What I would do differently if I wrote the *SEPG Guide* today

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Abstract. The *Software Engineering Process Group Guide* (*SEPG Guide*) was researched and written by Priscilla Fowler and Stan Rifkin in 1988-1990, and published by the Software Engineering Institute in 1990. It is about how to improve processes every day. Many of the observations reported in it have proved useful over the years of application. Some additional information would have added significantly to its applicability, particularly (not in any order): one size does not fit all, the importance of process improvement by stealth, how we are misled by psychology and should pay attention to sociology, what patterns of adoption look like, a fresh look at "resistance," and how engineers might approach the subject of deployment.

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I. Introduction
A. Purpose
I am frequently asked whether the *SEPG Guide* still applies to modern-day software process improvement. After all, it was written over ten years ago! The answer is that I have learned a lot since its publication and this essay is a chronicle of my journey; it is something of an autobiography.

The purpose is to introduce users of the *Guide* to some of the ideas that didn't make it into the *Guide*, but should have. Many were known at the time of writing, but some were not. And almost none were known to <u>us</u>, the co-authors, at the time, so the ideas in this essay represent true learning – at least for us.

Another purpose of this essay is to prod and provoke, and for that reason I exaggerate in places. I learn by being challenged and I hope you do, too.

B. Background

When I joined the Software Engineering Institute (SEI) in 1988 I was instantly asked by Priscilla Fowler whether I would be willing to write a section on action planning in a technical report she and Steve Masters were writing. She and Steve Masters had begun to write a survey of best practices on how to implement software process improvement (SPI). The notion was that there should be a focal point for software process improvement, called a software engineering process group (SEPG), that, while not responsible for process improvement, would be the collector and disseminator of SPI technology and on how to implement, deploy, and transition SPI into practice.

The inspiration for the survey was Chapter 14, "The Software Engineering Process Group," in Watts Humphrey's seminal *Managing the Software Process* (Addison-Wesley, 1989). It was part of that early definition of process maturity level 3, the defined process level. Mr. Humphrey outlined the tasks of the SEPG, so our job was to add a best practices survey of "how."

Priscilla, Steve, and I often discussed the outline and approach for writing the work. We wanted to closely follow the outline of the duties that Watts had presented in his book. Our focus on the "how" would balance Watts' on the "what." Accordingly, we ended up doing what very few at the SEI did at the time: leave the building to survey how actual process champions achieved their objectives. We interviewed a number of such champions, mostly in commercial firms. We could see two things: there were patterns, and there was a lot to learn for those of us who were not professional champions or change agents.

We surveyed and wrote from 1988 through 1990. The review process at the SEI results in much written material not being published; that is, it ends up on the "cutting room floor." One question we had at the outset was whether we had made the right decisions about what to include and exclude. The test of time is upon us and this essay reports on my professional observations since the *SEPG Guide* was published.

Incidentally, I made an important mistake at the outset. In my zeal I did not notice that the section should have been entitled "Action," not "Action Planning." We are fine at planning, it's just that we often fail to take action.

The *SEPG Guide* is available for free download as SEI 90-TR-24, September 1990.
http://www.sei.cmu.edu/publications/documents/90.reports/90.tr.024.html

I shall assume that the reader is familiar with the work.

II. Positives

We felt that there was already enough written about process improvement at the SEI that was directive, prescriptive, normative. Besides, we could find little authority that guided the efforts that we observed in the field. Accordingly, we sought to be true to the spirit of a survey and write something without *should*s.

What we saw in the field was an emphasis on soft skills, that is, on dealing with humans and organizations. And we saw in every case a boundary spanner, someone who lived in two worlds, the world of software technology and in the world of helping people to change. By definition, incidentally, boundary spanners are marginal in both. And they are rare.

We collected in one place what we could not find hitherto ourselves, so we knew it would be useful to change agents going forward.

The emphasis on reporting what we saw, on soft skills, and on trying to add value by bringing together in one place a collection of tips made us focus on being practical and applied, in order to produce something SEPG members could use every day.

And last, we tried to supply pointers to additional resources that had helped us. That way users of the *Guide* could expand on what we had observed and develop greater understanding than we had.

III. Negatives

Probably the biggest fault with our work, one that we did not really realize at the time, was the need to have a way to evaluate suggestions, ours and those that we heard during the survey and later on. We believed all that we heard and read. We did not have a filter, a way of organizing or evaluating the information we gathered.

As much as we tried to be practical and not directive, in retrospect we had too much "one size fits all." This reflected the mood of the SEI at the time and we fell victim to it. Various people, most notably Dave Card, tried to dissuade us from its force, but we were too easily influenced by the Zeitgeist.

Also, we were not mature enough to see the bigger patterns of adoption that we were hearing about. In a word, we had not read and understood (Rogers, *Diffusion of Innovations*, 1995) (it was in its third edition then). And (Moore, *Crossing the Chasm: Marketing and Selling Technology Products to Mainstream Customers*, 1991) had just come along, after the *Guide* was published.

There is something that draws us engineers[1] and computer professionals to psychology. But, in order to deal with groups, we should have learned sociology. We have over-relied on psychology, to our detriment. One negative, then, is that we did not introduce the operative learnings from sociology.

There was a widespread feeling at the SEI at the time of writing the *Guide* that we all resist change and that this resistance requires a strong counterforce. I have come to think that we were wrong-headed about resistance and have done a disservice to our readers and practitioners. Sometimes resistance is the appropriate response to change.

We also did not provide enough pointers into the literature of planning and managing change for engineers and computer professionals. There was much that we could have pointed to that would have sped up learning for those of us with hard science backgrounds.

We also underrated the place of negotiations and how much SEPG members needed to know about how to conduct them. I don't think we even mentioned the topic, but many SEPG members find themselves having to balance competing interests all the time, so being well versed and well practiced in the science and art of negotiation is important.

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[1] I use the term "engineer" broadly to include information systems professionals.

And last, we should have listed what we knew and what we didn't, so that users of the *Guide* could be on the lookout for what were truly new developments, and not have to re-warm what was already known. We should have helped create a curiosity about the important aspects of implementing SPI that are not yet decided. Sometimes at SEPG Conferences, for example, we hear as new something that has been known all along.

The organization of the essay is that each of the following sections deals in turn with an improvement we should have made, in the order of the items listed above. In a real new version of the *SEPG Guide* each of the sections would be chapters, with more detail and less autobiography.

IV.Means to evaluate suggestions

"There is nothing quite a practical as a good theory." – Kurt Lewin

Do you believe everything you read? Why not? The usual reason is that there is something contradictory in it. For example, when a salesperson says, "I exist only to serve you," we might not believe that because we have previous information about rewards. Or, "I can be objective about the solution to your software management and development problems," said by an SEPG member! We have reason to doubt this, as any SEPG member would have a bias about the solution, and that would interfere with the perception of the problem.

But when we read a book or article the author's biases might not be evident. How do we know whether we should take the advice being offered? The short answer is that if I can find the theory that supports what is being said, then I can evaluate the advice by comparing the underlying theory with the theory I hold about the world. If the theories match, then I am inclined to believe the story (= advice).

We all have theories, whether we articulate them or not. We use them to screen what perceptions we let impact us (some of us do not see "flying saucers," for example), how we make sense of the perceptions, and how things tie together into something that is useful for us. Theories are the induction we make in light of our experience. They contain the patterns we have sensed, but in a shorthand, an abbreviation, a generalization.

There are many useful synonyms or terms related to theory: paradigm, world view, model, framework, lens, and school of thought. The words and phrases are defined and differentiated in more precise terms in (Kuhn, *The Structure of Scientific Revolutions*, 1970) and (Burrell & Morgan, *Sociological Paradigms and Organisational Analysis : Elements of the Sociology of Corporate Life*, 1979). The picture I have of theory is:
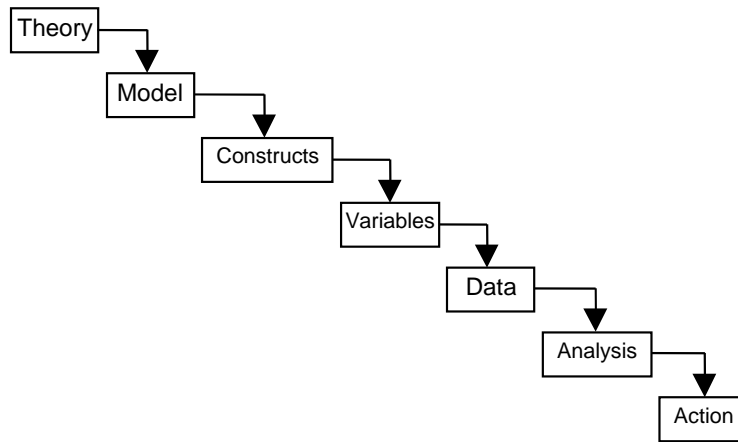
Figure 1 – The flow of theory to action.

The intuition is this: I have a theory that is "floating" around in my mind and I write it down in some abstract way, at the highest level of abstraction, in fact. We call that highest level a model; it shows the major boxes and arrows, and at least implies flow, collaboration and communication among the boxes. Constructs are what we call the constituents or components of our mental model. "Morale" is an example of a construct, so is "resistance to change."[2] These are the names we have invented of collections of properties of things we may have invented. Constructs are made up of things that can take on values, variables. If I want to say something about an instance of a construct, such as how high morale is or how much resistance to change there is, then I would collect data on the value of variables. I would analyze the collected data to ascertain if I could see any patterns, and then, based on what I infer from the patterns, I might take action.

Here is an example to illustrate the use of theory. Ever notice that there is great excitement when a new leader is announced, such as CEO, or Chairperson, or President? We all rally around that person and then, usually slowly, perhaps ineluctably, we part ways with the new leader and begin to form a coalition to depose the new leader. The shine is off, the honeymoon is over. In fact, this seems to happen even with new (improvement) initiatives, such as TQM, Six Sigma, and, dare I say, CMM. Is it just my imagination, or does it always seem to happen?

The answer is in (Bion, *Experiences in Groups, and Other Papers*, 1961)[3]: all groups elect or appoint a leader and then try to kill her/him because he/she does not meet our unstated, unlimited, infantile wishes. This applies to the leader of an organization and to a leader of an initiative, like software process improvement. The lesson for me is that it's not personal, and I really appreciate that there is a theory I can read and come to understand that will explain what happens in all groups. Incidentally, the really astonishing revelation to me is that this happens in work groups <u>and</u> in therapy groups!

Why have or use theories? For me the reason is that my brain is small, I cannot remember very much, so having a shorthand for a really big thing – such as Bion's theory on how all groups work – is helpful to me. It is a parsimonious representation of a possibly complex thing. Other reasons include the ability to predict the future (where the billiard ball – or missile – will be in a few minutes), see things I didn't know mattered

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[2] Incidentally, so are "force," "momentum," and "acceleration," not to mention "time."

[3] Two things are worth noting: this is a small book and we need to beware of small books because every word is golden, and it is old. In fact, there is very little that is new in this essay, it's just that we are not exposed even to the old stuff.

(the spin on the billiard ball), and deepen my understanding of how interaction takes place (the angle of incidence is equal to the angle of reflection).

Why don't more of us use theories? Why isn't there a track at the SEPG conferences on the theory of implementation? After all, we are all trying to implement process improvements. I think (Thorngate, *"In General" Vs. "It Depends": Some Comments of the Gergen-Schlenker Debate*, 1976) has put his finger on it. He says that a theory (model, framework, etc.) cannot simultaneously be general, accurate, and simple, which is depicted in Figure 2.
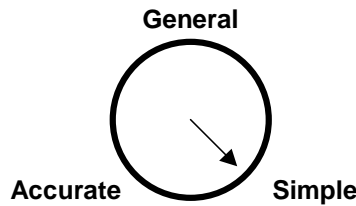

Figure 2. Thorngate's one-armed clock. (Adapted from Thorngate, 1976, p. 406)

What I see at SEPG conferences is that some people are disappointed in theories, claiming that they are not general enough, or simple enough, or accurate enough. But, of course, any one theory cannot be all of those at once. It is a comfort to know that. In fact, we can select theories that best suit our usage, if they exist.

Some people at SEPG conferences have suggested that organizations are like families and we can fruitfully apply a theory of families to the organizations in which we are trying to improve software processes. This raises the question of generality: are family theories sufficiently general to apply to our industrial, non-profit, and governmental organizations? What is the equivalent of the "parental role" in our organizations? Does that make sense in the theory we already have in our minds of how our organizations work? Is the purpose of a family sufficiently like the purpose of our organizations to be able to make the link, or does purpose not matter?

This brings us to the related question of "unit of analysis." If my brain is small, I want a theory that works for the stuff I am dealing with so that I don't have to tinker with (that is, personally extend) the theory. If I am dealing with the origin of the universe I may not want to use a theory about the start of life on Earth. Here is a table of the units we might be dealing with and their corresponding fields of study:

Unit of analysis	Field of study
Cells	Biology
Individuals	Psychology
Collectives	Sociology
Nations, civilizations	Anthropology

If we as SEPG members are dealing with collectives – groups, teams, organizations, companies, subsidiaries, divisions, subcontractors, branches, offices, etc. – then it might be beneficial to look at theories of social systems, the subject matter of sociology. Luckily for us, there is at least one such theory, Talcott Parsons' General Theory of Action.

Talcott Parsons is the most famous American 20th century sociologist. He tried to create a grand unified theory, like the one physicists are searching for. The good news is that he was a prolific writer and he wrote thousands of pages on his theory, and thousands more were written by others about it: the theory is accessible. The bad news is that Parsons' style was "thick" and difficult to understand. The best entry point to the Theory of Action is (Bluth, *Parsons' General Theory of Action: a Summary of the Basic Theory*, 1982); for a critique of how difficult it is to understand Parsons directly, see (Black, *The Social Theories of Talcott Parsons*, 1961); for a bibliography of Parsons' work see (Turner, *The Talcott Parsons Reader*, 1999); for a framework that places Parsons into a larger fabric, see (Burrell & Morgan, *Sociological Paradigms and Organisational Analysis : Elements of the Sociology of Corporate Life*, 1979) and (Van de Ven & Poole, *Explaining Development and Change in Organizations*, 1995). And there is an attempt to provide a deductive logic framework for the theory in (Brownstein, *Talcott Parsons' General Theory of Action: an Investigation of Fundamental Principles*, 1982).

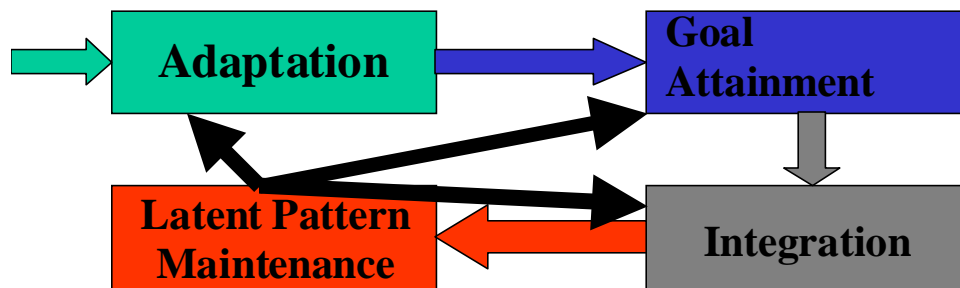His theory of social systems looks like this:

Figure 3 Model of Parsons' General Theory of Action. (AGIL framework)

External energy begins the clockwise flow, into Adaptation. Parsons postulated that there were four prerequisites that every organization has to address in order to survive and flourish:

1. Adaptation, the interface with the outside environment, scans for "interesting" items and takes in energy, usually in the form of new ideas, and if those ideas are worthwhile (that is, consistent with the behavior patterns of the organization) then
2. Set goals and allocate resources accordingly.
3. Based on the goals and resource allocation, integrate new processes into the behavior.
4. Maintain the patterns of behavior in the organization. This is often called "culture" at SEPG conferences.[4] The term "latent" means hidden, unseen.

The arrangement of the four prerequisites (that's what the boxes are called: functional prerequisites) is the static structure, and the arrows among them are the dynamic exchange of information among the prerequisites, which instantiates how each of the four boxes interacts with the others. In fact, the latent pattern maintenance one is different, special, as it impacts the rest of the boxes by forming the filter that lets in – or does not let in – the energy that travels clockwise around the circuit. In a sense, latent pattern maintenance tries to restore the organization to its form before being "disturbed" by the new ideas. Parsons likened latent pattern maintenance to the law of physics that for every disturbing force there is an equal and opposite restoring force.

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[4] "Culture" in sociology refers to what is studied in anthropology, such as national culture, not corporate or organizational "culture."

When I look at organizations I ask myself how each of the four prerequisites are being met and whether the interchange among them is operating. That is, the Parsons framework can be directly used for organizational diagnosis and then action can be couched in terms of what the theory anticipates and expects. It's the ultimate of practicality![5,6]

I am going to say quite a bit about resistance to change in section VIII. As a preview, what do you think Parsons would say about resistance to change? He would say that it is a vital, fundamental function (latent pattern maintenance) and if it didn't work then the organization would suffer and die.

So, how do you know how to evaluate suggestions that come your way? Ask if they are consistent with a/the theory you are using.

V. Too much "one size fits all"

The mood at the SEI when we were writing the *Guide* was that organizations lacked the backbone to make changes, that they needed strong words to encourage – well, force – them to see the value in the improvements we were espousing. We had to be unequivocal in our guidance, no room for argument or discussion. We had to be directive, powerful, and unwavering.

This is in contradistinction to what social systems "engineers" call equifinality: there are many ways to reach objectives. It's taken on faith that there are many means possible to achieve goals, that the most important distinction is not to confuse ends and means.

In that spirit, I will never forget a presentation Dave Card made at an early SEPG conference. He showed how his division had accomplished all of the functions of an SEPG, but different internal entities did them: the functions were distributed. There was not one dedicated group, but rather the functions were integrated into mostly-existing structures. That was heresy at the SEI, and the standard response to predict failure because there was not enough management commitment to centralize the resources. Parsons, on the other hand, would have rated the chances of success as very high because it was a style of integration (one of the

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[5] See "Son of Behavioral Clues to Organizational Process Maturity," by Judah Mogilensky and Stan Rifkin, presented at SEPG 2002, for additional examples, presented per CMM process maturity level.

[6] We can revisit the suggestion that family systems thinking applies to the kinds of collectives we face in SPI. Parsons' unit of analysis was any collective; the family is a specialization of that. Do we go with the general or with the specific, even though the specific is not what we directly face? The question, again, should be: do we seek accuracy, simplicity, or generality? In my consulting practice I seek generality because I have a small brain and cannot remember all of the details in accurate models. As one who has to explain what I find to others, I appreciate (the power of) simplicity. And, in the end, my advice has to apply, so it's important for it to be accurate. The answer is that we have to strike a balance, usually somewhere between accuracy and simplicity; generality is not generally valued by clients. And we know that applying family system thinking to our kinds of organizations is not accurate, so it might be that it is simple and can be easily understood by our clients. After all, we all have families!

As an aside in this competition of the general vs. the specific, Parsons made his theory able to be more accurate, definitely at the expense of simplicity. The accuracy is obtained by examining in detail the interactions among the exchanges to/from each functional prerequisite (that is what each box is called). In his theory every box gets information from every other box and gives information to every other box; I simplified it in Figure 3. Parsons has even postulated a theory on the patterns one should see in those exchanges (he calls it the theory of pattern variables). The constituents of the patterns can be assessed (I hesitate to say measured) and those observations can be analyzed in order to diagnose and take action.

four functional prerequisites), a reward for using what already worked and increasing the scope of that to encompass the next great thing.

I used to sponsor a "One size does not fit all" panel at SEPG conferences, but program committees evidently grew tired of them and the proposals were never again accepted. Panel members proved, at least to me, that what worked in a large, centralized, command and control corporation like Boeing or IBM was unlikely to work in a small, flat, democratic, techie company like Ashton-Tate. We had speakers from defense and civilian agencies, defense contractors, metal benders, commercial computer providers, and software houses. No two were alike in how they organized, paid for, justified, or operated their SEPGs. Clearly, one size did not fit all.

But what I can borrow from what I hear or read, given that no two organizations may be the same? That is a settled question, by a field called contingency theory. Contingency theory asks, "What is the best way to organize?" and answers with "It depends." "Depends on what?" you ask. It depends upon a set of factors that have been theoretically and empirically shown to make a difference. The best description of contingency theory and what it means to say that one organization is like another is (Burton & Obel, *Strategic Organizational Diagnosis and Design: Developing Theory for Application*, 1998).

Some organizations have had trouble getting software process improvement started. The accepted wisdom is that that is caused by a lack of sponsorship, that those who print money do not see the (true, obvious) value in SPI. They are deluded, bad characters. I have found the contrary, that SPI as dictum in the CMMs is detrimental to many organizations: it is contrary to their value proposition to the marketplace. Those organizations have to perform SPI by stealth, not because of lack of will, but rather because it is the most effective and most appropriate way.

The logic comes from (Treacy & Wiersema, *The Discipline of Market Leaders; Choose Your Customers, Narrow Your Focus, Dominate Your Market*, 1995), a study of 80 high performing firms. The authors ask "What was the secret to their success?" and answer with "Focus," but that is not new. Digging deeper they found that highly successful organizations focused on one and only one value proposition or market discipline"
1. Operational excellence – lowest price because it has the lowest cost, usually because it has the highest quality for its category. Process innovator, no product innovation. Short menu, "formula" for the delivery of goods or services. Examples: FedEx, McDonald's, Wal-Mart, semiconductor manufacturers.
2. Product innovation – emphasizes new features. Measures its success by number of patents, Nobelists, or turns in the marketplace. Examples: Sony, Intel, Lucent, every pharmaceutical development company.
3. Customer intimacy – will do anything for a client, offers one-stop shopping, the total solution. Infinite menu. Examples: Big Five accounting firms, Computer Sciences Corp.

Treacy and Wiersema are quick to point out that while high performance organizations concentrate on one and only one discipline, every organization has to perform at a threshold level on the disciplines that it is not focusing on. That is important in the case of traditional, CMM-centric software process improvement because it is specifically for operationally excellent organizations, organizations that differentiate themselves in the marketplace by their quality. The other two disciplines only have to reach a threshold level of opera-

tional excellence, and the CMM is silent about process areas that would specifically help product innovative and customer intimate organizations beyond the threshold level.

Therefore, it is appropriate for product innovative and customer intimate organizations to achieve "just enough" process improvement, and perhaps to do even that by stealth as a way to take clear aim on the dominant strategy of the organization. So, some leaders are precisely correct in not embracing SPI: it was inappropriate as a goal for two out of the three disciplines. They were not bad characters, as we accused them, rather they had a sense that while more quality was better, that was not what drove their organizations; the marketplace expected something different, and SPI would not directly deliver that.

More details on the connection between *The Discipline of Market Leaders* and SPI can be found in (Rifkin, *What Makes Measuring Software So Hard?*, May/June 2001).

VI. Not enough about patterns of adoption

There are many synonyms for getting new processes into practice or new products into our lives: deployment, implementation, technology transfer, technology transition, technology diffusion, and adoption. They all mean changing the way we work or what we buy/use.

A. Diffusion of innovations

One of the pioneers in seeing a pattern in how processes and products are adopted is Everett Rogers. He collects stories of adoption and has assembled the fruits of that collection in (Rogers, *Diffusion of Innovations*, 1995). He reports that adoption often follows this pattern:
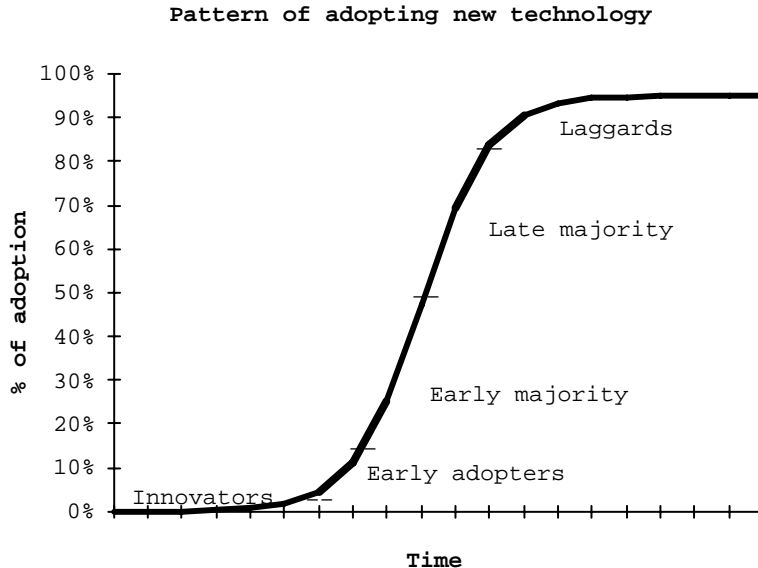
The S-shaped curve has along it the names of the groups of people who adopt at different epochs in the life cycle. Suffice it to say that the model is one of a communication process (or contagion) where the message of the value of the new process or product is diffused from adopter to adopter. Informally, adoption by an organization as a whole is declared when about 50% of the people use it commonly. That is, it is the way to do things in about half of the projects, and the usage is increasing.

One of the inspirations for the S-shape is logistic or Gompertz growth, which occurs when there is a growing population that is dependent upon a fixed resource (think bacteria in a Petri dish, real estate in Pittsburgh, and the number of people who can adopt a new process in an organization). S-shapes in the context of diffusion of innovations have been criticized because they only predict increased adoption. For a counter-argument, see (Chaddha & Chitgopekar, *A "Generalization" of the Logistic Curves and Long-Range Forecasts (1966-1991) of Residence Telephones*, Autumn 1971), which tried to explain why Picturephone failed to become adopted. Also, the S-shaped curve depicts the cumulative adoption; the sum of the normal distribution is also S-shaped, which will be handy to know as we explore …

B. Crossing the Chasm

The literature on adoption is filled with responses and rebuttals to Rogers' pioneering work. The most colorful may be (Moore, *Crossing the Chasm: Marketing and Selling Technology Products to Mainstream Customers*, 1991). He rewrites the adoption curve as:
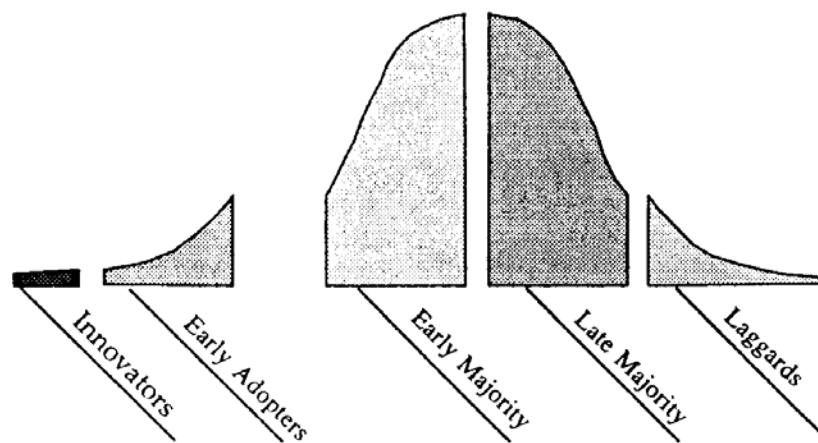

Figure 4. Pattern of adoption according to *Crossing the Chasm*, p. 17.

Basically, there are chasms or deep valleys between each epoch, between each class of adopter. And there is a particularly deep one between early adopter and early majority, where SEPGs try to operate once SPI gets rolling in an organization. Accordingly, Moore's work is both entertaining and informative.

So, which is more accurate, Rogers, Moore, or others (e.g., (Tornatzky & Fleischer, *The Process of Technological Innovation*, 1990), that says it's all more complicated than a simple communication process)? As a contingency theorist, I would respond, "It depends." First, it depends upon whether adoption is primarily a matter of communication. To the extent it is, as in health and safety issues, then I find in my practice that Rogers' model is fine. If, rather than a communications process it is a selling process, then I find that Moore is more informative. But, when there are many competing ways to perform a new process, then I find Tornatzky to be more predictive of what I see. Another answer would be to follow the International Federation for Information Processing (IFIP) working group 8.6 (e.g., (Levine, *Diffusion, Transfer and Implementation of Information Technology*, 1994), which reports on a 1993 conference held at the SEI), http://www.indiana.edu/~ifip86/, which is trying to sort out these and other related issues, particularly as they relate to the adoption of software process improvement.

VII. Too much psychology, not enough sociology

Psychology addresses the wrong unit of analysis for our work. It is focused on the individual, but we cannot afford to help organizations change one person at a time. We should be focused on organizations, so we should be learning about sociology. Unfortunately for us, psychology does not scale up to sociology. They are not just on different scales, they are different.

A. Myths due to psychology

Here are three myths about groups that we have inherited from psychology:

1. Myth: Teams need to be goal-aligned

Wrong. It is sufficient to be means-aligned. We do not have to agree on a common goal to work as a team, we only have to agree on how to achieve the end. (Weick, *The Social Psychology of Organizing*, 1979)

The standard example is any US professional football team. Each person is on the team for a different reason. Some for the money, some for fame or glory, some because it's what they do best, some because they don't know what else to do. There are many reasons, many personal goals. But they all agree on the play-book. It's what they practice, what they expect from each other, no matter how disparate and even competing their individual goals may be.

This would work with our software and systems development teams. We can agree on the playbook, even though we do not agree on the goals for our individual and collective work. In our case the playbook is the organization's defined process. To think that processes come from places other than collectively-agreed goals is considered heresy to most SEPG members, primarily because we are crippled by psychology thinking.

2. Myth: Teams form, storm, norm, and then perform

There are a lot of pages used to describe the phases a team goes through to get its work done. Most of it is made up. No theory, alas. A UCLA researcher went to study, really to validate, the form, storm, norm, perform phases that we have all learned (well, memorized). She was not exactly unbiased and open, she was going to study those four phases. She was a bit surprised, and even frustrated, that the work teams she studied did not go through those phases at all, so she studied some more. What she found is that the teams she observed went through two phases: the first in which the members discuss roles and responsibilities, and team processes, like decision-making and assignments and progress reporting. Then the halfway mark comes and the team panics because it has not accomplished anything, so it jumps into the second phase: heads-down work performance. (Gersick, *Time and Transition in Work Teams: Toward a New Model of Group Development*, 1988)

There is another explanation I like, too, and very steeped in theory, particularly by Bion. In fact, you don't have to read Bion directly if you read this (Smith & Berg, *Paradoxes of Group Life: Understanding Conflict, Paralysis, and Movement in Group Dynamics*, 1987) instead. The authors observe that teams progress until they get stuck! The authors see that teams have to address a series of issues and unless and until they do, they do not make progress. The issues are paradoxes, problems that by their nature are contradictory and cannot have a single answer.

Here is an example. A configuration management (CM) working group has defined the new CM process, but will not release it for trial use. The SEPG is trying every method of persuasion it has, but so far to no avail.

What is the problem, why/how is the group stuck? Members of the working group are not satisfied that the process description is good (perfect) enough, and they would be embarrassed by their peers if they released a flawed process, it would discredit their standing as experts. But, of course, you cannot tell if it's flawed or not until it is released and tried in the field. So, one must not release it, but one also must. An SEPG member versed in paradoxes will see that it, along with all paradoxes, is a framing issue. The issue cannot remain per-fection because that cannot become known inside the working group meetings; the process would never be released with that criterion and method of determination. Rather, the criterion has to be shifted to "engineer satisfaction," so that the path forward is to release the process and then quickly respond to flaws discovered in use.

3.   Myth: Knowing the personality type is helpful

At SEPG conferences the most common method I see advocated to know the personality of another person is the Myers-Briggs Type Indicator (MBTI), a variant, some say perversion[7], of Jung's idea that we are born with certain proclivities and they are manifest in our choices, in our behavior. The Type Indicator is a four-letter code out of 2^4 possibilities, which is too many for my small brain. No problem: 85% of the people in computing are INTJ.

But here is the problem. I have scoured the MBTI literature for even a single research article that, armed with the Type Indicators of the participants, predicts the behavior of a group. None found. In other words, to exaggerate, you can know all about the psychological composition of your teammates and never be able to predict what will happen when they all come together to act as a group. Personality type indicator is the wrong unit of analysis. What is the personality type of people who overuse personality types: JDGI, Just Don't Get It.

No, we need to learn more about social systems (sociology) and let that knowledge naturally replace what we have learned about individuals acting individually. And you would think that books like (Hohmann, *Journey of the Software Professional: a Sociology of Software Development*, 1997) would help, but there's actually no sociology in it.

VIII.   Wrong-headed about "resistance"

Right up there with inappropriate borrowing from psychology is the construct of resistance to change. I have commented, above, that at the SEI we believed that any person who resisted our forceful sales job on soft-ware process improvement had a bad character, and was disloyal, unpatriotic.[8] I have come to learn that some of the resistance was appropriate, and some was about the mortgage.

The "mortgage" angle is simply this: if you reduce my ability to meet my mortgage payments then expect me to respond – negatively, as you might imagine. The application to SPI is simple: if software process im-provement will make me look stupid, incompetent, or otherwise less powerful than the position I have strug-gled lo these many years to earn, then you can count me as against it. Does this mean that the person in question, and incidentally, in authority, is resistant? I don't think so, I think the person is acting appropriately to proximately protect his/her mortgage payments.

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[7] See, for example, (Loomis, *Dancing the Wheel of Psychological Types*, 1991).

[8] A person at the SEI, though not there at the time of writing the *Guide*, who believed differently is Linda Levine, who wrote (Levine, *An Ecology of Resistance*, 1997).

A. Competency-enhancing vs. competency-destroying

How did I come to this line of reasoning? One brick is (Tushman & Anderson, *Technological Discontinuities and Organizational Environments*, September 1986). In this seminal article, the authors investigate how it is that some firms make technological changes and thrive, and others do not and perish. They find that at least in part it's the technology! They classify the technologies – and this is their contribution – as either competency-enhancing or competency-destroying. Competency-enhancing technology performs functions you do today, just better, cheaper, and/or faster. Competency-destroying technology performs functions you have probably never performed, such as object-oriented design or Java programming or, well, software process improvement. The authors found that those firms that made successful technological transitions time and time-again differentiated how they implemented competency-enhancing technology vs. competency-destroying. For competency-enhancing, a few hours of instruction (at most) may be sufficient, as are on-line help, FAQs, and tutorials. For competency-destroying technologies, though, an entirely different approach needs to be taken, else those affected will try to protect their mortgages (not quite the way they put it) and will not learn the new stuff.

It bears mentioning that the world advances by competency-destroying technologies, so we need to learn how to implement them. Tushman has made something of a career of exploring this, beginning with his discovery in his first article, above, through to his latest book, (Tushman & O'Reilly III, *Winning Through Innovation: a Practical Guide to Leading Organizational Change and Renewal*, 1997). For those who are patience-impaired, that book is well-redacted in (Tushman, Anderson, & O'Reilly, *Levers for Organizational Renewal: Innovation Streams, Ambidextrous Organizations, and Strategic Change*, 1998). If one follows the writings of Tushman through his odyssey, one will see a transformation of his. He has come to see that in order to be effective, organizations have to be equally adroit at (discovering and) implementing competency-enhancing <u>and</u> competency-destroying technologies simultaneously.[9] He sees cycles of rapid change where discontinuous, competency-destroying innovation is prevalent, followed by relatively stable epochs of incremental improvement and competency-enhancing technologies, followed by the tumult of discontinuous change and its white-water characteristics, and so on.

B. Life cycles

The idea that organizations have life cycles and that different skills might be appropriate and required during each one is most prominently due to (Quinn, *Beyond Rational Management: Mastering the Paradoxes and Competing Demands of High Performance*, 1988). Quinn posits that every organization goes through four sequential cycles:
1. Innovating, inventing whatever the new enterprise's value proposition will be.
2. Discovering that people are its most important assets.
3. Integrating robust processes into its business life so that it can repeatably address the issues of the marketplace.
4. Developing a strategy that will insure that the enterprise will survive and flourish.

This work, incidentally, is an application of Parson's General Theory of Action; the insightful student will be able to identify the AGIL framework, in order!

Quinn posits, in addition, that for each phase a different set of skills are appropriate and the expression of them is a kind of balancing among competing values. The SPI angle is that we typically act as though we are

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[9] Tushman calls this ambidexterity.

in the third phase when there's a ¾ chance that we are not! We have to learn how to act in the other three phases and Quinn's book is an excellent guide. For more detailed guidance one can consult (Quinn, *Becoming a Master Manager: a Competency Framework*, 1990).

Therefore, the existence of life cycles also implies another reason that the concept of "resistance" may be wrong-headed: SPI may be inappropriate in several of the phases, or at least less valuable than in the third, when it would be wildly important.

C. Strategy

And here is just a quick reminder about a point made in section V. Sometimes it is appropriate to "resist" the proposed changes because they are inconsistent with the organizational strategy. In the case of SPI, the CMM is targeted at operational excellence. If your organization's strategy is either product innovativeness or customer intimacy, then you'd better use the CMM to bring up the organization to a threshold of operational excellence. Any more than that should be resisted on strategy grounds.

D. Institutionalization

One of the life cycles of change used by the SEI uses the term "institutionalization" in it and the SEI adopted that term for the CMMs. The term institutionalization has, unfortunately for the SEI, numerous meanings, including:
1. Civil confinement of individuals for mental health or community safety reasons.
2. The habit of an organization to repeat what it knows and to imitate others it admires.

The SEI means it in the sense of adoption, as in section VI.A, the way Ev Rogers defined it as "regular usage."

But institutionalization as sociologists use the term (2., above) is important, too. Just look at the title of the seminal article on the subject, (DiMaggio & Powell, *The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields*, April 1983). "The Iron Cage"! Iron cage is the literary term for prison. Max Weber, one of the most famous sociologists, wrote: "… the care for external goods should only lie on the shoulders of the 'saint like a light cloak, which can be thrown aside at any moment.' But fate decreed that the cloak should become an iron cage."[10] DiMaggio and Powell write that by this Weber warned that rationalism had ushered in an era in which capitalism and its off-spring, bureaucracy, had become an iron cage for humanity (p. 147). The authors note the strong resemblance of organizational structure from one organization to another, not withstanding their disparate market orientations, such as Microsoft and Ford Motor Company, for example. That is, the organization charts of those two firms are nearly identical at some scale.

What accounts for the lack of diversity in organizational life when organizations themselves – from the standpoint of the diversity of the people in them and the diversity of their markets and market disciplines – seem so diverse? It's that organizations copy one another and there is great pressure to look and act alike, the authors show. They use the sociologist's term for this pressure: institutionalization. The main point of the literature on institutionalization is what a strong, pervasive, and latent force it is. Organizations may not so much resist change, rather they conform to very large, powerful norms.

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[10] (Weber, *The Protestant Ethic and the Spirit of Capitalism*, 1958), p. 181. Note that Parsons was the translator! There is some controversy about whether he translated the term "iron cage" correctly. See (Baehr, *The "Iron Cage" and the "Shell As Hard As Steel": Parsons, Weber, and the Stahlhartes Gehäuse Metaphor in The Protestant Ethic and the Spirit of Capitalism*, May 2001).

E. What can be changed

While I do not like using psychological constructs, it might be instructive to look at a few, and leave as an open question about whether organizations act like people in this regard. First, the addiction literature notes that back-sliding (that is, failing to make a permanent change, called "relapse" in the model) is normal and part of the life cycle of improvement (see esp. (Miller & Rollnick, *Motivational Interviewing: Preparing People to Change Addictive Behavior*, 1991), p. 15, Fig. 2.1, citing the six stages of change by (Prochaska & DiClemente, *Transtheoretical Therapy: Toward a More Integrative Model of Change*, 1982)). Second, (Seligman, *What You Can Change & What You Can't: the Complete Guide to Successful Self-Improvement*, 1994), summarizes his 250-page synopsis of psychology by listing behaviors and correspondingly the chance of changing. The list goes from curable, through mild or moderate relief, to unchangeable. The pattern that emerges from the list is that what can change is a function of how deep the behavior is. Depth is elusive and difficult to define, but intuitively ranges from biological "destiny," which is the hardest to change, to how strongly we believe something, which is the easiest to change because, in some circumstances we can apply logic (or cognitive therapy, which is currently popular).

(Schein, *Organizational Culture and Leadership*, 1992) generalizes the psychology literature and theorizes that organizational "culture" is manifest on three levels:
1. Artifacts – things that we can see and read, the surface, visible.
2. Espoused values – what is said to be believed, such as strategies, goals, philosophies.
3. Basic underlying assumptions – latent, not spoken, understood, unconscious, taken for granted, the ultimate source of values and actions.

The order is from easiest to change to most difficult.

Is a person or organization being resistant if it is asked to change that which is very difficult to change? Do we even have a right to ask for such a change? Do we know where software process improvement is in the spectrum of what is possible to change?

F. Language as inhibitor or accelerator

Along the lines of cognitive therapy are the ideas in (Kegan & Lahey, *How the Way We Talk Can Change the Way We Work: Seven Languages for Transformation*, 2001), redacted in (Kegan & Lahey, *The Real Reason People Won't Change*, November 2001). The distinguished authors note that we construct our own iron cage with the language we use for change. They take us step-by-step away from the language that silently removes change from our consideration and towards language that commits us to consider change. The work is artful in that we are not made aware of the deep psychological basis for our antipathy towards change, but are led to learn a new way to frame the choice to change that appears to be as natural as the one to avoid it.

G. Change is harder than we think

To me, this section, along with other information, implies that change is more difficult than we think. In fact, it might be a lot more difficult than we think. After all, how is change measured? We don't have a change effort metric and there is virtually nothing written about how difficult it is quantitatively for a person or an organization to change. I take this to mean that we know very little about the effort it takes to change and whether that energy is justified, so it is cheap to require change, as we have done at the SEI for a long time.

IX.Insufficient pointers for engineers entering new subject areas

There is a wealth of information about social systems that may appeal to us engineers that we were unaware of when we wrote the *Guide*. This collection can roughly be divided into a view of social systems as systems of (usually non-linear) differential equations, and those that rebut the view of social systems as billiard balls. The approach to characterizing social systems as a set of non-linear differential equations is simulation, sometimes by numerical integration and sometimes by discrete events that push tokens (as a surrogate for work) around a network. And there is a red herring in the mix: chaos theory, which at this point is a metaphor when applied to social systems but is a set of non-linear differential equations when applied to selected physical, biological, and economic systems.

One counterforce at the SEI was a group of people who had studied the liberal arts and had a distaste for engineers (at the Software *Engineering* Institute), saying that we engineers were never going to be extroverted enough, in touch with people enough, to understand change and organizations. They created an atmosphere that was antagonistic to my learning about social systems because I was genetically not up to the material, I was told. They, on the other hand, had a difficult job dealing with us insensitive, untreatable dolts, but someone had to it.

I was pleased to learn that there are entry points into the study of social systems that do not depend upon extroversion or intuition about people. In fact, mathematics, engineering, and the hard sciences would better equip the learner for the access points below.

A. Burton and Obel

Perhaps the most interesting work in organizational behavior and organizational design has been performed by this team of researchers. They are the epitome of "management science" meets "organizational science." The first contribution I want to note is (Burton & Obel, *Designing Efficient Organizations : Modelling and Experimentation*, 1984), where the authors ask whether there is an optimal organizational structure, an optimal organization chart. Until these authors, organizational design used heuristics and every book you read would have a different, idiosyncratic set. It was very much art, with a little science (based on very selectively introducing the results of field research). Burton and Obel came to see the problem as one of optimization: what is the arrangement of entities on a chart that either maximizes or minimizes some mathematical function that I can compute? If the arrangement can be reduced to constraints and the function to be maximized (such as profit) or minimized (such as decision speed or communication noise) can be actually stated, then the problem of finding an/the optimal arrangement is a typical linear programming problem.

To make an interesting story short, Burton and Obel invented a way to transform the question of organization design into the computation of an optimal arrangement. I used it on a consulting engagement and it created an organization chart no one had never seen before, one ideally suited to the particular and peculiar constraints of the situation.

Later Burton and Obel wondered if enough is known about contingency theory to help an actual organizational designer diagnose and design particular organizations. Remember, contingency theory asks the question "What is the best way to organize?" and answers with "It depends – upon many factors that have been shown empirically to make a difference." So Burton and Obel read everything written on contingency theory and extracted rules from the studies and arranged them into an expert system, the Organizational Consultant, OrgCon. It is on a CD ROM included with their encyclopedic treatment of all of contingency theory, (Burton & Obel, *Strategic Organizational Diagnosis and Design: Developing Theory for Application*, 1998). OrgCon

can take as input and existing organization and produce a diagnosis of "misfits" that bear investigation and possibly remediation, or it can take as input a proposed organization to produce the same type of report so that the potential arrangement can be tuned on paper before being implemented in practice.

I use OrgCon to diagnose the structure of my clients because I want to know the extent to which organizational problems contribute to problems implementing SPI. And then I use OrgCon to propose an arrangement that will accelerate SPI. And I do all of this using a practitioner-independent, repeatable process – without resort to art.

I use the example of this Burton and Obel book for another purpose: organizational stuff is accessible to us engineers. I am proud to be acknowledged by the authors in the second edition because I went through the first one and noted what I thought were discrepancies in how I understood contingency theory. I think this is evidence that there is room for us engineering-types to substantively contribute to the understanding of organizations.

B. Vité

Vité is a Stanford University start-up that has developed a method of answering the questions, "What is the best way to arrange my people on this project?" and "What is the best way to arrange the work of this project?" The answer is that they inter-depend; for a particular project, the optimal arrangement of people depends upon the arrangement of the tasks, and vice versa. This is new news.

The start-up, based on twenty years of research in the Civil Engineering Department, offers a product, Sim-Project,[11] that takes as input the organization chart of a project, a Gantt chart of the tasks and their dependencies, and the connection between the organization chart and the task network, that is, who is going to perform which work in the project plan. SimProject then simulates work coursing through the network, consuming worker's time, generating exceptions (errors) and rework, meeting, and answering the phone and e-mail. The output of SimProject is a set of displays that show how far this arrangement of people and work is going to be from the duration predicted by the Critical Path Method that is present in every project management software package, how much each person gets backlogged and bottlenecked and when, and the extent to which the work is productive, rework, coordination, or waiting. Using the displays one is led to rearrange the work and organization to seek an optimum (e.g., shortest duration, highest quality).

More detail is available in (Rifkin, *When the Project Absolutely Must Get Done: Marrying the Organization Chart With the Precedence Diagram*, 2000), including the observation by the creators of SimProject that the project management literature gave them no insight at all into how knowledge work (such as civil engineering design and software engineering) can be modeled and predicted.

C. Implementation Management Associates

At the SEI we sought the best provider of training and consulting on how to plan and manage technological change. I don't think we expected to find The Best, but rather a short list of providers that we could recommend to the SEI's constituency. But we did find The Best: Implementation Management Associates (IMA). The SEI went on to license IMA's material and deliver its own version of the popular entry level course. IMA went on to steadily improve its materials.

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[11] Master Systems Inc., my employer, is Vité's channel partner for the application of SimProject to software development.

IMA materials are tailor-made to us engineers and computer professionals in a number of ways. First, no intuition about people or groups is required. The whole point of the IMA approach is to make its adherents consciously competent, in distinction to our gifted, people-oriented colleagues who are unconsciously competent. The IMA method is based on Plan-Do-Check-Act, the cornerstone of our SPI quality approach. And the IMA method is data-based: every one of its ten steps is based on collecting data about the environment into which we are trying to introduce change. In sum, the method is algorithmic without being a cookbook. It requires training, practice, and judgment, just like everything else in software process improvement.

One of IMA's principals, Byron Fiman, has made a specialty of addressing CMM-based SPI. He has helped introduce change in many organizations and has tuned the IMA materials, case studies, and examples to SPI. See http://www.imaworldwide.com

D. System dynamics

Jay Forrester at MIT has come to understand human systems as systems of non-linear differential equations. If you have ever worked with such systems of equations you know how difficult it is to solve them, to make inferences from them because the interactions among the variables, even for something as small as three equations, is very difficult to understand and characterize. Forrester invented a way to visualize the effect of the system of equations by introducing a graphic language of icons that indicate "stores" (the static part of the system, the structure) and "flows" (the dynamic, time-varying part). Then his graphic depiction is simulated by numerical integration.

If one can create the equations, then his approach, called system dynamics, is a powerful method of making inferences about how structure and results interact. System dynamics has become a compelling method of understanding the effects of (public) policy in such diverse areas as zero population growth and heroin needle exchange programs. General references are too numerous, as there is a whole department at MIT and other universities focusing on system dynamics. The best current book on the general subject is (Sterman, *Business Dynamics: Systems Thinking and Modeling for a Complex World*, 2000). See also http://www.albany.edu/cpr/sds/

One of the more fruitful streamlining of the system dynamics approach to the solution of systems of non-linear differential equations has been made in by one of Forrester's students in (Senge, *The Fifth Discipline: the Art & Practice of the Learning Organization*, 1990), a popular approach to explaining the deep structure of organizations and organizational behavior. Without meaning to be pejorative, Senge uses a redaction or dumbing-down of Forrester's stocks and flows – called causal loop diagrams (CLDs) – to make inferences about conditions in human systems that are present due to the structure of the actors and actions, not by chance or choice. Causal loop diagrams cannot be "solved" directly, so they are a precursor to systems of differential equations.[12] The purpose of CLDs is understanding, inference. There is an interesting field of study called qualitative modeling that tries to model without using numbers and CLDs fall into that category. Also, (Moberg, *Diagnosing System States: Beyond Senge's Archetypes*, 2001) describes some lessons learned, some generalizations, based on field use of Senge's descriptions of how systems work.

(Abdel-Hamid & Madnick, *Software Project Dynamics: an Integrated Approach*, 1991), in what is essentially Abdel-Hamid's MIT doctoral dissertation, applied traditional system dynamics to software develop-

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[12] At one point I was going to write an expert system that could translate CLDs into stock and flow diagrams so that the CLDs could be simulated, so that the inferences could become (more) quantitative.

ment and management. He examined the truth in Brooks' Law (adding people to a late project make it later), whether independent validation and verification are worth it, and why actuals always seem to exceed estimates. Jim Hart is writing a book applying systems dynamics to software process improvement.

E. Chaos theory, complex adaptive systems

There is a relatively new field, chaos theory and its synonym complex adaptive systems, like its predecessor catastrophe theory, that models systems as systems of non-linear differential equations (beginning to sound familiar?!). Most of the breakthroughs in chaos theory have centered around attractors and phase space. An attractor is simply a solution to the system of equations characterizing the mechanics in question. It appears that nature tends towards a solution, so as the value of variables change, the system of equations is drawn towards solutions, that the trajectory of the variables appears to be attracted, as if my some sort of magnetism, in a certain direction (towards a solution) or away from a certain direction (away from a solution).

This is often illustrated by drawing the functions in a phase space. A phase space, in the sense used here, is the variable vs. its derivative. Some trajectories that look random in the space of the variable look very regular and orderly in phase space. This has given rise to expressions such as "order out of chaos," which is a way of looking at irregular phenomena and seeing a pattern – that was always there if only we knew how to see it.

The idea of seeing order out of chaos has attracted writers of management literature, and even a few software methods and tools vendors. Many of them lack any mathematical background at all, so they miss the important point that for organizations chaos theory is a metaphor, not a computational reality. Perhaps you have seen the completely awful book, (Wheatley, *Leadership and the New Science: Learning About Organization From an Orderly Universe*, 1992). The author confounds so much it is difficult to know where to start to straighten out the content. One of the most frustrating aspects is that she did not pay attention to scale. She uses quantum physics to try to explain organizational behavior, yet the rest of us know that at any other scale most of the findings at the quantum scale do not apply. And she does the same thing at the cosmological scale. And she, and many other authors, invite us to apply the findings of chaos theory to organizations. They miss the fundamentals, among them that the systems of non-linear equations that characterize chaos are drawn from physics, usually the conservation of energy. The equations equate one form of energy to another or to mass. What is the analog of conservation of energy in human/social systems? What is conserved? Surely it's not energy, as there is no limit on the amount of human intellectual energy, especially if we think of it manifested as ideas. What, then, is the source of the equations that exhibit non-random trajectories? What variables in social systems would we graph vs. their derivatives to find out? What is time (that is, dt) in social systems?

One good introduction to chaos theory is (Gleick, *Chaos: Making a New Science*, 1987); (Nicolis & Prigogine, *Exploring Complexity: an Introduction*, 1989) and (Prigogine & Stengers, *Order Out of Chaos: Man's New Dialog With Nature*, 1984) started the whole thing, mostly in chemistry; (Goldstein, *The Unshackled Organization: Facing the Challenge of Unpredictability Through Spontaneous Reorganization*, 1994) and (Guastello, *Chaos, Catastrophe, and Human Affairs: Applications of Nonlinear Dynamics to Work, Organizations, and Social Evolution*, 1995) thoughtfully apply chaos theory to human systems, noting carefully the usefulness (or not) of the metaphor; if you like binary then you will love (Kauffman, *The Origins of Order: Self-Organization and Selection in Evolution*, 1993) and (Kauffman, *At Home in the Universe: the Search for Laws of Self-Organization and Complexity*, 1995); and (Cohen & Stewart, *The Collapse of Chaos: Discovering Simplicity in a Complex World*, 1994) offer a thought-provoking counter to chaos theory, arguing that

some forces in nature are not entropic (that is, gain entropy, go towards disorder = chaos), but rather oscillate between chaos and order. And (Olson, *Exploiting Chaos: Cashing in on the Realities of Software Development*, 1993) missed the bit about chaos being a metaphor.

"... despite the promise indicated by various authors within the field, complexity science has thus far failed to deliver tangible tools that might be utilized in the examination of complex systems." (Moberg, *Diagnosing System States: Beyond Senge's Archetypes*, 2001)

F. Quantum organizations

How many different organization structures are there? How many different sizes are there? We might be tempted to say "infinite," but research indicates that there are only a few. That reminded (Miller, Friesen, & Mintzberg, *Organizations: a Quantum View*, 1984) of quantum states.[13] Quantum states are found (only) at the sub-atomic level: electrons travel in well-defined orbits and jump from one orbit to the adjacent one, never really existing in the space between the orbits. The essence of quantum states is that some possible states are unreachable, not allowed, not found in nature.

Miller found that organizations only exist in certain configurations and there are not many of them. Mintzberg, in the same volume, reiterated what institutional theorists have known for a long time: there are only a few types of organizational structures, and very few once a certain scale is reached.

The importance to implementers of SPI is that certain forms are degenerate, and we would want to know them and whether our client organization is in one of them, and what the progression from state-to-state looks like for our organization so that we can guide and anticipate such transitions.

Danny Miller is one of only two extant management theorists (the other is Karl Weick). He has won the Strategic Management Society Award for the most significant article published in the *Strategic Management Journal* from 1980-1990, and named as author of two of the ten most cited *Academy of Management Journal* papers in that publication's 40 year history. I try to read everything Miller writes. And all of his critics, such as (Donaldson, *For Positivist Organization Theory: Proving the Hard Core*, 1996), Ch. 6, "For Cartesianism: Against organization types and quantum jumps."

G. Interpretation systems, not billiard balls

My background in mathematics and engineering often tempts me to want to characterize organizations the way I do physical objects. I want to write equations and solve them! I have found much in organizations that resembles the physical world, so I try to explain organizational behavior in physics terms. That is a mistake. The mistake is clearly explained in (Daft & Weick, *Toward a Model of Organizations As Interpretation Systems*, 1984), which relies on (Boulding, *General Systems Theory: the Skeleton of a Science*, April 1956). Basically, rather than passive physical objects, like billiard balls, we humans and our collectives <u>interpret</u> the forces that impinge on us and decide to react or not, and that reaction is not necessarily proportionate in any sensible way to the stimulus. In fact, every response we make as a collective is a very complex action that is, in its simplest form, the sum of all stimuli and responses hitherto; we have memory, after all, and billiard balls don't.

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[13] Don't confuse this with (Zohar & Marshall, *The Quantum Society: Mind, Physics, and the New Social Vision*, 1994).

That we interpret our stimuli is a powerful antidote for me that prevents me from (over-) using physics analogies. Unfortunately, it does not stop others, so beware.

H. Computational & mathematical organization theory

There is an emerging field of great interest to our engineering side: computational and mathematical organization theory (CMOT). It actually started in the mid-1960s in, of all places, Carnegie Mellon University, with (Cyert & March, *A Behavioral Theory of the Firm*, 1963). The field is composed of people who span the boundaries of organization study (sociology or management science), mathematics, and engineering. There is a journal from Kluwer Academic (see http://www.wkap.nl/prod/j/1381-298X), an on-line journal, *Journal of Artificial Societies and Social Simulation* (http://jasss.soc.surrey.ac.uk/JASSS.html), and several foundation books: (Carley & Prietula, *Computational Organization Theory*, 1994), (Burton & Obel, *Design Models for Hierarchical Organizations: Computation, Information, and Decentralization*, 1995), (Conte, Hegselmann, & Terno, *Simulating Social Phenomena*, 1997), (Prietula, Carley, & Gasser, *Simulating Organizations: Computational Models Institutions and Groups*, 1998), and (Ilgen & Hulin, *Computational Modeling of Behavior in Organizations: the Third Scientific Discipline*, 2000).

I. Reading list

Here is a list of articles and books that, were I starting over again to learn about social systems, I would read in this order:

1. (Daft & Weick, *Toward a Model of Organizations As Interpretation Systems*, 1984) – Why human systems are not like billiard balls. Best to get this out of the way early.
2. (Katz & Kahn, *The Social Psychology of Organizations*, 1978) – Responsible for converting many hard scientists into social scientists. Leading early authority on the systems view of collectives.
3. (Kaplan, *The Conduct of Inquiry; Methodology for Behavioral Science*, 1964) – Written by an ex-physicist who became a social scientist. Very searching and scholarly work that has influenced me greatly.
4. (Smith & Berg, *Paradoxes of Group Life: Understanding Conflict, Paralysis, and Movement in Group Dynamics*, 1987) – The best book on teams. It includes what you need to know about Bion, too. All the other books on groups look sophomoric by comparison.
5. (Weick, *The Social Psychology of Organizing*, 1979) – This is a small book. Beware of small books because they contain dense material. In this one, many of the sentences are or will become PhD dissertations. For this reason Weick is called generative. I try to read everything Weick writes.
6. (Bluth, *Parsons' General Theory of Action: a Summary of the Basic Theory*, 1982) – A quick, accurate introduction to Parsons.
7. (Berger & Luckmann, *The Social Construction of Reality: a Treatise in the Sociology of Knowledge*, 1966) – You will have to read this sooner or later. It's about what you can know for sure regarding social systems. Kaplan prepares you for this.

X. Understanding negotiations

"In every change – indeed, in every system – there are winners and losers." – Tom DeMarco

As I hope you can tell by now, I am a fan of methods that are step-by-step and do not rely on intuition. In other words, practitioner-independent repeatable processes. Such methods exist for many human-centered endeavors and more are being added every day.

There are many skills we engineers need to develop in order to help our clients implement the improvements they strive for. I think one of the highest priority ones is reframing, taking a problem statement in one point of view and expressing it in another, that of the listener. In other words, the skill is to listen with one set of filters, mentally translate into another, and then re-state the same problem with a different set of filters. While it cannot be taught, it can be learned.

Our challenge is to frame the situation so that there are only winners. This is problem-solving in its highest form, and since most of us were attracted to engineering and computing because we are born problem-solvers, this should fit with our personalities. And it's a solved problem!

A. Harvard Program on Negotiation & Theory-W
The Harvard Project on Negotiation, a multi-university consortium, mostly of law schools, has developed a step-by-step method of listening for what each side to a dispute wants, trying to establish a measure of fair value to any prospective solution, and then problem solving to try to create a solution that makes all parties winners. The method is called "principled negotiation." These step-by-step methods are colorfully detailed in:

> (Fisher, Ury, & Patton, *Getting to Yes: Negotiating Agreement Without Giving in*, 1991)
> (Ury, *Getting Past No: Negotiating Your Way From Confrontation to Cooperation*, 1993)
> (Fisher & Brown, *Getting Together: Building Relationships As We Negotiate*, 1988)
> (Stone, Patton, & Heen, *Difficult Conversations: How to Discuss What Matters Most*, 1999)

For the most part these are short books, so beware because they are dense. For courses and more information, see http://www.pon.harvard.edu/

If all of this sounds vaguely familiar, it is! (Boehm & Ross, *Theory-W Software Project Management: Principles and Examples*, July 1989) have translated *Getting to Yes* into application in software development, and Barry Boehm has continued that elaboration through his work with Win-Win Negotiations (see http://sunset.usc.edu/research/WINWIN/)

B. How to break bad news
Related to winning and losing (though, again, we are seeking all winners!) is how to tell someone that they have lost in some regard. As an engineer I have no intuition on how to do this, so I seek step-by-step methods. The best one I have found is in (Buckman, *How to Break Bad News: a Guide for Health Care Professionals*, 1992), the author of which is an oncologist who must surely have the most difficult job of all. He has tuned and developed an algorithm that is a compassionate alternative to intuition.

XI. What we know & what we don't
The intent of this section is to outline something like (Asbell, *What They Know About You*, 1991), an encyclopedic treatment of what is known about the human psyche, except about the kinds of groups we deal with as we implement SPI. It would be difficult to claim such a comprehensive treatment as Asbell's, so consider it a beginning. And it needs to contain, but does not yet, all we know about implementation. I have only listed a very few of the major findings that are infrequently referenced in SEPG conference materials.

A. What is known
1. Mutual adaptation – Implementing any technology is a process of mutual adaptation: the technology is tailored to the organization and the organization is tailored to the technology. The specific steps are

messy. (Leonard-Barton, *Implementation As Mutual Adaptation of Technology and Organization*, October 1988) (This is from the *SEPG Guide*)

2. Waves of change – this is an original contribution by (Caputo, *CMM Implementation Guide: Choreographing Software Process Improvement*, 1998), Chapter 4, "Improvement cycles: dancing with the rhythms." Kim Caputo synthesizes some disparate findings about pattern of adoption (à la *Crossing the Chasm*) and institutionalization (used in the adoption sense, not in the sociological sense), and then added her own SPI implementation experience to create a novel explanation of what we experience as the up's and down's of implementation.

3. Is my organization like yours? – And therefore, can I profitably borrow what you did? This is a solved problem, as contingency theory answers the question of what factors make two organizations alike and to what degree those factors have to agree in value. There is a sense in which this question is not asked enough; if one's organization is unlike another, the borrowing of practices must be <u>very</u> selective. Little about implementation is generalizable.

B. What is not known

1. Re-framing – There is no step-by-step method that I know. It still relies on practice and intuition.
2. Implementation success and contingency factors – We need empirical results on the relationship between implementation success and contingent factors – that is, what spells success: "It depends!" Depends on what? We still have almost nothing quantitative on how long implementation takes and how many/much resources it consumes. The only study I know is (Lopata, *The Cooperative Implementation of Information Technology: a Process of Mutual Adaptation*, June 1993), which is difficult to obtain.

XII. In conclusion

We need to keep our eyes open, question authority (even or especially mine), keep asking "Why?" When I listen to speakers at SEPG conferences I ask myself "Why is that so? Why do we have to sell SPI so hard? What's wrong with SPI that it takes so much effort to sell?"

A lot is already known about implementation, so we need to read and classify our knowledge. We all need to relearn the lessons of the applicable aspects of sociology so that we don't have to learn it by failure in the field.

And last, remember that even "old stuff" may be helpful: there are very few new problems under the sun!

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