

Reaching Level 3 Is Like Traveling a Wide Sea

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This article looks at the changes facing an organization as it moves from CMM® Level 2 to Level 3. The author compares the journey to crossing the Bermuda Triangle. Dangers lurk, but there are steps an organization can take to change from the project-centered view of Level 2 to the broader organizational view of Level 3. The article focuses on the action of the organization's management and software engineering process group.

So your organization has reached Capability Maturity Model (CMM) Level 2, and you have decided to move on to Level 3. What does that mean? Where exactly do you go?

The organization faces a difficult journey across uncharted waters to Level 3. The focus of Level 2 is very clear and very pragmatic. Level 3 is a little foggy. Organizations can go adrift as they search for a course from project-focused improvement to organization-focused improvement. At this point the journey to improvement can enter an area like the Bermuda Triangle. There are a number of similarities between the trip from Level 2 to Level 3 and the trip across the wide Sargasso Sea. Organizations' challenges can be compared to three major concerns that plague those entering the triangle: no clear direction, disoriented instrument readings, and motionless waters.

No Clear Direction

Ships entering the Sargasso Sea at the heart of the Bermuda Triangle encounter an area of unusually calm waters. The area contains a large mass of seaweed, or *sargasso*, that adds to its sluggish nature. Early navigators lost their sense of direction in this unusual area. An organization can fall into this same trap. An organization that has just reached a repeatable level of process maturity runs the danger of resting on its laurels. It is easy to enjoy the relative calm of a repeatable level of performance.

Such organizations need a strong captain. Without one, the calm waters can lead the ship to run adrift. A loss of course could lead to falling back to earlier behaviors. The captain that led the ship to the repeatable level must plan a change in course to keep them moving. At Level 2, projects organized their software development practices to a degree of discipline that can repeat past success. This means that each crew understands how to set the rigging and trim the sails. What if you have more than one ship? Will the same practices that work for a sloop work for a schooner? What happens if you add a ship to the fleet?

At this point, the captain must step back and look at the whole fleet. All the ships have similar needs and can benefit from the experience of the others; however, they all have unique needs as well. To address organizational needs, the captain must assemble a command staff that has the responsibility for making sure the individual ships work together. In a software organization, this is the Software Engineering Process Group (SEPG). The SEPG serves as a communication channel from the captain to the commanders of the individual ships. The SEPG also monitors the sailing requirements of each ship to determine how it relates to the others and to find the best practices used by each ship. The SEPG works for the captain while serving as an advocate group that supports every ship commander. In this role, they ensure that the captain's vision is communicated clear-

ly to the ship commanders. The SEPG helps ship commanders put that vision into practice.

The SEPG works with the captain to set the fleet's direction and to define the sailing process to follow that direction. The SEPG works with individual commanders to build a standard fleet-wide process for trimming the sails and battening down the hatches. After the fleet standards have been set, the SEPG goes over the processes with the individual ship commanders to make sure they fit. The schooner may need specific steps to set its many sails. A sloop has a different set of sails and may have different types of hatches. The standard fleet process can be tailored to fit the needs of the individual ships. These standards help the ships determine what to do when they reach unknown waters. When the ships enter calm waters, they all know to take the same steps to sail through them at the fastest possible speed.

When the fleet is outfitted with new vessels, the captain and SEPG meet with the commanders to see how well the standard sailing processes fit. If a steam powered ship is added to the fleet, its needs will be very different; however, some basic fleet processes will still apply. While the new commanders' uniforms are being tailored, so are the fleet's processes.

In a software development organization this comes into play when new projects are developed. If the organization tackles a new project from a new customer, the SEPG works with the new commander to tailor the standard software process and establish a life-cycle flow. When the new commander looks to build the details of his process, he chooses from proven methods used throughout the fleet. He may take the estimating details from Project A and the requirements management process from Project B. If a new technology is being brought into play, the old processes may not fit, and new details will need to be developed.

Without a strong captain and dedicated command staff, an organization faces might run adrift in new territory. The challenges of the Sargasso Sea may prove too much for Level 2 ships, but should be a reasonable challenge to a Level 3 fleet.

Disoriented Instrument Readings

Legendary Air Force Flight 19 lost its way over the Bermuda Triangle. In-flight, the commander radioed that his instruments were acting funny. Sailors since the days of Columbus have also reported problems when crossing the area. Software development organizations rely on instruments, too. Level 2 organizations track size, effort, and schedule, but they may not track them well. The fleet is learning how to use its instruments.

Even Level 1 organizations generate numbers. Some of them may not be collected or reported as consistently as they could be, but the numbers are there. As an organization progresses to Level 2, it gets a better handle on its numbers. It may

be the first time the captain sees some usable numbers. What happens if the numbers look worse as time goes on? What could cause such a problem? How can it be fixed?

Since the fleet may be inexperienced in using instruments for navigation, it may take some wrong turns. When numbers are collected for the first time, there is no historical information to compare to them. Are they good or bad? They may be neither or both—it is just too hard to tell. If the numbers go up or down with the second iteration, are they good or bad? This time, there may be a way to tell.

The key to using the instruments is the reliability of the data. Numbers on things like expended effort and defects may look worse after the ship has sailed to a few new ports. Part of this comes from growing pains of learning. As people become more familiar with capturing defects and more comfortable with how to charge their time, numbers may go up and look worse. Everyone may feel like the ship is sailing smoothly, but the instruments show something else. At this point, the captain must be patient. Realigning the sails or forcing a commander to walk the plank is probably not the answer. Calibrating the instruments is better.

The captain and the SEPG should look for a measurement that is the most consistent. In the software development world, both size and effort lend themselves well to this task. Size measurements like function points or source lines of code can be defined precisely enough so that a size measurement to one ship is the same as a size measurement to the next ship. Having such a normalization factor is key to comparing and combining measures into meaningful metrics. Similarly, if an expended hour is clearly defined for the entire fleet and used consistently by all ships, it can be used as the normalizing measure.

Starting with a normalization factor like function points, an organization can calculate such metrics as defects per 100 function points, hours per function point developed, and cost per function point. Each value should be calculated for each ship for each time it sails. The captain and ship commanders should be aware of such numbers. Each time a trip is made, the numbers can be compared to those calculated for the previous voyage or series of voyages. With some historical data for comparison, the captain and ship commanders can determine the success of the current voyage. They can also predict with some degree of certainty how the next voyage will go. If the voyage is dramatically different from the previous ones, the captain can look for special causes like bad weather or the drag of the sargasso. Even these special causes can be factored in to predict future performance.

In a software organization, each software release represents a voyage. As the measurement process improves and historical data are built, some comparisons can be made to previous releases. If the defect rate per 100 function points goes up, the ship commander may want to look for special causes. If a change is made to the process, the ship commander will want to see the effect on defect rates, delivery rates, and cost factors. Each voyage builds a history and helps set expectations for ship performance. By reviewing current results against those expectations, the commanders gain greater understanding of their process and greater insight into needed changes to the process.

The Level 2 voyage gathered information that can be used for the Level 3 crossing. The information allows the captain and

ship commanders to make informed decisions on how to manage the fleet's activities.

Motionless Waters

As stated above, early navigators found unusually calm waters in the Sargasso Sea. The log kept by Columbus mentions several days floundering in the still waters of what is now called the Bermuda Triangle. The crew became restless, and talk of mutiny began. In software development organizations that reach Level 2, such mutiny can come in the form of regression to earlier behaviors. The resulting loss of direction in the motionless waters can also lead to losing sight of what got the fleet to its current position. For the fleet to successfully negotiate these waters, everyone must coordinate their efforts and communicate clearly.

The legend of Flight 19 also shows the problems with faulty communication and coordination. While lost over the Triangle, the flight's commander began having radio problems. Poor visibility made him disoriented, and his failing radio made communication spotty. While members of his flight suggested they were flying along the Atlantic seaboard, he insisted they were in the Gulf of Mexico. When he gave them the order to fly east to look for Florida, he simply sent them further into the Triangle, where they were lost.

What can the captain do to ensure the fleet stays together? How can the ship commanders relate their concerns to the captain? How can the crew members become involved? Should the fleet rely on semaphore flags or Morse code?

For a software development organization, a lot depends on how the organization approached its initial process improvement activities. If the captain's message focuses on the grade, the organization runs a higher risk of reverting to less mature behaviors. The rush for a grade can motivate a crew to put a lot of changes in place. However, it often does not reinforce the desired behaviors that go along with the higher maturity level. After the assessment team has left the ship, crew members fall back on the familiar and disregard the new. If the captain has not communicated intentions beyond the initial improvement efforts, a ship confronting the still waters of inactivity is more susceptible to covert resistance and may court open mutiny.

A software organization's captain must set clear goals based on a well communicated mission and vision. The importance of good communication cannot be stressed too much. The captain and his command staff must constantly work to ensure that the crew understands their role in executing the mission and vision.

The role of the captain and command staff is critical to avoid stagnation or mutiny. As stated earlier, the captain must set a clear course for the fleet as well as communicate that course to the ship commanders. If they do not act accordingly, the fleet remains trapped in Level 2 waters with each ship taking care of its own concerns. The good of the fleet becomes lost in each commander's private concern. The captain must reinforce the fleet's vision and goals. In turn, the commanders must communicate the course to all of their crew members. The entire fleet must be aware of the course for the individual ships to work together. The SEPG plays a critical role in coordinating the fleet's efforts.

Different ships in the fleet must coordinate their activities. By focusing on understanding a ship's needs and finding depend-

able methods of communication, the captain and the SEPG can ensure they consistently convey the right messages to keep the fleet working together. As stated earlier, the SEPG serves as the fleet's channel for communication. While the SEPG does not work for any individual ship, it does work for all of the ships. The SEPG coordinates the improvement activities and ensures that each ship fits in an organization's armada. Regular communication between the SEPG and all parts of the fleet is critical to success. The SEPG serves as the captain's ears when listening to concerns from the commanders. It must also serve as the captain's voice when explaining and coordinating improvement activities. The SEPG also assists commanders in communicating directions to the crew. Additionally, the SEPG must listen to crew member concerns and communicate them back up to the commanders.

The ship commanders must be able to communicate their needs to the captain without fear. While the captain must balance the many concerns of the fleet, the commanders must balance new directives with the fleet's primary mission. The captain must realize that commanders' perceptions drive their behaviors. The clarity and consistency of the message passed down the chain of command shapes how the fleet reacts. The crew listens to commands, but watches actions. The two must be aligned for the fleet to move in the captain's chosen direction.

One way to ensure this is to form a management steering group (MSG) consisting of the captain and his ship commanders with the SEPG in a consulting role. The MSG sets the direction for the organization. Working together to set the organization's mission, vision, and goals, the captain and the ship commanders can communicate a shared message to the organization.

While sailing across Level 2, the ships established their own courses. When facing the expanse of the Level 3 sea, the entire fleet from the captain to the crew must understand the direction of the entire fleet. Through consistent communication and coordination, they can ensure the fleet moves as a whole and finds its way out of the still waters of complacency and routine.

Summary

The Level 3 Triangle holds many challenges for captain and fleet. The stagnant water can make a fleet lose its course. It is critical that the captain be a person of strong mind and clear vision. It is the captain's job to set a direction for all to follow. If each ship sets its own course, the fleet will disperse. Even if instruments seem to be giving false readings, the captain and commanders must trust processes that the fleet has established. That trust will be rewarded when future efforts can be predicted from current ones, and when information can give the leaders a clearer picture of the course being followed. To negotiate the motionless waters, the captain and the SEPG must lead the organization to shift from a ship-centric view to one that encompasses the whole fleet. That view must be passed down clearly from the captain, through the commanders, to each crew member. Crew members, in turn, must be able to communicate concerns and ideas back up the chain of command. These coordinated efforts make it easier for the fleet to find its way out of still waters. By addressing these challenges, the captain can ensure that all the ships set their sails correctly and follow the right tack.

About the Author



Paul Kimmerly has 13 years experience in software development for different incarnations of the Defense Finance and Accounting Service (DFAS) Information and Technology Directorate. Since 1993, he has served as a member of the SEPG, chairing the group for the past five years. In addition to local duties, he chaired a group representing the six software development sites within DFAS that addressed process improvement issues. Paul is a member of the Kansas City SPIN and has given several presentations to the group. He presented part of a tutorial entitled *Transition Success from the Field* at the 1997 SEI Symposium. He also served on a panel at the 2000 SEI Symposium, Statistical Process Control as a Method of Continual Improvement. His article *Quietly Making Noise: A Parrothead's Look at Software Process Improvement* was published in the May 1998 edition of CROSS TALK.

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2001 Measurement Science Conference
www.msc-conf.com/findex.html#cfp2001.html

January 25-27

Ryerson 2001: A Software Approach
www.ryerson.ca/~csie/2001



January 30-February 2

CIEC 2001 Odyssey: Industry & Education Engineering
www.asee.org/conferences/html/ciec2001.htm

February 7-9

Network and Distributed System Security Symposium
www.isoc.org/ndss01/call-for-papers.html

March 5-8

Mensch and Computer 2001
<http://mc2001.informatik.uni-hamburg.de>

March 12-15

SEPG 2001 *Software Engineering
Process Group Conference*
www.sei.cmu.edu/products/events/sep9



March 31-April 5

Conference on Human Factors in Computing Systems
www.acm.org/sigs/sigchi/chi2001

April 22-26

*Twentieth Annual Joint Conference of the IEEE
Computer and Communications Societies*
www.ieee-infocom.org/2001



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www.stc-online.org

