

# Software

Q U A L I T Y

## VISION:

To be the leading authority and recognized champion on issues related to software quality.

## MISSION:

To improve the ability of individuals and organizations to satisfy their customers with quality software products and services through education, communication, research, outreach, and professional development.

Check out the Software Division Web site at [www.asq-software.org/](http://www.asq-software.org/)

## A SOFTWARE QUALITY METRIC FOR PROACTIVE QUALITY IMPROVEMENT

BY LISA BERGEN OHM AND ALKIN BARSHEFSKY  
LUCENT TECHNOLOGIES, NAPERVILLE, IL

### INTRODUCTION

One of Lucent Technologies' flagship products is the 5ESS™ switch, an electronic switching system. A switch is a large-scale, highly complex hardware/software system that controls the management, routing, billing, and other operations of voice and data traffic through a telephone central office. A switch is typically part of an overall network of telephony equipment owned and operated by telephone service providers. Lucent switches are currently deployed to service providers throughout the United States and around the world.

High reliability of the telephone network is expected by end users trying to make calls and by the service providers operating the network. Reliability and quality are a function of many factors of the network, including the methods used by the telephone service providers for maintaining, provisioning, and operating the switch and other equipment, the interworking of network components, which often include equipment from multiple vendors, and the quality of the switches and other network equipment. In this article, we focus on one component of the overall system, the quality of the software in the switch. The software itself is highly complex and grows with each new technological innovation in the telecommunications industry. Current versions of the software in our switching product contain more than 10 million lines of source code.

A switch in operation produces a continuous stream of report messages, generated by the switch's internal software. These report messages allow maintenance, support, and R&D engineers to understand all aspects of the switch's operation and performance. The messages consist of error and warning messages, results of system audits and diagnostics, system reports, and performance data. Every 5ESS switch in the world generates these data, regardless of whether it currently has a problem in need of diagnosis. This mechanism is called the Voice of the Switch. The Voice of the Switch allows engineers and managers to understand everything that is happening on every switch, everywhere, every day.

The Voice of the Switch from an individual switch generates large amounts of data output in the range of 3 to 5 megabytes in size. Considering the thousands of switches that are installed and running in customer locations, the amount of data that is generated daily is enormous. The challenge is to distill these large amounts of data into a form that is readily available for ad hoc and systemic analysis and is also easily understandable for the engineers performing the analysis and their managers.

A collection mechanism has been set up for the Voice of the Switch data, shown in Figure 1. With our customers' agreement, daily data files are sent from

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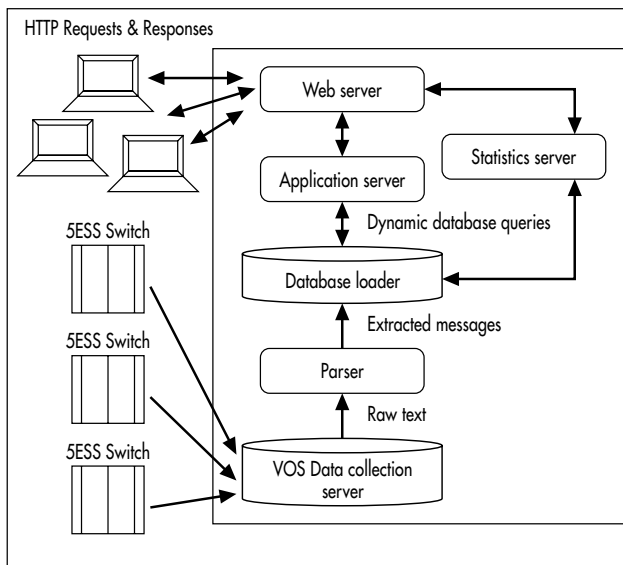
# SOFTWARE QUALITY METRIC

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our customers' locations to a centrally located data collection and storage server. The data files are parsed to break down the data into their component parts and translate them into a form that is then loaded into an Oracle™ database. A Web-based user interface, powered by Cold Fusion™, allows real-time query and display of data on any customer location around the world. Statistical computations are done using the statistical language, SAS™, and displayed on static Web pages, which are generally updated once a week.

In the past, software quality improvement efforts have primarily been driven reactively by problems identified by our customers. In general, pressure for improvement has been one way, from our customer directed at us, or from internal measures captured during development. We have had little consistent knowledge of what is happening with our products in our customers' environments, resulting in minimal feedback from our customers about quality problems until they escalated to major irritants. This is not an effective mode of operation, as it tends to degenerate into crisis management for both vendor and customer.

Fig. 1: Data collection high level architecture



The challenge that we undertook was to move from a reactive mode to a proactive mode. This move fundamentally implies being able to be aware of switch performance in our customers' environments. One of our first steps was to define a Software Index, which measures the "health" or ability of the switch software to perform as required. The Software Index provides daily insight and detailed information on software quality, allowing our engineers to monitor, respond, and fix software problems before they become major crises and to use these data to improve software development processes.

## SOFTWARE INDEX

Since software is such a large component of the switching system, software quality is very important and highly visible. The

Fig. 2: Message classes and weights

Message Class	Description	Weight
Full reboot	Entire software system shuts down and "re-boots"	25
Partial reboot	One or more of the components "re-boot"	10
Process purge	One of the real-time processes running in the software is purged from operation and resets itself	5
Software error	Error message that in itself is not severe, but could escalate to a more serious problem if not attended to	2.5
Warning	A non-severe warning message	.5

intent of the Software Index is to provide a measure that can be used to compare switches, to determine historical trends, and to proactively improve software quality. Although much has been written about quality metrics (Conte, 1986) (Jones, 1991), our approach is to use data on software-related error messages from switches in operation. The Software Index is an algorithmically computed number between 0 and 100, with 100 indicating perfectly functioning software, and 0 indicating the presence of significant quality problems. A Software Index is calculated for each of our customers' switches every day. The fluctuations in the value of the Software Index from day to day could result from changes in operation or usage, such as a new software release being installed on the switch or an unusually heavy amount of telephone traffic.

There are three primary components of the Software Index, which are the use of a weighting scheme to indicate severity of software-related error messages, use of calculations to minimize the impact of multiple occurrences of the same message, and normalization of the index by the size of the switch. Each will be discussed in the following sections.

## Message Class Weights

Messages from the Voice of the Switch are categorized into message classes. Within each message class, there may be many different types of messages, identified by message codes. Different message classes may be associated with hardware problems, software problems, or other types of problems. The Software Index takes into account only those Voice of the Switch message classes that are related to software problems.

The occurrence of different message classes can have a radical different effect on the functioning of the software. To account for this fact in the Software Index, each message class is given a different weight, based on the severity of the underlying software problems. Those message classes that indicate problems that could escalate to a system outage are assigned higher weights than message classes indicating problems less likely to lead to an outage. An example of a weighting scheme is shown in Figure 2.

In determining the weights, the important factor is not the absolute value of the weights, but the relationship of the weights to each other. That is, the weight of the Process Purge message class is two times that of Software Error message class because the severity of Process Purge problems is viewed to be twice as severe. Once the relative ratios are established, the weights can be adjusted up or down depending on how sensitive we wish the index to be in relation to changes in quality.

## Multiple Occurrences of the Same Problem

Another characteristic of certain types of message classes is that multiple occurrences of a specific message in the message class are no more severe than a single occurrence of the mes-

Fig. 3: Impact list for an individual switch

No.	Message Class	Message Event Code	Weight	# Occurrences	Impact	Improved SI
0	Base SL		-	-	-	83.61
1	Process purge	54689-01	5.00	262	3.30	86.90
2	Process purge	54103-24	5.00	201	1.96	88.86
3	Error	21201	2.50	424	1.70	90.56
4	Error	23278	2.50	330	1.67	92.24
5	Error	55396-98	2.50	84	0.95	93.18
6	Process purge	53958-01	5.00	46	0.79	93.98
7	Error	21169	2.50	61	0.68	94.66
8	Warning	W40592	0.50	369	0.48	95.14
9	Error	22911	2.50	45	0.48	95.61
10	Process purge	53501-21	5.00	18	0.30	95.91
11	Error	32837	2.50	22	0.24	96.16
12	Error	41498	2.50	22	0.24	96.40
13	Process purge	54090-23	5.00	11	0.24	96.64

sage. If the message occurs once or the message occurs 100 times, there is no significant difference in terms of software performance or likelihood of a system outage. For example, the software may have scheduled certain system audits to run every 15 minutes, and each audit may generate the same error message. The multiple occurrences of the same error message do not indicate multiple errors but simply the fact that the same error has been identified multiple times. For this reason, a natural log function is used for some message classes to minimize the effect of multiple occurrences of the same message code.

#### Normalization by Size

Size of a switch is measured by the amount of telephone and data traffic on the switch. Different switches receive different amounts of traffic activity. Some of these differences are due to location (urban versus rural), switch type (local exchanges versus long distance), or other telephone dialing patterns. For this reason, the Software Index for each switch is normalized by the amount of traffic activity occurring on the switch. This allows like comparison between switches with different characteristics.

#### IMPACT LIST

While the Software Index provides a measure of the quality of the software, its usefulness lies in its ability to identify what to do to improve the software. The mechanism we use for doing this is called the Impact List. The Impact List uses a form of the Pareto principle (Juran, 1995) applied to the Software Index.

A simple application of the Pareto principle would involve identifying which Voice of the Switch messages happen the most frequently and using this simple count of number of occurrences to prioritize the order in which problems are fixed. This approach has been found to be ineffective for us, because often the messages that happen the most frequently are report messages or warning messages that have little impact on the quality of the software or the performance of the switch. For example, a Warning message may occur thousands of times, and indicate only a warning that a potential problem might occur, while a Full Reboot event is catastrophic if it happens only once. What we wanted to be able to do instead was to focus on those problems that had the biggest impact on system performance.

In the Impact List, instead of using a simple count, we determine the impact that each individual message has on the overall Software Index. The impact is defined as the amount that each message reduces the Software Index from its perfect score of 100. A high-severity event, like a Full Reboot, will reduce the Software Index by a large amount, thus having a high impact, while a low-severity Warning will reduce the Software Index by a small amount and have a low impact. The impact is a function of the weight and the number of occurrences of the message. The Impact List, then, is a list of all message events, sorted in order of highest impact to lowest impact. An example of a partial Impact List for one switch is shown in Figure 3. In the list, we see the prioritized list of messages, along with the message class weight, the number of occurrences, and the impact of each. Also included in the list is the improved Software Index (SI), which shows the improvement in Software Index that would result if the problem causing the message event was removed.

This list provides a blueprint for engineers of all types to direct their quality improvement efforts for maximum effectiveness. By fixing the software problems in the order specified in the Impact List, the maximum possible quality improvement is achieved. The list identifies what to fix (the message code), in what order problems should be fixed, and how big of an impact on software quality the fix will have. For example, an engineer would start by investigating the message on line 1. This indicates a Process Purge error message that occurred 262 times. The impact of this Process Purge is 3.3, which is the amount by which the Software Index would improve if this Process Purge were fixed. A link is provided on the Web page from the message event code to another page containing additional information about the message event. From this, an engineer can investigate and determine what underlying software problem is causing the Process Purge to occur, and once the underlying software problem is identified, a software update can be installed in the switch which improves switch performance.

Fig. 4: Customer network impact list

No.	Message Class	Message Event Code	Weight	# Occurrences in Network	Network Impact	Improved Network SI	# of Offices w/ Event
0	Base network SI	-	-	-	-	73.60	-
1	Process purge	54685-03	5	1229	5.29	78.79	4
2	Process purge	55203-34	5	1143	4.97	83.86	2
3	Process purge	53798-31	5	889	2.71	86.57	5
4	Process purge	54492-33	5	666	1.80	88.37	3
5	Process purge	55100-00	5	569	1.77	90.14	1
6	Error	21635	2.5	930	1.09	91.23	5
7	Process purge	55987-10	5	202	0.72	91.95	4
8	Warning	W84903	0.5	2449	0.43	92.38	5
9	Process purge	56221-21	5	99	0.30	92.68	5

The list also allows the engineers to determine how many software problems they need to fix in order to reach a predefined quality level. For example, if a Software Index of 92 has been identified as indicating a high level of quality, the Impact List shows that only the first four items on the list need to be fixed in order to reach the goal. Additionally, engineers know

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from this list which message events have low impact and therefore can be assigned a lower priority and deferred until after the higher impact items have been resolved.

The Impact List in Figure 3 shows data for a single switch. In most cases, a customer has more than one Lucent switch deployed throughout their network. For these cases, our engineers are often interested in improving the overall quality of switch software across the entire customer network rather than focusing on a single switch. To facilitate this objective, we have created a Customer Network Impact List, which is shown in Figure 4.

For the Customer Network Impact List, the average impact across the entire network is calculated for each message event and used as the prioritizing factor. The number of occurrences indicates total number of events across the entire customer network, and the Software Index improvement is an average across the network. An additional piece of information is included, which is how many offices (i.e., switches) have occurrences of each message code. This provides information about the ubiquity and nature of the message code. The same type of analysis and prioritization can be used for the Customer Network Impact List as for the Switch Impact List.

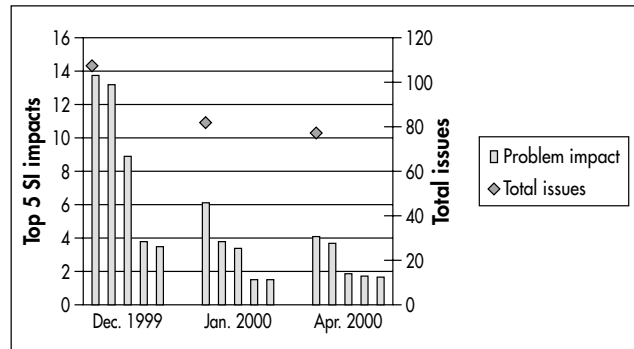
## SOFTWARE QUALITY IMPROVEMENT

The Software Index and the Impact List are the tools that support software quality improvement, but process is what enables the improvement to happen. The process we have adopted involves first setting a global goal for improvement. Our goal is to have 90% of all customer switches demonstrate an average Software Index greater than 90. A Software Index of 90 is deemed to demonstrate sufficiently high software quality, and have 90% of all switches showing the highest levels of software quality was extremely important to us. The global goal is broken down by geographical area, with managers taking ownership for the goal in their region. Within each region, the goal is broken down by country and then by customer. At each level, different managers take ownership for improving the goal for their domain. Improvement results are reported on a monthly basis, and the managers are held accountable for reaching the targets for their domain. The key here is that current status and results which in the past have been hidden are now made visible. Managers can see the status of their goal immediately at any given time simply by accessing the Web pages. Not only can they see the status of the goal, but by looking at the Impact List they have an extremely simple mechanism to tell them how to improve the goal. All results for all locations worldwide are kept up to date and are readily available to the entire support team. We know all occurrences of every potential software problem, every day, for every switch, and we know which of those are the truly high impact problems that require immediate attention.

Improvement also depends on the right kind of teamwork. Customer Technical Support (CTS) engineers working at customer locations monitor the Software Index and the Impact List on a regular basis. For items on the Impact List, they investigate to the extent they are able. In some cases, the fix may be something they can implement immediately. In some cases, however, the fix must be implemented by software development personnel. In

these cases, the CTS staff work together with the developers to identify causes of the message. The developers then implement a software change, test it, and the fix must be sent back out to the customer location for the CTS engineers to install. After installation, the Software Index and the Impact List is monitored closely to ensure that the fix has indeed been effective, and the switch performance, as measured by the Software Index, has improved.

Fig. 5: SI Problem impacts, 12/99-4/00



The results of one such improvement effort are shown in Figure 5. In December 1999, it was noted that one of our customers was experiencing rather severe software quality problems. A joint team of CTS and development engineers was formed to analyze the issues using the Software Index Impact List. As shown in the figure, the impact of the five most severe problems range from 3.7 to 13.9, and there were 107 issues on the Impact List. Further analysis of the top five message events on the list resulted in a software update being installed in January that fixed these high impact problems. A new Impact List was generated that showed a definite improvement in the impact of the top items and the total number of items. The impacts of the five most severe problems now ranged from 1.7 to 6.1. Although the severity of the top five problems was greatly reduced, further improvement was deemed necessary, so another detailed analysis of the top five items on the Impact List was performed, resulting in a second software update being issued in April. It was clear from the results of this second update that further improvement in software quality had been achieved.

## CONCLUSIONS

The Software Index and Impact List have been in use since October 1999. As a result of usage, several changes and improvements have been observed.

**We have become more focused on impact of error messages rather than simple frequency.** In the past, we have expended much effort in reacting to emergency events or on fixing message events that showed up frequently in the Voice of the Switch but did not substantially improve the software quality. By using the prioritized Software Index Impact Lists, we have learned that focusing on high impact messages will guarantee that our efforts will result in quality improvement.

**The boundary between software developers and the end customers is closing.** With the Software Index and Impact List for any customer location throughout the world available on demand, software developers can see at a glance the quality level of "their" software as it is used by customers. They are thus able to focus internal software quality improvement efforts based on external customer-based reality rather than internal motivations.

**Engineers are able to respond to quality problems proactively and more efficiently.** Because customer support engineers can identify software quality issues before they become major problems or large customer dissatisfiers, they are able to save time and money in responding to customer complaints and in reacting to crises. Savings are also realized in the software development area by fixing the high impact quality problems rather than spending effort working on fixes that won't improve quality.

In summary, the essential power of the Software Index and Impact List has proved to be in their ability to provide externally driven, objectively defined metrics for improvement. They have enabled proactive problem prevention and internal focus on external customer data and needs, as well as cost savings and efficiency improvement. The greatest change, however, is in the paradigm shift from a reactive mode controlled by customer complaints to a proactive mode of knowledge sharing between customer and vendor.

#### REFERENCES

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Jones, C. (1991). *Applied Software Measurement: Assuring Productivity and Quality*. New York: McGraw-Hill, Inc.

Juran, J. M. (1995). *Managerial Breakthrough*. New York: McGraw-Hill, Inc.

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## CHAIR'S CORNER

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BY MIKE KRESS

As summer draws to a close, we are nearing a return to reality. Summer seems to have the effect of less traffic, more days off, more late night barbecues, and in general more fun. But alas, September brings the return to getting kids off to school, PTA meetings, football, soccer taxi service and, yes, another year of challenges for our division.

As someone who has been with the division since the early '80s when we were still a technical committee, I have seen us grow from fewer than 100 members to more than 3000. It's hard to believe we have sponsored 11 highly successful ICSQs (International Conference on Software Quality) and our next one in Ottawa promises to be among the best ever. (See our Web site at [www.icsq.org](http://www.icsq.org).) I hope to meet many of you there and hear about your thoughts and concerns.

Speaking of concerns, we recently completed a member interest survey via our Web site. Nearly 350 of you responded by identifying your interest in several technical interest areas:

- Open systems
- CMMi—Integrated Capability Maturity Model<sup>SM</sup>
- ISO 9001:2000/9000-3
- Applications of Six Sigma to software
- COTS in safety critical applications
- QA of e-commerce software

The results were published in the spring issue of *Software Quality*. Many thanks to our *Software Quality* editor and publications chair, Dr. Tom Griffin, for putting the survey on the Web, collecting, analyzing, and charting the results. This was a non-trivial job, and Tom, I want to thank you again. Interestingly the



survey results told me that our members are interested in all of these areas without very much variation. (Tom has summarized and analyzed the results quite thoroughly so I invite you to consider his report.) What I found surprising, however, was that the highest percentage of you expressed "No Interest" in Six Sigma for software. This is very surprising to me because I have personally seen good data coming out of Six Sigma applications to software. Time will tell if this will change. These data will help us plan material for our newsletters, our journal, the ICSQ, and eventually our Software Quality Resource Guide (planned, we hope, for 2003).

I invite you to read the report by our chair-elect and strategic planning chair, Tim Surratt, for news about our challenges and strategies for the near term.

Our Web site committee is working hard to evaluate options for improving our current Web site. We want a site-common "look and feel," that supports business and administrative functions, that is easy to access, has access to other relevant links, and is easy to maintain.

We have a great team of leaders and regional councilors and I would encourage all of you to feel free to contact any of us if we can be of assistance in answering your questions or pointing you in the right directions for those answers. I hope you all had a wonderful summer.

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## SOFTWARE DIVISION TRACK THEME FOR AQC 2003 KANSAS CITY, MO— MAY 19-21

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**"YOUR WORLD DEPENDS  
ON QUALITY SOFTWARE"**

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BY CAROL DEKKERS, AQC SOFTWARE  
DIVISION TRACK CHAIR

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Did you know that 2002 was the first year that the Software Division had its own track at the Annual Quality Congress? Supported by an outstanding array of volunteers and speakers, we successfully demonstrated the importance of quality when it comes to software—no matter what industry. In light of this inaugural success, ASQ has again granted us an entire track at AQC 2003, in Kansas City, MO. This means that our division again has the opportunity to showcase the role and importance of software quality to our members and across all ASQ divisions. My thanks go out to the myriad of Software Division Council volunteers and speakers who were instrumental in making AQC 2002 a success. Many of you have already stepped forward to assist and perform your magic again for next year's AQC.

What can you expect at AQC 2003? We have seven track sessions we are currently lining up with speakers and practitioners. Our speakers will apply their software quality expertise to quality issues of various ASQ divisions. Our theme "Your World Depends on Quality Software" (within the overall AQC 2003 theme, "Expanding Horizons—Global, Personal, Tools, Networking, Solutions"), has already provided us with a skeleton for our software quality sessions. The following list of track session chairs and potential topics provides you with a sneak preview of where we are headed:

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## DIVISION AQC TRACK

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1. Proposed joint session with the Biomedical Division on a topic related to "Software Validation." Track session chair: Sue Carroll
2. Proposed joint session with the Health Care Division on a topic related to patient safety and/or HIPPA. Track session chair: Tim Surratt
3. Software Division session on "Certification of Software Professionals." Track session chair: Rufus Turpin
4. Proposed joint session on Six Sigma targeting an introductory, interactive presentation pertaining to the essential elements of Six Sigma. Track session chair: TBD
5. Potential joint session with Metrology and/or Automotive Division on the topic of TL 9000. Track session chair: TBD
6. Potential panel on the new CMU's "Sustainable Software Consortium" (intended to address the industrywide issue of software quality and featuring members such as Microsoft and Oracle). Track session chair: TBD
7. Other potential sessions include (but have not been confirmed or rejected): Human Development & Leadership joint session; ISO 9000 and its importance in software; other joint sessions.

Do you have ideas and/or recommended speakers who would add to our lineup? If so, send me an e-mail (Dekkers@qualityplustech.com) together with the proposed speaker's name, e-mail, phone, and suggested topic. Additionally, if you'd like to help out in any way with the planning or speaking at AQC 2003—or if you've got ideas to help our division grow and flourish, send me or Tim Surratt (chair-elect) an e-mail sharing your thoughts.

As the time nears rapidly (gosh, May 2003 is only two-thirds of a year away!!!) we hope that you will make plans to join your colleagues and all of us who are planning to make the Software Division track at AQC 2003 a track to remember!

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## PROGRAMS

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### BY THERESA HUNT, PROGRAMS CHAIR

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Much appreciation goes out to this year's International Conference on Software Quality (ICSQ) planning committee. The following individuals have contributed many volunteer hours planning and insuring the success of 12ICSQ in Ottawa.

Larry Jones, 12ICSQ Conference Chair

Karen Bishop-Stone, 12ICSQ Tutorials Chair

Rufus Turpin, 12ICSQ Technical Program Chair

Beth Adams, 12ICSQ Exhibitor/Sponsor Chair

Linda Westfall, 12ICSQ Web Site Chair

Remember that in addition to a full day of tutorials, two days of technical presentations, and post-conference course opportunities there will be a special sitting for the ASQ Certified Software Quality Engineer (CSQE) exam on Sunday, October 27, at the conference hotel. Visit our Web site at <http://www.icsq.org> for all the details. We hope to see you in Ottawa at 12ICSQ and in Texas for 13ICSQ. If you have any questions please do not hesitate to contact me at [Theresa\\_Hunt@Westfallteam.com](mailto:Theresa_Hunt@Westfallteam.com).

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## SOFTWARE DIVISION: ANNUAL MEETING ANNOUNCEMENT

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The Software Division will hold its annual meeting Monday, October 28, 2002, in conjunction with the 12th International Conference on Software Quality. The meeting will be held at 6 p.m. at the Westin Ottawa Hotel (conference hotel). The meeting will review the activities of the division for the past year, and provide an opportunity to meet the division officers as well as many members of the Division Council. Refreshments will be provided. We hope as many members of the Software Division as possible can attend.

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## REPORT FROM THE CHAIR-ELECT

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### BY TIM SURRATT

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Greetings! I'm Tim Surratt and I'm chair-elect of the Software Division. If you are one of those who reads every bit of the newsletter, you will recognize that I have been secretary of the Software Division for the last four years. My job now is to manage the 'internal operations' of the division and of course learn what is needed to be chair in two years. The committees I have responsibility for are: Examining & Awards under Sue Carroll, Bylaws under Jayesh Dalal, Marketing under Rufus Turpin, and Nominating under Linda Westfall. I want to elaborate on the Strategic Planning Committee, which I lead.

Over the last year the Division Council has invested significant energy, if not resources, in examining our organization structure and bylaws and streamlining our operation. As a division of ASQ, we are doing a lot of the "right" things: We have a good newsletter, the CSQE certification, a popular conference (the International Conference on Software Quality, this year number 12), and a strong presence in standards. We put on a great track (seven full sessions!) at AQC, we publish a journal (*Software Quality Professional*), and we are financially solvent. Nevertheless, we see some real need for improvement. This year we are embarking on several key goals:

#### 1. Build a level 2 organization

By this we mean to finish the job we started in streamlining our organization, put in place a stronger strategic planning process, get all our committees and teams full staffed, and use the ASQ Division Management Program as a measure of how we are doing.

#### 2. Build member value

We are embarking on initiatives to publish an authoritative reference based on the CSQE body of knowledge, an effort led by Taz Daughtrey. We have a team that will greatly improve our Web site and enable electronic delivery of our newsletter. We are strengthening our connection to sections by providing more focus on our regional councilors and by identifying and focusing on these sections where we have the highest membership. On a longer range agenda, we are looking into the publication of a *Software Quality Resource Guide* that would respond to a perceived desire for an easy-to-follow road map for those trying to navigate the information highway.

### 3. Continue our strengths

As I mentioned above, our certification, our conference, and our journal add significant value for our members; we will make sure we continue our support for those strengths at the same high level while undertaking the new tasks.

What else? We need to address the need for training materials for the CSQE, both for individual and for section use. We need to partner more strongly outside ASQ. We need to establish and strengthen our 'brand,' especially to distinguish our BOK and certification vs. some commercial offerings. The bottom line is that the division is strong and striving to grow stronger in the coming year.

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## SOFTWARE QUALITY ENGINEERING QUIZ

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BY LINDA WESTFALL

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Whether you are preparing for the Certified Software Quality Engineer (CSQE) examination or just testing out your knowledge of software quality engineering, why don't you sit back and let your brain do its thing. The answers can be found on p.14 if you need a helping hand.

Note: The items in this quiz are NOT from past CSQE examinations NOR were they created as part of the CSQE exam development process.

1. Which of the following would be a role of the quality action team's sponsor?
  - A. Directing the team including making assignments
  - B. Recommending quality improvement tools and techniques
  - C. Providing ongoing resources to the team
  - D. Arranging team meeting locations and other logistics
2. A software systems analyst has identified a way to improve the organization's defined requirements elicitation process. Which of the following should the analyst do first?
  - A. Change the way they personally elicit requirements in order to pilot the improvement
  - B. Update the requirements elicitation process definition to document the improvement
  - C. Document a lessons learned and post it on the intranet
  - D. Document the improvement in a change request and forward it to the process owners
3. Which of the following is NOT an element of the unified modeling language (UML)?
  - A. Data flow diagrams
  - B. Use cases
  - C. Interaction diagrams
  - D. State diagrams
4. Which of the following would typically be reviewed as part of a senior management project review meeting?
  - I. Details of upcoming tasks and inter-task dependencies
  - II. Changes to the project's objective or business climate
  - III. Status of high priority project risks
  - IV. Project schedule status against milestones
  - A. III and IV only
  - B. I, II, and IV only
  - C. II, III, and IV only
  - D. I, II, III, and IV

5. As a facilitator, you would recommend the use of a checklist when the team is trying to:
  - A. organize and categorize a large number of ideas from a brainstorming session.
  - B. analyze and organize the root causes of a particular problem.
  - C. ensure that all of the important items have been included in their discussion.
  - D. identify driving forces that help move toward reaching their goal and restraining forces inhibiting movement toward their goal.
6. Which of the following is a characteristic of an inspection but NOT of a walkthrough?
  - A. Conducted by a team of peers
  - B. Focused only on defect detection
  - C. Evaluates a software work product
  - D. Attended by the work product author
7. Which of the following would NOT be considered a role of software configuration management?
  - A. Allocating system-level requirements to each software component
  - B. Creating or releasing baselines for internal use and for delivery to the customer
  - C. Controlling changes to the content of software components
  - D. Assigning unique identifiers to each software component

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### Software Quality Systems Software Process Improvement Software Testing

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# FROM THE REGIONS

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BY DAVID WALKER, REGIONAL COUNCILOR COORDINATOR

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## Region 1 John Pustaver

Recent meetings of the Software Quality Group of New England included a metrics program case study by David Heimann in June, and the annual Hot Topics program in July. Steve Rakitin contributed copies of his book, *Software Verification and Validation*, and Empirix contributed copies of Boris Beizer's *Black Box Testing* for door prizes. The ninth season of the Software Quality Group kicks off in September with a presentation by John Pustaver called Flavors of Software Test Automation. Meetings take place at the Sun Microsystems campus in Burlington, MA. To be placed on the e-mail list contact John Pustaver, [Pustaver@swquality.com](mailto:Pustaver@swquality.com).

Northeastern University's new certification program in software quality begins in September. Courses include introductions to software QA, testing, configuration management, peer reviews, and metrics. Certification can be obtained by completing six courses. Please check the Web site at <http://www.nuol.edu/> for information.

SQE's software test automation conference returns to Boston September 24-27. You can get the details at [www.sqe.com/testautomation](http://www.sqe.com/testautomation).

Job hunters should check the Jobs page at [www.swquality.com/users/pustaver/jobs](http://www.swquality.com/users/pustaver/jobs). Job have been trickling in so keep checking. If you know of a job opening in the New England area, please send an HTML file with position description and contact information to John Pustaver, [Pustaver@swquality.com](mailto:Pustaver@swquality.com).

## Region 2 Jean Burns

Plans are being made for Software Quality presentations at the local university. This, of course, is not open to the public so cannot be made public as an invitation. I am working with two other local folks to put together a presentation on extreme programming for the local ASQ section.

## Region 4 Chris Fitzgibbons

Ottawa Valley Section 407 and members of the ASQ Software Division in Canada look forward to hosting the **12<sup>th</sup> International Conference on Software Quality** (12 ICSQ) this October 28-30. A very strong lineup of speakers and presentations make this a conference you won't want to miss. You can review the conference program at [www.icsq.org](http://www.icsq.org) and obtain any additional information from the technical program chair, Rufus Turpin ([info@carpedieminfo.ca](mailto:info@carpedieminfo.ca)) or the conference chair, Larry Jones ([joneslf@magma.ca](mailto:joneslf@magma.ca)).

Ottawa is a very scenic venue, especially in late fall. You may want to consider extending your stay in Canada's capital city while attending one of the pre- and post-conference courses. From October 21 to 25, Linda Westfall of the Westfall Group will instruct the **CSQE Training Course**. There are two post-conference courses offered October 31 to November 1. **Software Metrics** will be taught by Claire Lohr of Lohr Systems and Linda Westfall. **Software Functional Testing** will be instructed by Theresa Hunt of ECC International. Pricing and additional course information are available from the conference Web site: [www.icsq.org](http://www.icsq.org).

There are several software quality groups meeting regularly throughout Region 4. The **Ottawa Software Quality Association (OSQA)** holds events on the last Thursday of each month. A schedule of events and a subscription to the OSQA mailing list is available from their Web site: [www.osqa.org](http://www.osqa.org). Some recent topics include: Web Testing, Web Metrics, Functional Points Analysis, Software Inspections, and Regression Testing. Similar topics are being discussed by the **IEEE/ASQ Discussion Group for Software Quality in Calgary**. The group meets every two weeks from September through May. A list of upcoming events and speakers is available through their Web site [www.software-quality.ab.ca](http://www.software-quality.ab.ca). There are also several active **Software Process Improvement Network (SPIN)** groups throughout Region 4. A list of SPINs in Canada is available at [www.sei.cmu.edu/collaborating/spins/spins.html](http://www.sei.cmu.edu/collaborating/spins/spins.html). And, the **International Council on Systems Engineering (www.incose.org)** has a chapter in Vancouver and emerging/start-up chapters in Toronto and Montreal.

## Region 6 Tom Gilchrist

On July 25, 2002, the Seattle Area Software Quality Assurance Group (SASQAG) held their first "\$99 Training Day" event on function points with Carol Dekkers. On October 25, 2002, SASQAG will hold another \$99 Training Day on Six Sigma in Software. For information on this training or future events, visit [www.sasqag.org/99days](http://www.sasqag.org/99days).

On the third Thursday of every month (except December), SASQAG holds monthly public meetings in the Seattle area at Attachmate in Factoria. SASQAG also supports certification and study groups. If you are in the area and want to attend, please check [www.sasqag.org](http://www.sasqag.org) for upcoming events, directions, and meeting time.

On Oct. 15 and 16, the Pacific Northwest Software Quality Council Conference is holding their 12<sup>th</sup> Annual Conference in Portland, OR. The keynote speakers include Alberto Savoia on "Maximum Efficiency Testing" and James Bach on "How Testers Think". A single day of workshops will be held Oct. 14.

If you have information on local software quality and testing events in your area of Region 6, please send it to me for our events calendar. I am looking for more information about activities and events in California. Visit <http://www.tomgtomg.com/asq6> for information on events around Region 6.

## Region 8: Michael Kiefel

The Software Division congratulates Michael Keifel, the new regional councilor for Region 8. Michael has held the position of business systems manager, QA/Legal, for Ross Products Division of Abbott Laboratories in Columbus, OH, for the past four years. He has more than 30 years in quality and IT areas in the cosmetic, drug, and nutritional business of which he has spent the last 19+ years at Ross. He has been a member of ASQ since 1984, an active member of Columbus Section 801 for 15 years, and a member of the Section Exec Committee for five years. He is a member of both the Software and FD&C Divisions and obtained his CSQE in December 2001. Job responsibilities include support of the division quality functions in all areas of IT including

new project proposal, funding, management of SDLC methodology, applications development, site support, and IT compliance issues (validation, SQA, and 21 CFR Part 11 compliance). In addition, he is a member of the division's computer validation review board and also represents the division quality area at a corporate level on an IT quality review board.

#### **Region 9      John Lowe**

John Lowe, regional councilor for Region 9 (Indiana and Eastern Ohio) would like to identify software quality related activities or news within the region. If you are aware of any such information sharing or would like to be informed of such activities, please respond to [lowe\\_john@prc.com](mailto:lowe_john@prc.com).

#### **Region 10      Nancy Poma**

The Software Division congratulates Nancy Poma, the new regional councilor for Region 10. Nancy has over 20 years' experience supporting software applications for manufacturing, such as statistical process control, where she was considered a subject matter expert by the customer community. She has been involved with ASQ for more than 10 years, and maintains a CSQE, CQA, and CQE. Nancy has participated on three CMM level 3 assessment teams, presented at three international EDS CMM conferences, led three CSQE study groups in EDS, and is currently chairing the 3rd Annual Michigan Quality Conference. She is currently a quality specialist, coaching teams in project management and software engineering practices.

The 3<sup>rd</sup> Annual Michigan Quality Conference will have a full-day software track on October 10, 2002, at Madonna University, in Livonia, MI. For more information, contact either Nancy Poma at [nmpoma.comcast.net](mailto:nmpoma.comcast.net) or Deb Beaman at [jdbeaman@comcast.net](mailto:jdbeaman@comcast.net). Here are the topics and speakers:

"Extreme Programming"—James Goebel and Rich Sheridan

- "Biggest Bang for the Buck: Document and Software Inspection"—Darcie DeBasio
- "Testing—Reducing the Number of Test Cases"—Louise Tamres
- "Six Sigma for Software Demystified"—Gershon Blumstein and Kazam Mirkhani, Ph.D.
- Fifth Session—TBD  
Mark your calendars and plan to attend.

The Ann Arbor Software Quality Professionals meet monthly. Contact Lynne Rago at [lynnerago@comcast.net](mailto:lynnerago@comcast.net) for more information.

The Great Lakes Software Process Improvement Network hosts presentations between September and May. Each meeting takes place on the second Thursday of the month. The meetings generally alternate between University of Michigan, Dearborn and Oakland University. Visit [www.gl-spin.org](http://www.gl-spin.org) for more information.

#### **Regions 13, 14, 15, & 25**

These positions are open and volunteers should contact David Walker at [david.w.walker@pharmacia.com](mailto:david.w.walker@pharmacia.com) for more information.

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## **CERTIFICATION REPORT**

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**BY DOUGLAS HAMILTON**

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A CSQE Exam Review Committee meeting was held September 13 and 14, 2002, in Milwaukee. I would like to thank the following volunteers:

Karen Bishop-Stone, Jim Borucki, Terri Deupree, Ganesh Gururajan, Kathie Harris, Alex Hilgendorf, Alice Lewis, John Novocki, Maria Spiak, Rocky Thurston, and Art Trepanier.

The volunteers are what make the exam a success. The meetings are fun, challenging, and you learn something every time. If you are interested in volunteering, you must be a CSQE. Please mail your resume to Mary Martin at [mmartin@asq.org](mailto:mmartin@asq.org) for consideration for future workshops.

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## **EXAMINING AND AWARDS**

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**BY SUE CARROLL**

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As the new Examining and Awards chair for the Software Division, please consider me a resource. You can contact me at [sue\\_carroll@bellsouth.net](mailto:sue_carroll@bellsouth.net).

Would you like to become a Senior member of ASQ? Please send e-mail to me and I will send the application to you via e-mail. A Senior level status shows commitment to the profession of software quality. With renewal you can choose to add the *Software Quality Professional* journal as your membership perk.

I am not able to process CSQE recertification. This must be handled through your local section.

We are investigating a scholarship program that would be championed by the division. The details are unclear at this time. If you have interest in helping to develop this program or if your company would be willing to sponsor part of this scholarship, please contact Jean Burns at [burns@uic.com](mailto:burns@uic.com).

ASQ sponsors a number of medals. I will begin explaining those medals in the next column.

# STANDARDS CHAIR REPORT

BY SCOTT DUNCAN

This report includes material on the IEEE Software Engineering Standards Committee's Management Board and Executive Committee meetings August 12-14 SESC in Ft. Walton Beach, FL, and an update on the status of ISO/IEC JTC1/SC7 standards work since the plenary meeting in May in Busan, Korea.

## IEEE SESC WORK

### Overall SESC Direction

The SESC is moving more and more toward process, rather than product, standards. As standards are due to be revised, the product material (i.e., forms and requirements related to use of forms) will be moved to informative (guidance) appendices and removed from normative (required) parts of the documents. This is consistent with the SESC trend to adopt more international (ISO) standards and framework (foundation) standards and specialize them for IEEE purposes with appendices and informative material.

### Management Board and Executive Committee Participation

In February, I was invited to join the SESC Executive Committee as the ASQ Software Division liaison. The Executive Committee makes policy and architectural decisions about SESC activities and standards work. In early spring, I was asked to put my name on the ballot for a position on the Management Board

and was elected to that in June. The Management Board supervises and assists Working Group chairs who, in turn, handle the actual work of standards revision, affirmation, etc.

Those interested in IEEE SESC standards work should go to <http://standards.computer.org/sesc> and, from there, examine various aspects of the SESC, including officers, committee and board members, information on balloting standards, etc. Any interested person who meets the SESC requirements can join and request to be notified when standards are put up for balloting. My role is to influence and guide work at a strategic level, though I will participate as an individual on ballots and in working groups. The main advantage for the ASQ Software Division will be the direct information that will come to us through my participation and our opportunity to act on that (e.g., work on revising a standard or suggesting new ones, knowing when documents will be coming up for balloting, etc.) without every interested person having to monitor the SESC site routinely.

### Management Board Work

The main activity of the Management Board, as noted above, is to supervise the work related to reaffirming or revising standards. As with ISO standards, SESC standards must be "renewed" about every five years. If they are not, they are dropped. Reaffirmation involves the decision to extend the standard, as is, without revision, for another five-year period. (In this case, the standard's original creation or last revision date is retained as the date of the standard.) Reaffirmation can also be a way to continue the life of a standard while a proposal for more substantive changes is being prepared. Revision involves making changes (no matter how major or minor) to the standard. A revision proposal does not have to wait for the potential expiration of a standard. Therefore, a standard can be reaffirmed and then immediately proposed for revision. In either case, a ballot "pool" is created from among SESC members who, when asked, respond that they would like to be involved in the balloting of a specific standard's reaffirmation or revision.

Standards undergoing reaffirmation or that have been reaffirmed this year include:

- 610.12—Glossary of Software Engineering Terminology
- 1008—Software Unit Testing
- 1028—Software Review Process
- 1044—Classification for Software Anomalies
- 1045—Software Productivity Metrics
- 1061—Software Quality Metrics Methodology
- 1062—Recommended Practice for Software Acquisition
- 1074—Developing Software Life Cycle Processes
- 1228—Software Safety Plans
- 1233—Guide for Developing System Requirements Specifications
- 1420.1—Information Technology—Software Reuse—Data Model for Reuse Library Interoperability: Basic Interoperability Data Model (BIDM) [also 1420.1a-1996 + 1420.1b-1999]

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- 12207.1-1997 Guide for Information Technology—Software Life Cycle Processes—Life Cycle Data

Work has also been (or is still being) devoted this year to:

- 730—Software Quality Assurance Planning
- 828—Software Configuration Management Plans
- 829—Software Test Documentation
- 830—Recommended Practice for Software Requirements Specification
- 982—Dictionary of Measures to Produce Dependable Software
- 1016—Recommended Practice for Software Design Descriptions
- 1175—CASE Tools

Next year and beyond there will likely be work on:

- 1517—Reuse Processes
  - 14143.1—Functional Size Measurement (some form of adoption of the ISO standard)
  - 1471—System Design—Architecture Description
- Standards being allowed to expire are:
- J-Std-016—Interim Standard on Software Life Cycle Processes for Acquirer/Supplier Agreement
  - 1430—Guide for Software Reuse
  - 1175—Reference Model for Computing System Tool Interconnections (being replaced by new 1175 work, in five parts)
  - 982.2—Dictionary of Measures to Produce Reliable Software (one part of the 982 set)

#### Executive Committee Work

As noted above, the Executive Committee concerns itself with SESC policies and procedures, major decisions about the future of individual standards and the combining of standards (as guidance to the Management Board), and other projects related to making SESC standards more effective in industrial settings.

One project will be to cross-reference IEEE standards to important frameworks outside SESC such as ISO 12207, ISO 15288, and the SEI's CMMI to show how SESC standards can help organizations implement the higher-level goals in the frameworks.

Another group will be looking into future “markets” for standards, such as wireless device software, and providing guidance on bridging the gap between more formal methodologies and the use of lightweight (Agile) methods.

#### SC7 WORK UPDATE

For the most part, this just confirms document balloting anticipated in the last report.

#### SquaRE Work

CD ballots for 25000 (Guide to the entire SquaRE effort) and 25030 (Quality requirements) have been issued and will close this fall.

#### Process Assessment (15504, WG10)

The CD ballot on 15504-1 has been issued and will close this fall.

An FCD ballot for 15504-3 has been issued and will close this fall.

A combined WD registration and CD ballot for 15504-5 (the exemplar model) has been issued and will close this fall. It contains a full Process Assessment Model based on ISO 12207 Amd 1 2002 (i.e., the amended version of 12207 issued which covers processes in the

TR version of 15504-2 not already in the base version of 12207).

#### ISO 900-3 Revision (WG18)

An FCD ballot has been submitted and will close this fall.

**Scott Duncan** is the Standards chair of the Software Division. As always, people interested in standards work can contact Scott at: [softqual@knology.net](mailto:softqual@knology.net), 706-649-2345 (weekdays), or 706-565-9041 (evenings and weekends).

## PRACTICAL SOFTWARE AND SYSTEMS MEASUREMENT (PSM) USERS' GROUP CONFERENCE

BY DAVID ZUBROW,  
ASSOCIATE EDITOR

The PSM Users' Group Conference was held July 22–26 in Keystone, CO. PSM is a software measurement method sponsored by the U.S. Department of Defense. However, the method is generally applicable to any software development and conference attendees (approximately 100 in all) hail from both commercial and government organizations and represent a wide variety of application domains. More information on PSM can be found at [www.psmc.com](http://www.psmc.com).

This year's conference agenda included 1.5 days of presentations followed by 1.5 days of workshops addressing various topics related to software and systems measurement. The 16

(cont. on p. 12)

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presentations were organized in a single track. A senior manager of ABN AMRO Bank delivered the keynote address, "Establishing a Measurement Program in a CMM® Level 1 Organization (...It isn't easy)." His speech reviewed and rated the challenges his organization confronted while establishing its measurement program. In his experience, identifying and designing measures was relatively easy. Alternatively, collecting data was very difficult due to resistance, a lack of existing documents or measures, and collection inconsistencies—where data did exist they were likely to have been collected using different definitions and processes. He made the following recommendations based on his experience:

- Wait until your processes are established and mature to start the operation of the measurement program.
- Start the culture change early.
- Pilot the program.
- Start with a simple baseline and refine and evolve it as the measurement program and the organization mature.

This was followed by a presentation on common problems from the perspective of a CMM assessor. This talk reviewed the role of measurement in the CMM Integration (CMMI<sup>SM</sup>) and CMM models. Four measurement-related problems common to assessments were discussed:

1. the measurement and analysis common feature is often not satisfied,
2. measures are collected but not used,
3. the project or organization does not have a measurement plan,
4. the measurement repository is weak.

The next presentation described a business case developed to support a process improvement initiative at General Dynamics Advanced Information Systems. The presentation illustrated how a business case can be developed using a mixture of organizational and industry data once a good business model had been developed.

Other presentations addressed software and systems cost estimation, barriers to using measurement as well as suggestions for how to implement a measurement, and a panel discussing measurement and achieving CMM level 4. Eight workshops followed the presentations. These included topics such as standards mapping, acquisition support, COSYSMO, business cases, conducting pilot studies and projects, progress measures, and reliability.

The venue, single track organization, and focus made this year's PSM conference a good opportunity for networking. Also notable was the presence of several members of the Australian Department of Defense that has adopted PSM and the CMMI. Check the PSM Web site ([www.psmc.com](http://www.psmc.com)) to see the presentations and workshop reports as well as for information on next year's conference.

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<sup>SM</sup> CMMI is a service mark of Carnegie Mellon University.

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## WHAT DOES "INSTITUTIONALIZATION" MEAN?

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BY MARK C. PAULK

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One of the “magic words” in software process improvement is institutionalization. Anyone doing improvement based on the Capability Maturity Model for Software (CMM) has to both implement and institutionalize their processes to fully satisfy a key process area. The definition in the CMM is that institutionalization is “the building of infrastructure and culture that support methods, practices, and procedures so that they are the ongoing way of doing business, even after those who originally defined them are gone.” This definition captures the concept but is not operationally satisfactory.

In the early days, some organizations “defined their process” the week before an SCE team arrived and expected to get credit for having a process in place. How much more than one week (or how many executions of the process) is needed to show “this is the way we do things around here”?

Appraisal teams need better guidance to make consistent judgments. The CBA IPI Lead Assessor’s Guide, v1.2 (CMU/SEI-2001-HB-002, December 2001) states on p. 2-41:

*“Processes are not to be considered fully institutionalized unless they have been in place for a sufficient amount of time so that the organization has had the opportunity to fine-tune them and determine their effectiveness. The intent of institutionalization is for a process to be stable and repeatable. Some heuristics can be applied:*

- *Is the process performed and trained? Is training available?*
- *Has the process been performed more than three times following this procedure?*
- *If the process is performed ‘frequently,’ e.g., weekly or monthly, has it been in place for the last six months?”*

While this is much more helpful, this elaboration does not provide an absolute rule. You will not find anything in the CMM that states how many months are required for institutionalization. Assessors have to make judgments on whether a process is really in place or not. Fundamentally, a process is what you do. It is not a document. Process improvement is a lifestyle change. Behavior change takes time, and it requires a supporting infrastructure (in some senses similar to Weight Watchers or AA).

Other SEI materials, such as the “High Maturity With Statistics” course, suggest that a reasonable heuristic for judging institutionalization is 6-12 months. Many of my colleagues feel more comfortable observing a year’s worth of behavioral evidence. But the answer depends on management support, frequency of execution, training, and other infrastructure issues. This “rule of thumb” is not an “official rule”—it’s a heuristic, to apply with judgment and common sense.

To add to the complexity, institutionalization occurs at the same time as continual improvement. The process you are implementing today is probably at least incrementally improved over the one you used a year ago. It may be radically different if you’ve adopted a whole new technology or methodology.

Does adoption of a new technology or method mean a drop in organizational maturity? If it did, we’d never get beyond Level 1! Does adoption of a new technology mean (at least potentially) a drop of process capability for the projects going through the learning curve? Probably. Even Level 5 organizations are continu-

ally changing (improving) their processes. The practical answer is that a change in the flavor of a process that does not affect the fundamental discipline of the process does not require “re-institutionalizing.”

What kind of change affects the “fundamental discipline”? Which I have carefully not defined....That’s the judgment part. It’s a matter of “degree” becoming great enough to become “kind” sometimes. If there’s a wholesale process change, as might happen after a buyout or merger, then institutionalization is likely to be a significant risk to manage.

To make it operational in project terms, if you have one big process change in a project, that’s piloting. If you have several, that’s chaos, and the project is going to have some significant challenges to deal with. If most projects are in that boat, the organizational capability is unpredictable.

So what does institutionalization really mean? It means setting expectations for the process while, as Collins and Porras put it in *Built to Last*, applying the “genius of the AND” rather than falling prey to the “tyranny of the OR”—maintaining process stability AND supporting continual improvement. It means establishing a culture of following a disciplined process (with different attributes as one moves up the maturity levels) even though that process (or set of processes) will be systematically changed in a controlled fashion over time. Maturity “regression” occurs when the “disciplined culture” falls apart.

So what we’re really looking for when we examine institutionalization is whether a disciplined process is being systematically followed, even though the implementation details change over time (and maturity adds in attributes associated with the levels). Six months or so is the minimum time for demonstrating behavioral change associated with the “clusters

(cont. on p. 14)

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of process attributes” that characterize each level, and if you’ve ever been on a diet, a year is probably a much better indicator, but the possibility of regression exists even after five years.

To return to the LA Handbook guidance, an institutionalized process is “in place for a sufficient amount of time so that the organization has had the opportunity to fine-tune [it] and determine [its] effectiveness.” This implies both consistent execution over time and that the organization has learned how to do the process better. One implication of an institutionalized process is, therefore, that it has been improved!

This alleviates the problem of institutionalization becoming an “iron cage” that constrains creativity via bureaucracy. Of the three forms of isomorphism associated with institutionalization in the sociological literature (see Paul J. DiMaggio and Walter W. Powell, “The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields,” *American Sociological Review*, April 1983), we would prefer normative rather than coercive or mimetic. Normative isomorphism is associated with professionalization—making software development and maintenance a legitimate engineering discipline.

The bottom line is that the appraisal team has to come to consensus that the documented process is “the way we do things in this organization.” The consensus of a team of knowledgeable professionals is one of the keystones of consistent appraisals—it’s not black-and-white, but when properly done, it works well.

*Mark Paulk is a senior member of the technical staff at the Software Engineering Institute. He has been with SEI since 1987. He was the “book boss” for Version 1.0 of the Capability Maturity Model for Software and was the project leader during the development of Software CMM Version 1.1. He is also involved with software engineering standards, including ISO 15504, ISO 12207, and ISO 15288. His current interests center on high maturity practices and statistical control for software processes. He is also working on an eCommerce Capability Model (eCCM) in collaboration with the IT Services Qualification Center at Carnegie Mellon University.*

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## ANSWERS TO THE SOFTWARE QUALITY ENGINEERING QUIZ

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1. **Answer C is correct.** One of the responsibilities of the team’s sponsor is to ensure that the team has required resources to adequately perform their function. The team’s facilitator is the expert on the use of quality improvement tools and techniques and would make recommendations to the team on their use. The team’s leader would typically direct the team, including making assignments, and would also arrange for meeting rooms and other logistics. **CSQE Body of Knowledge Area: I.C.3**
2. **Answer D is correct.** Changes to a defined process should be done formally through a change request process that involves the process owners. This allows the improvement to be appropriately analyzed as to its impact on the entire quality system. A single individual should not personally deviate from the defined process or change the process documentation without formal approval. Simply doing a lessons learned posting on the intranet will not insure that the improvement

idea is considered and implemented if appropriate. **CSQE Body of Knowledge Area: II.B.5**

3. **Answer A is correct.** A data flow diagram is a graphical representation of how data flow through and are transformed by the processes of a system. Data flow diagrams are not one of the elements of UML. **CSQE Body of Knowledge Area: III.D.1**
4. **Answer C is correct.** The senior management project review meeting would not review the details of individual tasks and inter-task dependencies. This would typically be dealt with at the lower level project team status meetings. **CSQE Body of Knowledge Area: IV.B.4**
5. **Answer C is correct.** A checklist can be used to ensure that all of the important items have been included in their discussion. An affinity diagram can be used to organize the ideas into categories. Affinity diagrams can also be used with defect data, customer quality requirements, audit observations, or any other set of data that need to be organized into categories. A cause and effect diagram, also called a fishbone diagram, would be a good tool to help the team analyze and organize the root causes of a particular problem. The force field analysis tool can be useful when trying to identify driving forces that help move toward reaching their goal and restraining forces inhibiting movement toward their goal. **CSQE Body of Knowledge Area: V.C.2**
6. **Answer B is correct.** Inspections focus exclusively on defect detection while walk-throughs include both defect detection and engineering analysis aspects. Both inspections and walk-throughs are peer reviews that are used to evaluate software work products. The work product author plays a critical role in both inspections and walk-throughs. **CSQE Body of Knowledge Area: VI.B.1**
7. **Answer A is correct.** The allocation of system-level requirements to each software component is done as part of defining the system and software architecture, and is therefore a role of software development or systems engineering, not configuration management. **CSQE Body of Knowledge Area: VII.A.1**

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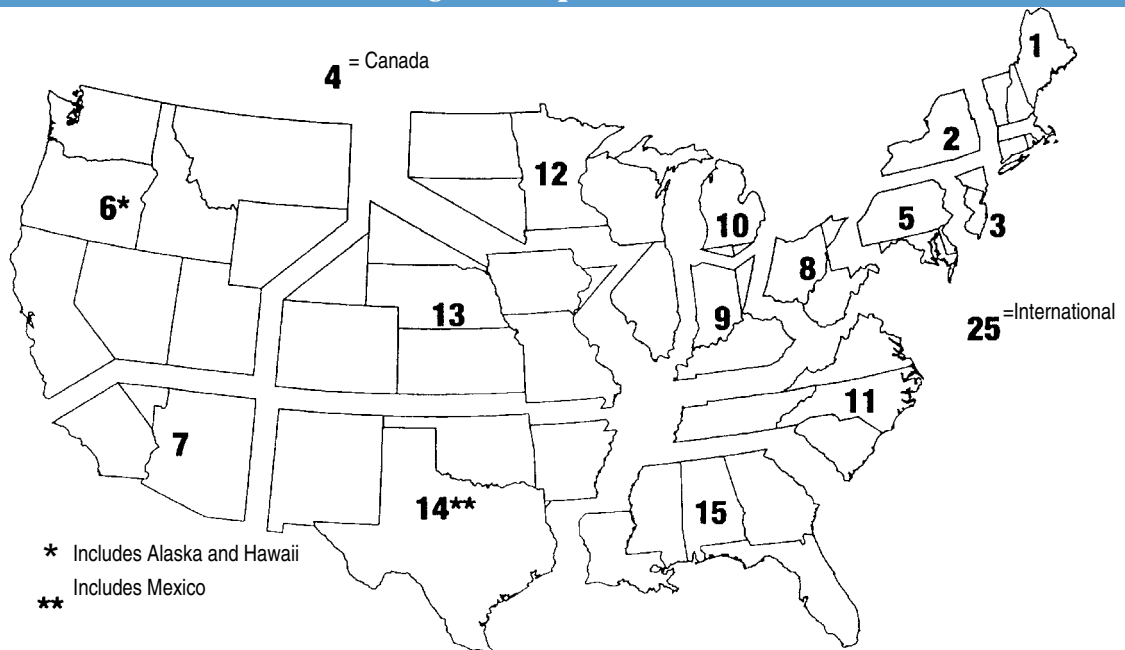
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voice: 334-244-3304 (Business)  
fax: 334-244-3792  
e-mail: tgriffin@monk.aum.edu

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