are missing from CMMI best practices that work well—especially with small, co-located project teams. CMMI provides the systems engineering practices that help enable an Agile approach on large projects. CMMI also provides the process management and support practices that help deploy, sustain, and continuously improve the deployment of an Agile approach in any organization.*"

As far as reconciliation with the ISO/IEC 15504 com-

munity is concerned, doors have always been open shown among others by the pertinent abstract of a most recent paper [27]: "*In the last two decades several models for evaluating software process capability have been defined and became more and more popular. The application of such models, and in particular the ISO/IEC 15504, determined a general software process improvement in many domains. Nevertheless, the application of the ISO/IEC 15504 standard is still considered by many agile developers as incompatible with agile approaches. Such an attitude is mainly based on common misunderstandings on what the ISO/IEC 15504 is and on what its application involves. This paper aims at showing that this standard, if genuinely applied, can be effectively used also in agile contexts.*"

Integrating all approaches with the aim of benefiting the software, systems and services industry, an associated event will take place at the annual European Systems & Software Process Improvement and Innovation Conference 2009 <http://2009.eurospi.net/> in Alcalá de Henares near Madrid, creating the Manifesto for SPI with initial supporters from a wide international community.

9 Conclusion

The last couple of decades were rather turbulent in the field of software process improvement among others. The hype cycle model can be used to cognitively domesticate the understanding of this turbulence as shown in this paper.

The future will hopefully lead to mutual appreciation of the special advantages of the different approaches to software process improvement as well as to better comprehension of the way their combination can benefit the industry.

References

[1] B.W. Boehm. Characteristics of software quality. North Holland, 1978.

[2] J.A. McCall. The utility of software metrics in large scale software systems development. IEEE Second software life cycle management workshop, August 1978.

[3] W.S. Humphrey, W.L. Sweet. A Method for Assessing the Software Engineering Capability of Contractors. Software Engineering Institute, CMU, Technical Report CMU/SEI-87-TR-23, 1987.

[4] M. Biró, R. Messnarz, A.G. Davison. The Impact of National Cultural Factors on the Effectiveness of Process Improvement Methods: The Third Dimension. Software Quality Professional (ASQ~American Society for Quality) Vol.4, Issue 4 (September 2002) pp.34-41. <http://www.asq.org/pub/sqp/past/vol4_issue4/biro.html>.

[5] J. Fenn, M. Raskino. Mastering the Hype Cycle. Harvard Business Press, 2008. ISBN-10: 1422121100.

[6] M. Biró, C. Tully. The Software Process in the Context of Business Goals and Performance. Chapter in the book entitled "Better Software Practice for Business" Benefit (edited by R. Messnarz, C. Tully). IEEE Computer Society Press, Washington, Brussels, Tokyo, 1999. ISBN 0-7695-0049-8 <http://eu.wiley.com/WileyCDA/WileyTitle/productCd-0769500498.html>.

[7] The Standish Group. CHAOS Summary 2009. <http://www.standishgroup.com/newsroom/chaos_2009.php> (accessed on 15-Jul-2009).

[8] M. Biró, P. Sz.Turchányi. Software Process Assessment and Improvement from a Decision Making Perspective. ERCIM News (European Research Consortium for Informatics and Mathematics) No.23 (1995) pp.11-12. <http://www.ercim.org/publication/Ercim_News/enw23/sq-sztaki.html>.

[9] Software Engineering Institute. Sunset Information for SW-CMM. <http://www.sei.cmu.edu/cmmi/adoption/sunsetreminder.html>. (accessed on 15-Jul-2009).

[10] M. Biró, É Feuer, V. Haase, G.R. Koch, H.J. Kugler, R. Messnarz, T. Remzsô. BOOTSTRAP and ISCN a current look at the European Software Quality Network. En: The Challenge of Networking: Connecting Equipment, Humans, Institutions (ed. por D. Sima, G. Haring). (R.Oldenbourg, Wien, München, 1993) pp.97-106.

[11] M. Biró, É. Feuer. Convergence of the Software and Systems Engineering Capability Maturity Models (CMM, CMMI) and ISO 9000:2000. Proceedings of the X Quality Week International Conference (ed.by A.Róth, I.Jancsovics). Hungarian Quality Society, 2001, pp.136-141 (in Hungarian).

[12] M. Biró, J. Ivanyos, R. Messnarz. Pioneering Process Improvement Experiment in Hungary. Software Process: Improvement and Practice Volume 5, Issue 4, 2000. pp. 213-229. John Wiley & Sons, Ltd. <http://www3.interscience.wiley.com/cgi-bin/abstract/76503384/START>.

[13] Dennis R. Goldenson, James D. Herbsleb. After the Appraisal: A Systematic Survey of Process Improvement, its Benefits, and Factors that Influence Success. Technical Report CMU/SEI-95-TR-009 ESC-TR-95-009 (August 1995).

[14] James Herbsleb, David Zubrow, Dennis Goldenson, Will Hayes, Mark Paulk. Software Quality and the Capability Maturity Model. Communications of the ACM June 1997/Vol. 40, No. 6.

[15] PMQG Solutions. <http://www.pmqgsolutions.com/Quotations.html>. (accessed on 15-Jul-2009).

[16] M. Biró, R. Messnarz. Key Success Factors for Business Based Improvement. Software Quality Professional (ASQ~American Society for Quality) Vol.2, Issue 2 (March 2000) pp.20-31. <http://www.asq.org/pub/sqp/past/vol2_issue2/biro.html>.

[17] Miklós Biró, Peter Fehér. Forces Affecting Offshore Software Development. En: I. Richardson et al (Eds.), Lecture Notes in Computer Science, Volume 3792/2005, Springer-Verlag, pp.187–201. ISBN: 3-540-30286-7. <http://dx.doi.org/10.1007/11586012_18>.

[18] Software Engineering Institute. CMMI® for Development, Version 1.2 CMMI-DEV, V1.2 CMU/SEI-2006-TR-008 ESC-TR-2006-008.

[19] Software Engineering Institute. CMMI® for Services,

Version 1.2 CMMI-SVC, V1.2 CMU/SEI-2009-TR-001 ESC-TR-2009-001.
[20] Enterprise Spice. <http://www.enterprisespice.com>. (accessed on 15-Jul-2009).
[21] Software Engineering Institute. <http://www.sei. cmu.edu/cmmi/faq/15504-faq.html>. (accessed on 15-Jul-2009).
[22] Kent Beck et al. Manifesto for Agile Software Development. <http://agilemanifesto.org/>. (accessed on 15-Jul-2009).
[23] B. Boehm. A Spiral Model of Software Development and Enhancement, IEEE Computer 21(5):61-72, May 1988.
[24] T. Gilb. Principles of Software Engineering Management. Addison-Wesley, 1988. ISBN-10: 0201192462.
[25] B. Boehm, R. Turner. Balancing Agility and Discipline: A Guide for the Perplexed. Boston, MA: Addison-Wesley. ISBN: 0-321-18612-5.
[26] Hillel Glazer, Jeff Dalton, David Anderson, Mike Konrad, Sandy Shrum. CMMI® or Agile: Why Not Embrace Both! 2008. Technical Note CMU/SEI-2008-TN-003.
[27] Giuseppe Lami, Fabio Falcini. ISO/IEC 15504 Applicable to Agile Methods? In: Springer Lecture Notes in Business Information Processing, Agile Processes in Software Engineering and Extreme Programming 10th International Conference, XP 2009, Pula, Sardinia, Italy, May 25-29, 2009. Proceedings (eds. Pekka Abrahamsson, Michele Marchesi and Frank Maurer), pp.130-135.

