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Keeping Complex Projects on Track

How Executive Sponsors Influence Project Success

The role of project sponsors is often overlooked. But for every stage of a project, there are key executive sponsor behaviors that can make the difference between success and failure.

BY TIMOTHY J. KLOPPENBORG AND DEBBIE TESCH

THE LEADING QUESTION
What can executive sponsors do to facilitate project success?

FINDINGS

- For every project stage, there are success factors that project sponsors should consider.
- Effective partnerships with project managers require a great deal of informal dialogue.
- When a project is wrapping up, sponsors should work to apply lessons from the project.

COMPANIES UNDERTAKE PROJECTS to create and improve their products, systems and services. To improve the chances that projects will be successful, it's common for organizations to choose senior executives with an interest in the outcome to act as the project's sponsors. Executive sponsors are responsible for lining up the necessary resources at the beginning, managing (or personally performing) certain activities while the project is underway, and ultimately delivering results.[1] Since executive sponsors rarely have enough time to manage projects personally, they must rely heavily on project managers. So which activities and behaviors can busy sponsors perform in the course of a project to increase the chances of a project's success?

According to recent studies, this is an important question. The Project Management Institute, a professional association for project management professionals based in Newtown Square, Pennsylvania, states that having executive sponsors who are actively engaged is the leading factor in project success.[2]

In researching what makes for successful project sponsorship, we used a project life-cycle model with four stages: (1) initiating — from the preliminary idea through approved charter; (2) planning — from approved charter through approved project plan; (3) executing — from approved project plan through acceptance of major deliverables; and (4) closing — from acceptance of major deliverables through final completion. Projects come in many shapes and sizes, and many life-cycle models are used to guide behavior and understanding. We chose to use the simplest model.

Most successful organizations are familiar with the initiating stage of a project. Also well accepted is that there are steps that need to be taken to close down the project after the major project deliverables are completed. While the first and last stages of projects are clear, in some settings, the planning takes place before executing starts; other times, there is overlap between planning and executing, or the two are iterative. To ensure that our research was valid for all types of projects, we specifically asked participants in our planning study to focus on planning behaviors and participants in the executing study to focus on executing behaviors.

No matter what stage a project is in, there are established success factors that project sponsors should consider. In the past, project success has been defined by the so-called "iron triangle" of cost, schedule and performance. Thanks to several well-known studies[3] that have tended to build on each other, our understanding of project success has become broader yet more specific. Essentially, there are three important success factors. The first involves customer impact: specifically, the extent to which the project creates deliverables that meet the needs of the project's customers — whether those customers are internal or external to the organization. Meeting customer needs is almost always the most important success measure. The second success factor involves meeting agreements: Was the project completed on time, on budget and to specifications? The third success factor is tied to the future benefits to the company — be they new technology, new products and/or commercial success.

We conducted separate studies of each of the four project stages (initiating, planning, executing and closing), with literature reviews, focus groups, surveys and factor analysis in order to examine executive sponsor behavior and project success factors. (See "About the Research.") In each project life-cycle stage, we found that two or three behaviors had a significant impact on the project success factors. (See "Key Executive Sponsor Behaviors.")

The Initiating Stage

During the initiating stage, we identified three important sponsor activities and behaviors: setting performance goals, selecting and mentoring the project manager, and establishing priorities.

Set performance standards. Part of setting performance standards can be accomplished in the project charter by stating goals about the project's strategic value and how it will be measured. However, beyond what's stated in writing, the sponsor and the project manager need to develop a clear understanding of expectations about performance. Effective sponsor–project manager partnerships require a great deal of informal dialogue, especially during the project's early phases. Later, as project managers gain experience and prove themselves worthy of the sponsor's trust, the conversations can take place less often and be less detailed.

Select and mentor the project manager. When a sponsor selects and mentors a project manager, both the organization and its customers benefit. Since the sponsor and the project manager share responsibility for the project, it's important to select the project manager wisely and make sure that the person is up to the task. Once the project

ABOUT THE RESEARCH

We conducted four separate studies: one for each of the stages of initiating, planning, executing and closing. In all, more than 1,000 people participated in our research (about one-third executives, one-third managers, and one-third consultants, educators and researchers). The participants were recruited from professional groups, conferences and networks. About half had more than 25 years of experience. Just over half of the projects were less than one year in duration. About two-thirds of the participants were from the United States. No respondent helped in two consecutive parts of the research (such as focus group and pilot survey) or in the studies of two consecutive stages (such as initiating and planning).

For each study, we started with literature searches, discovering generally more than 100 possible sponsor behaviors. We then conducted focus groups with senior managers from various industries to help us document similar behaviors, express ideas more clearly and eliminate irrelevant data. We conducted pilot surveys to reduce the length of the study and eliminate any possible confusion. Then we conducted large-scale surveys. Finally, for each project stage, we conducted principal components analysis to identify, reduce and confirm both sponsor-behavior factors and project-success factors. To estimate the effects of sponsor-behavior factors on the project-success factors, a path model was created for each project stage. This identified the core sponsor behaviors that a sponsor should perform at each project stage and the specific success factor each helps achieve. Detailed findings from our research were reported in the February/March 2014 issue of *Project Management Journal*, in an article coauthored with our late colleague Chris Manolis.[i]

manager has been chosen, the sponsor needs to act as a mentor. Among the sponsor's key responsibilities are explaining how the project fits into the big picture, defining the performance standards and helping the project manager set priorities.

Establish priorities. In setting priorities, the most compelling questions are (1) what needs to happen first? and (2) how should conflicts be settled? Sponsors should address these questions both at the organizational and project level. The sponsor needs to ensure that benefits to the business are clearly explained and fully understood by the project manager and the executive team. The sponsor also needs to make sure that the project manager knows which aspects of the project are most urgent and which aspects can be postponed.

KEY EXECUTIVE SPONSOR BEHAVIORS

In each stage of a project's life cycle, there are two or three critical sponsor behaviors.

PROJECT STAGE	KEY SPONSOR BEHAVIOR
Initiating Stage	•Set performance goals •Select and mentor project manager •Establish priorities
Planning Stage	•Ensure planning •Develop relationships with stakeholders
Executing Stage	•Ensure adequate and effective communication •Maintain relationships with stakeholders •Ensure quality
Closing Stage	•Identify and capture lessons learned •Ensure capabilities and benefits are realized

The Planning Stage

For the planning stage, we identified two critical sponsor behaviors and activities. The first is to ensure that all the necessary planning is accomplished on a timely basis; the second is to develop productive relationships with stakeholders.

Ensure planning. Executive sponsors need to ensure all the necessary planning activities are completed, although most of these will be performed by a project manager and team. Sponsors need to provide leadership so that the project manager and team can set project goals that align with the vision and the broader organizational goals. Before committing to a particular approach, it's important to consider different options. Sponsors also usually need to ensure that project managers develop a schedule, a budget, a resource plan, a risk management plan, a communication plan, a change control process, an escalation process and a periodic review structure.

Develop relationships with stakeholders. We found that when an executive sponsor personally works to establish good relationships with the project's key stakeholders, the organization often benefits. Sponsors should ensure that all stakeholders are identified and should meet frequently with peers in client organizations to seek understanding. In addition to seeing that project stakeholder wants and needs are identified and understood, executive sponsors should make sure that stakeholders' emotional concerns are given adequate consideration. Successful executive sponsors create an environment that is conducive to effective communication between project teams and stakeholders. In some circumstances, it may be necessary for sponsors to become personally involved in that communication. It's up to sponsors to maintain effective communication and to ensure that the project's customers are involved in its planning and understand the project's value.

The Executing Stage

During the executing stage, we found that there were three important sponsor behaviors and activities. They are: ensuring adequate and effective communication, maintaining relationships with stakeholders and ensuring quality.

Ensure adequate and effective communication. As the project progresses, communication needs to take place regularly between the project team, the project manager and the stakeholders to make sure that the expectations are being met. The executive sponsor can facilitate this communication by visibly empowering the project manager. However, sponsors must also stand ready to manage the organizational politics with internal and external stakeholders. Effective sponsors can remove obstacles, resolve conflicts and encourage input. In addition, they can personally communicate their concerns to appropriate executives.

Maintain relationships with stakeholders. Executive sponsors can work with project managers behind the scenes to make sure that the project manager and project team communicate effectively. Yet there may be situations when a team member wants to interact directly with the sponsor. Effective sponsors need to be open to direct feedback from team members, both as individuals and groups. Sponsors ensure continued customer involvement and ensure that the expectations of key stakeholders are met. They should also plan to communicate directly with key stakeholders to explain significant aspects of the project and why they are relevant.

Ensure quality. We identified several sponsor activities and behaviors that help ensure quality. To begin with, executive sponsors can act as role models to ensure that ethical standards are upheld. They can also practice appropriate decision-making methods and work to resolve issues fairly. Finally, they can insist on using proven processes for managing change, monitoring risk, escalating issues and applying timely corrective actions. Sponsors should also work to ensure that the project's customers are satisfied with the project deliverables.

The Closing Stage

In the closing stage, we found two activities sponsors should stress. The first involves knowledge management. The second involves verifying that the organizational capabilities have been improved and promised project benefits achieved.

Identify and capture lessons learned. During the closing stage, sponsors need to make sure that meaningful lessons learned from the project are identified and captured. Such lessons need to be categorized, stored and distributed in such a manner that future project teams will be able to understand and capitalize on them. Sponsors should insist that any new projects begin with a review of the knowledge repository to determine which lessons from prior experiences to apply.

Ensure that capabilities and benefits are realized. Part of wrapping up a project is asking how the organization might increase its capabilities based upon what employees learned from the project. These capabilities could include employees becoming more committed and more capable, and processes that are more effective and more efficient. Assessing capability increases can begin as soon as the project ends. A second aspect of a project closing is verifying that the deliverables that were specified at the beginning were actually provided, work correctly and satisfy customers' needs. It usually makes sense to wait a few months to see how the project deliverables are actually working. Although there's a temptation to close the book and move ahead, sponsors need to push for this follow-up. Otherwise, it is unlikely to happen, and the company will miss an important opportunity to receive valuable input from the project customers regarding how they use the deliverables, how well their needs have been met and ultimately how satisfied they are. This input can help companies serve their stakeholders better on future projects. After all, the needs of the project's customers are the primary reason for undertaking a project and the most important measure of success.

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Accelerating Projects by Encouraging Help

To keep product development projects on schedule, establishing psychological safety and promoting cooperative behavior can be just as important as good planning.

BY FABIAN J. STING, CHRISTOPH H. LOCH AND DIRK STEMPFHUBER

Roto's roof and solar technology division developed a formal help process that resulted in a measurable improvement in product development project cycle times.

IN TURBULENT BUSINESS LANDSCAPES with rapidly changing technological platforms, many organizations are trying to accelerate product introduction cycles by prioritizing project delivery. However, many projects have two characteristics that make optimal delivery times elusive: First, the projects themselves tend to involve uncertainty (for example, they develop a new product function whose feasibility has not yet been established); and second, the workers have information about the status of their project tasks that is not observable to anyone but themselves, which many don't share. Therefore, behavioral issues are as important in project timeliness as diligent planning. These behavioral issues include the following:

- *Willingness to communicate and collaborate* under uncertainty and interdependence.[1] Why should employees seek help for a problem or help resolve a colleague's problem when they can leave the problem to later stages or hide behind their own task responsibilities?
- *Individual buffers.* If project workers face penalties for missed deadlines, why should they share private knowledge about task duration rather than "padding" their estimates of the amount of time they need to complete a task?
- *On-time incentives.* Why should employees exert themselves to finish their assigned tasks rather than fill time with fringe work or free ride on extra time buffers built into the project?[2]

THE LEADING QUESTION
How can companies get employees to pull together to meet project deadlines?

FINDINGS
- **Assure employees that they can disclose problems safely without fear of punishment.**
- **Promote cooperative behavior by emphasizing interdependence among workers and functional areas.**
- **Emphasize and support an organizational culture based on trust and improvement.**

COURTESY OF ROTO FRANK

This article examines the difficulties of project planning and execution and describes a management innovation at Roto Frank, a German company that produces hardware for industrial and residential windows and doors. Roto, headquartered in Leinfelden-Echterdingen, Germany, has augmented its project control system with a formal help process that encourages workers to seek and provide mutual assistance. We found that Roto's help process achieved a measurable improvement in project cycle time without changing formal incentives or other management systems. The initiative's success is based largely on two factors: establishing psychological safety, and encouraging cooperative behavior by emphasizing interdependence among workers. Because of its flexibility, we argue that this help process has the potential to accelerate projects in many environments.

Roto's Management Innovation

Of course, project management professionals have long thought about how to plan and execute projects in robust ways. An important strategy for handling uncertainty in projects is creating buffers of extra time.[3] But if buffers are applied at the task level, task owners sometimes hide behind them and almost always use them. The alternative is to aggregate the individual buffers into a combined project buffer, although it remains unclear how workers can be encouraged to give up their individual buffers.[4]

Another approach to uncertainty is to set task goals or deadlines.[5] However, there are side effects: Unless penalties are set for not meeting the goals or deadlines, workers tend to estimate their project completion times too optimistically (a problem often referred to as the "planning fallacy").[6] Yet when workers are threatened with penalties for being late, they tend to protect themselves by building safety margins into their announced task-time predictions, sometimes referred to as "padding."[7] In summary, studies on project planning work have focused on rational management, ignoring behavioral issues (for instance, reporting exaggerated estimates of task duration).

Yet another approach to project planning is the application of "lean manufacturing" concepts to project management, which refers to principles including value for the customer, smooth flow of products through the value-creating steps and constant efforts to eliminate defects.[8] (In fact, Roto's project planning innovation was originally triggered by an idea from a lean-thinking workshop.) Lean thinking promotes adherence to flow standards and quick correction of deviations. However, this can't be directly applied to product development project management because new product development projects are characterized by uncertainty about the nature of the tasks; typically, standards have yet to be established. Moreover, until the system is worked out, the interdependencies among the elements of the system are not known; one worker may cause unforeseen deviations for another.[9] Hence it is not clear what a "smooth flow" is and what needs to be monitored.

The final method that seems similar to Roto's system is "agile development" (a term coined in software development), which includes flexible development processes that incorporate quick feedback and iterations, and product architectures with built-in flexibility.[10] Although agile development systems rely on collaboration among project employees, they don't explicitly encourage such collaboration — a key change that was developed at Roto.

In developing a project planning and monitoring system that encouraged project workers to reveal private information about their tasks, Roto did not rely on incentives. In general, it's difficult for incentives to encourage people to work hard, reveal private information *and* collaborate with coworkers.[11] Information disclosure and collaboration require that the workers feel mutual obligation, as

> In general, it's difficult for incentives to encourage people to work hard, reveal private information *and* collaborate with coworkers.

well as safety in reporting problems.[12] Behavioral research has shown that employees can be more open to sharing what they know when offered psychological safety.[13] Research has also examined the role of informal group dynamics, trust and respect, and supportive organizational contexts.[14] Indeed, incentives don't necessarily need to be monetary or career focused; they can also be social and geared toward building positive relationships.[15]

We have found no study that investigates how the formal components of a project management system interact with mutual relationships and psychological safety in promoting project success. How, exactly, do the formal components of a project management system interact with psychological safety? What forms of incentives can lead to reasonable expectations of reciprocity? Which combinations of managerial actions are most likely to succeed at harnessing behavioral tendencies? Our study describes an actual system that works, displaying how psychological safety and mutual reciprocity can be incorporated into a fully implemented system. (See "About the Research.")

ABOUT THE RESEARCH

Our study employs a longitudinal single-case design. The case company, Roto, was selected not as a representative or "typical" project organization but rather because the authors were intrigued by unusual observed behavior: Project engineers were posting red cards above their desks in order to alert management and colleagues of a problem encountered. Management reckoned to have improved project time performance solely by establishing a formal help and problem-solving process — that is, without changing monetary incentives, buffers or any other component advocated by established theories. This motivated the authors to examine whether, and how, this was possible, using a grounded theory approach.

We first encountered Roto in February 2010 in connection with a survey of management practices in manufacturing companies, two weeks after the initial changes in Roto's project management system were introduced. Thereafter, eight data-gathering sessions (four days of on-site visits and four days of phone and video conferences) occurred over a span of three years.

From February 2010 to May 2013, we interviewed 31 key individuals (including the CEO, the head of new product development, six project managers, the product portfolio manager, nine project engineers and 11 key individuals outside the NPD department) in 55 semi-structured interviews lasting from one to two hours each. We conducted individual interviews with many managers (the NPD head, project managers and functional heads), but we interviewed project engineers in groups of two or three while ensuring that individuals in each group had the same seniority in the organization (to preclude self-censoring in the presence of superiors). We asked interviewees to describe managerial actions, the motivations and behavior of individuals and project execution performance.

Evidence related to NPD performance was gleaned from multiple sources. We triangulated interview data from individuals of different functional and hierarchical affiliations with documentation (on completed projects) that was standardized in terms of evaluating timeliness and quality. We also used Roto's red-card database, which enabled us to analyze not only the occurrences of project problems but also the problem-solving process. The case write-up and the final paper were subjected to review, commentary and — as needed — revision in order to maximize the reliability of our descriptions.

New Product Development at Roto

Roto, which has two business divisions that employ about 3,800 and which generated 2013 revenue of about 658 million euros, illustrates how psychological safety and mutual reciprocity can be incorporated into a complex system. Roto's roof and solar technology division, the focus of this article, produces roof windows with integrated solar systems. Its new product development (NPD) department was at the beginning of this study made up of 25 development engineers working on an average of 20 projects in parallel; four senior and two junior project managers; and four senior engineers who led small projects part-time. A portfolio manager supports the project managers and helps coordinate across projects.

A typical NPD project is a roof window platform that is composed of many elements, such as solar thermal applications, automatic closing mechanisms and ventilation devices. Roto's window systems are designed for customized manufacturing and installation, which requires having a modular platform with many variants. Roto introduces its new products at annual trade fairs, and new models are critical for retaining market share. In addition, the company needs to comply with increasingly tight energy regulations, which shape the choices of customers seeking subsidies for energy conservation.

On average, Roto's roof and solar technology division has 21 active projects and seven waiting to get started. The projects are discussed and prioritized monthly by the new product steering committee, which consists of the division CEO and the heads of development, purchasing, manufacturing and product management. Since 2005, Roto has used a standard stage-gate process for new product development. The process starts with a rigorous customer-needs document driven by product management, a business plan and a detailed specification document. For every project there are four more milestones, and for each major component there are five. Thus, a major project can easily have 100 to 150 milestones. A weekly schedule links the overall project plan to the individual activities, creating a weekly status report. Until late 2009, when visualization was decentralized to workers' desks, this schedule was recorded on a large chart in a meeting room directly adjacent to the engineering open space, listing the tasks that were completed, pending or late.

Redesigning the Project Execution System

In 2009, Dirk Stempfhuber, Roto's NPD manager, participated in a "visual management" workshop organized within the company's manufacturing department to help make workflow metrics visible and controllable by local work teams.[16] Stempfhuber was asked whether project management in his department at Roto was truly visual. His first reaction was: "Yes, of course." But upon reflection, he realized that the big chart in the meeting room was not something the engineers actually used. Engineers did not assume responsibility for the chart's accuracy on individual tasks, so it was often outdated. As a result, project managers often went directly to engineers to learn what was really going on, which further reduced the urgency to update the control chart. So even though there was a large chart, it was not aligned with the spirit of visual management.

Working with the portfolio manager and the project managers, Stempfhuber decided to relocate the control chart from the meeting room to each project desk, where the engineer's critical tasks for every day of the week would be clearly written. Engineers were responsible for their own charts, which were supposed to reflect the current status. In addition, engineers were asked to put up a red flag — referred to as a "red card" and visible to anyone walking through the open space — whenever a critical task was becoming late enough to affect other tasks. A green card indicated that all tasks were on schedule.

However, the concept of the red card initially raised fears. The immediate flagging of a possible delay made the affected engineer feel vulnerable and exposed to criticism. Furthermore, in soccer, a red card signals a player's banishment from the field — hardly a positive connotation for the engineers.

Management recognized that engineers needed to be reassured and that getting them to feel comfortable about using red cards might take a little time. Stempfhuber promised his staff that anyone who raised a red card: (1) would not be criticized, and (2) would receive help from either the portfolio manager, the project leader or Stempfhuber himself within 30 minutes. If a solution couldn't be found immediately, management would create a task force (called a "red-card team") to resolve the issue; the team (made up of selected people from all relevant technological and functional areas) would stay involved until the problem was resolved.

Although time would tell if this approach would be effective, the engineers had enough confidence in Stempfhuber to give the new system a try. The first red card for a project task was posted in December 2009, when a critical drawing for a window profile was delayed. Working alone, the project engineer had been unable to disentangle a design issue; however, the red-card team found a way to straighten out the problem and keep the project on schedule.

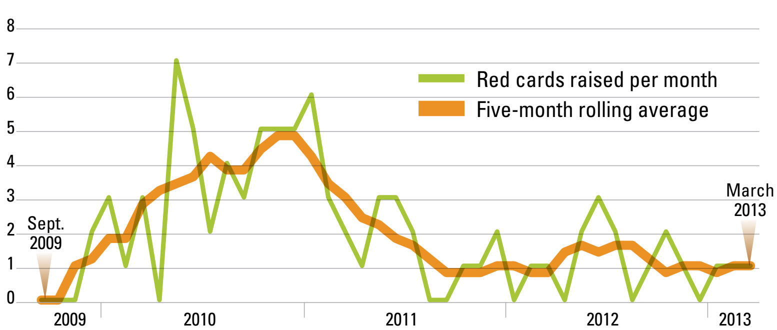
Within a short period of time, the red cards became accepted by Roto engineers as normal procedure. During the first 10 months, engineers used 30 red cards; the rate subsequently fell to about half that level. (See "The Frequency of Red-Card Postings.") On the surface, adopting the change was relatively simple — it didn't require new information or a new planning method. Yet the introduction of a help process was enough to affect performance.

The Impact on Performance

Roto's red cards illustrate the impact of visual management. Moreover, in combination with the built-in help process, they have enabled the organization to

THE FREQUENCY OF RED-CARD POSTINGS

In the early months, the use of red cards to announce project problems increased sharply before leveling off.



react more rapidly to problems. In the past, it took longer to detect problems — often as long as a month, by which time some spiraled into larger issues. Now even the suspicion of a problem triggers an immediate red card. Project performance has improved significantly (with staffing and the quantity and quality of work in progress stable), as measured by decreases in late changes, the cost of late changes, the average number of delays per project, and the average processing time of red-card issues. (See "Improvements in Project Performance Indicators.")

In the wake of the changes, planning for how long tasks will take has become more realistic. As one project engineer explained: "Previously, I had to deal with problems myself, so I had to give myself a buffer." There is also evidence of systemwide efficiency gains. Because Roto uses lower-priority projects as "backup work" and as an implicit buffer, there was an expectation that some secondary projects would be delayed. However, such delays have not occurred; project engineers say they no longer spend time fretting about and trying to avoid problems but attack problems early, which makes solving them faster and cheaper.

IMPROVEMENTS IN PROJECT PERFORMANCE INDICATORS

After the red-card help process was introduced at the end of 2009, late changes, number of delays and the costs associated with late changes declined.

	2009	2010	2011	2012
Late changes	6	3	4	3
Cost for late changes	€60,000	€48,000	€30,000	€27,000
Average number of milestone delays per top project	30	12	10	11
Average processing time of (urgent) red card	20 days	7 days	3 days	3 days

Changing Attitudes and Behavior

The first step in our analysis was to define the stages in the evolution of Roto's new project development process and to see how the use of the red cards changed over time. At the initial presentation, Stempfhuber made clear that the red cards were not tools for evaluating people but resources for characterizing the work. Over time, this view was internalized by the engineers, who came to see the cards not as a threat but rather as a source of help. As one mechanical part designer put it: "If I fall, I fall less hard because we work together and help one another."

In the second part of our research, we analyzed the interview data to identify how the interviewees' expressed attitudes affected their behavior in project work. We then compared attitudes over time in order to identify changes. The interviewees consistently reported two behavioral changes: (1) a decreased tendency to build individual time protection into project tasks, and (2) increased collaboration across tasks and projects.

We also interpreted the perceived attitudes and behavioral changes in light of behavioral operations management theory. Research on psychological safety has shown that employees may be willing to share their information (that is, give up their knowledge advantage in situations of information asymmetry) when they feel it is safe to take this interpersonal risk.[17]

The interview observations suggest that Roto's help process promoted more proactive worker behavior toward disclosing problems; increased psychological safety ultimately led engineers to view the red cards as a standard support mechanism to be used without fear of punishment or reputational damage.

The active help seeking and help provision may explain the systemwide efficiency gains noted above. Without fears of being blamed, workers were more inclined to call for help rather than procrastinating or passing latent problems on to the next project worker. The red-card process fosters cross-functional problem solving in teams, which can reduce engineering project costs, shorten schedules and, over time, decrease the amount of time needed to resolve a red-card issue. However, collaborative problem solving does not imply that problems can be solved in a predictable way — only that solutions can be found more effectively. (See "Resolving Red-Card Problems at Roto," p. 38.)

The Behavioral Dynamics of Mutual Help

In order for workers to cooperate in disclosing problems early, they needed to have confidence that they would receive assistance and wouldn't be blamed. But it was also important to explain the benefits of the help process for the help seeker and to quickly create a positive experience. Psychological safety was reinforced by the workers' experience that help was indeed forthcoming and that they would no longer be left alone with problems. A positive feedback cycle arose, initially created through implementation of the help process and the promise of no punishment.[18] (See "A Positive Reinforcing Loop.")

It's interesting to examine why the use of the red cards declined and then leveled off after the initial activity, and also how the red cards were connected to the improved project performance characteristics of Roto's NPD over time. First, capacity for helping others is limited — all employees are responsible for completing their own primary assigned project tasks. If workers have to spend too much time on helping others, the progress of their own tasks will suffer. So, to avoid delays on their own tasks, they will have to help others less. Thus, on an aggregate level, there is a natural limit to how many cards can be processed. But how do individual workers take this into account? Based on employee comments, we found that intensified cross-task and cross-project collaboration in the red-card teams made interdependencies explicit and fostered positive relationships across project workers. As a result, project workers self-regulate their use of red cards.

Although reciprocity encourages workers to help others, it limits using red cards to situations in which they are deemed essential. Workers don't want to burden their peers with unnecessary calls for help because sooner or later they really may need support from others. And since the red-card process is a "give-and-take" process, workers view any substantial imbalance as undesirable. This equilibrium between seeking and providing help explains why the use of red cards leveled off. In the language of system dynamics, the coexisting positive and negative loops lead to an equilibrium of behavior in which the balance between seeking help and not overburdening colleagues settles at about 1.5 red cards per month.

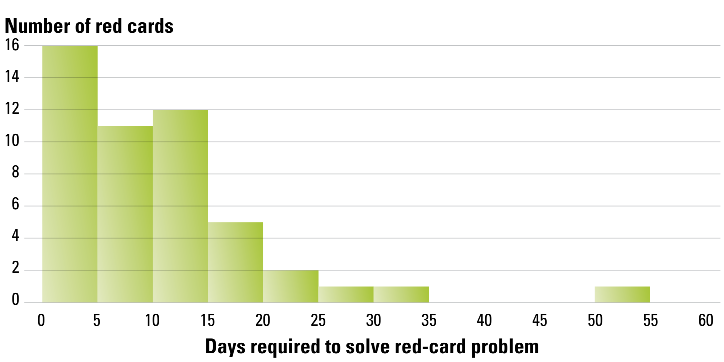
A second factor has to do with the genuine productivity improvements of the product development department enabled by the red-card process. Based on their feelings of psychological safety, workers are willing to plan more tightly and reduce their private time buffers. Moreover, the collaborative problem solving resulting from the red-card process serves to identify project problems earlier, and problems that are uncovered earlier typically take less time and effort to resolve. The red cards thus helped to reap the efficiencies of front-loaded problem solving.[19] Both effects reduce total project task times (including rework), thus reducing project duration and increasing the effectively available capacity.

Thus, the formal help process resulting from the red cards and the direct demands on project workers' capacity interact with the productivity improvement effects (through shorter project cycles): Capacity is limited, but the limit is to some extent relaxed by the productivity improvements. In the language of system dynamics, the equilibrium between helping and working is lifted up, allowing for a higher level of helping than would be possible if productivity improvements were not achieved. (See "Red-Card Usage, Team Relationships and Capacity," p. 40.)

To be sure, other theories could explain reduced task times in projects at Roto. For example, some might wonder if the change of behavior is caused by the mere fact of management attention rather than by any particular feature of the new process itself, a phenomenon known as the Hawthorne effect.[20] However, based on data we collected about the help process over a period of three years, we have excluded that possibility. During that period, the help process entered a normal mode of self-regulated operation by the employees without any special top management attention other than the regular monitoring of red cards.

RESOLVING RED-CARD PROBLEMS AT ROTO

Although many red cards are resolved within 10 days, the problem-solving time remains variable because of the novelty and uncertainty of any individual project.



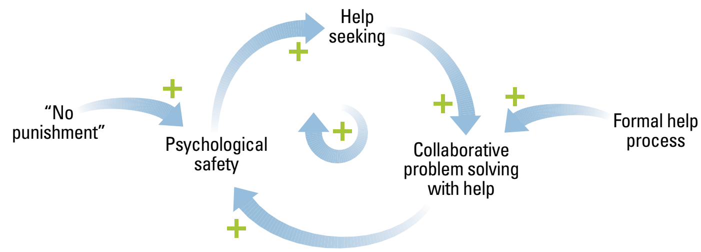
In addition, we can rule out that other factors were driving the performance changes. In particular, we don't believe that Roto has benefited solely from the cognitive benefits of visualization (as implemented via the red cards); the reduced planning fallacy from unpacking tasks (implemented via fine-grained weekly planning by every project worker); and the operational benefits from pooling task uncertainties. We also show that the help process described in this case study is not merely a variant of lean manufacturing methods.

Cognitive Benefits of Visualization By compressing information, visual representations can aid in solving complex problems.[21] Research shows that human input channel capacity is greater when visual abilities are addressed and used.[22] Clearly, the red cards have improved visibility at the level of the NPD department versus having a central project control chart in a separate room. However, our interviews indicate that individual workers had previously been reluctant to share their problems (and instead tried to fix them alone) not because of insufficient visualization but because they were afraid of being blamed or looking incompetent. As one project engineer noted, visualization alone (for example, a red card without the guarantee of help) would not yield the proactive behavior because "we [the project engineers] still try to weigh the benefits of help against all the stress when raising the card." Thus, while visualization was helpful, it does not explain the changed problem-solving approach.

Reduced Planning Fallacy From Unpacking Tasks Decomposing problems into manageable bites can mitigate the tendency to produce overly optimistic task-time estimates.[23] However, two observations argue against this being influential at Roto. First, the planning fallacy can lead to excessive optimism, and unpacking tasks should encourage more conservative (longer) task-time estimates. But we observed the opposite: The estimates actually became shorter, suggesting that "unpacking" was not an issue. Second, when we asked interviewees to describe changed behavior and its possible causes, project engineers noted the importance of the availability of help.

A POSITIVE REINFORCING LOOP

The help process triggered a reinforcing loop involving collaborative problem solving, psychological safety and help seeking.



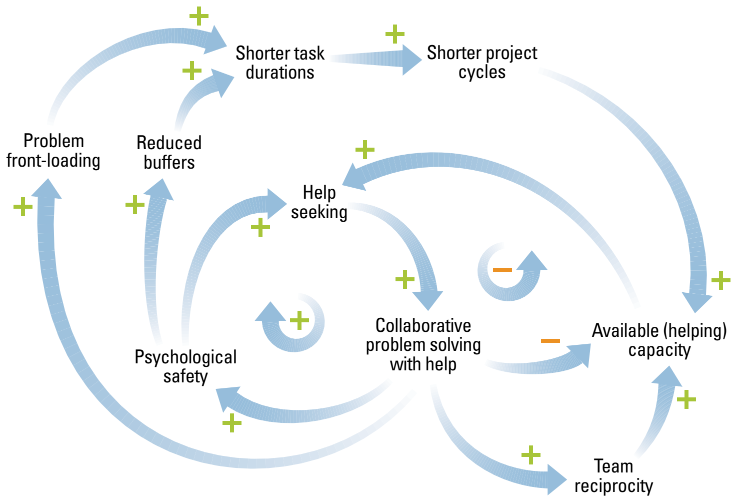
Operational Benefits From Pooling Task Uncertainties The red cards facilitate pooling, which allows for more efficient use of capacity by reducing the possibility of one resource sitting idle while another faces a work backlog. Once a project worker faces a problem that threatens on-time completion of a task and thus increases actual workload, additional capacity can be shifted to the troubled task from less urgent projects. The benefits of pooling could, in principle, lead to both lower task times and efficiency gains. However, at Roto, the total shift of capacity between top-priority projects amounted to only 5% of total capacity; moreover, the impact on less urgent projects was quite minimal. Any small changes in pooling that might have escaped management attention (for example, because engineering time was not faithfully recorded) would be too small to entirely explain the front-loading and efficiency gains that were observed.

Comparisons With Lean Manufacturing: Red Cards and Yellow Cards A final possible explanation for the improvements is lean management and its visual control to correct deviations. (One example is the well-known Andon system, which authorizes workers to stop the production line when they detect a deviation from the standard.) We have already mentioned that lean methods correct deviations from a predefined standard, while the red-card system deals with task problems where the outcomes have yet to be determined, and where more complex problems involve partially emergent interdependencies among multiple components and tasks.

To understand the difference between the red-card process and lean management, it is instructive to consider a "hybrid" system that Roto developed in 2012 involving "yellow cards." Yellow cards were

RED-CARD USAGE, TEAM RELATIONSHIPS AND CAPACITY

The exchange of help freed up capacity through efficiency gains, but the use of red cards was self-regulating.



introduced to address a simpler and more structured problem than new product development: namely, customer complaints about existing products and small product modifications that typically require a change in a manufacturing tool. The problems that yellow cards address are therefore conceptually closer to lean manufacturing than team support; these problems deal with variations from an existing product specification standard. The yellow-card system is highly organized and built on hierarchical responsibility (like the Andon system of lean manufacturing). In contrast, the red-card process relies on flexible teamwork, reflecting more fundamental problem solving.

This article is based on a longitudinal single-case study that documents a project management method innovation — how the implementation of a help process improves project performance. We identified two key factors that drove these changes. First, management created a formal process that led to the offering of help. The process was accompanied by managers' assurance that they would not blame or pressure help seekers. What's more, management led by example in calling for help themselves. It is important to note that the promise was based on the trust and improvement-oriented culture already present in the organization, which was necessary to get the help process started in the first place. The promises and their subsequent fulfillment had the effect of increasing the level of psychological safety, which made project engineers more comfortable about sharing information about problems or improvement opportunities on a timely basis. The availability and effectiveness of help guaranteed by the help process reinforced that psychological safety. Second, the identified problems were tackled collaboratively by teams that cut across project lines. This dynamic made the interdependencies explicit and encouraged the development of reciprocal relationships throughout the engineering department. Such institutionalized relationships motivated project engineers to adopt a "mutual help" orientation rather than focusing solely on their own respective domains of responsibility.

Although our study documents the innovation, it does not prove applicability in other project environments. However, the help process has been implemented (with appropriate adjustments) at other sites,[24] which suggests that formal help systems can be used to improve project performance.

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What Successful Project Managers Do

Traditional approaches to project management emphasize long-term planning and a focus on stability to manage risk. But today, managers leading complex projects often combine traditional and "agile" methods to give them more flexibility — and better results.

BY ALEXANDER LAUFER, EDWARD J. HOFFMAN, JEFFREY S. RUSSELL AND SCOTT W. CAMERON

THE LEADING QUESTION
How is the management of large, complex projects changing?

FINDINGS

- **Today's successful project managers often combine elements of traditional and agile approaches to project management.**
- **They cope with uncertainty by developing both detailed short-term plans with firm commitments and tentative longer-term plans.**
- **Project managers are designing project review processes that foster learning.**

IN TODAY'S DYNAMIC and competitive world, a project manager's key challenge is coping with frequent unexpected events. Despite meticulous planning and risk-management processes, a project manager may encounter, on a near-daily basis, such events as the failure of workers to show up at a site, the bankruptcy of a key vendor, a contradiction in the guidelines provided by two engineering consultants or changes in customers' requirements.[1] Such events can be classified according to their level of predictability as follows: events that were anticipated but whose impacts were much stronger than expected; events that could not have been predicted; and events that could have been predicted but were not. All three types of events can become problems that need to be addressed by the project manager. The objective of this article is to describe how successful project managers cope with this challenge.[2]

Coping with frequent unexpected events requires an organizational culture that allows the project manager to exercise a great amount of flexibility. Here are two examples of advanced organizations that took steps to modify their cultures accordingly.

A group of 23 project managers who had come from all over NASA to participate in an advanced project management course declared mutiny. They left the class in the middle of the course, claiming that the course text, based on NASA's standard procedures, was too restrictive for their projects and that they needed more flexibility. With the blessing of

An analysis of three Mars missions undertaken by NASA's Jet Propulsion Laboratory concluded that a key success for the Mars Pathfinder project (shown here) was a high level of collaboration.

COURTESY OF NASA

NASA's top leadership, the class members then spent four months conducting interviews at companies outside of NASA. This led to a rewriting of numerous NASA procedures. Among other things, NASA headquarters accepted the group's recommendation to give NASA project managers the freedom to tailor NASA's standard procedures to the unique needs of their projects. A similar movement to enhance project managers' flexibility occurred at Procter & Gamble, where the number of procedures for capital projects was reduced from 18 technical standards and 32 standard operating procedures to four technical standards and four standard operating procedures.

Concurrent with these changes at NASA and P&G, a heated debate emerged within the wider project management profession regarding the need for flexibility, as opposed to the traditional approach, which emphasizes that project success depends on stability. According to the traditional approach, project success can be achieved by focusing on planning and on controlling and managing risks. Although the popularity of this approach has sharply increased across industries, research covering a wide variety of projects consistently reveals poor performance. A large percentage of projects run significantly over budget and behind schedule and deliver only a fraction of their original requirements.[3]

The other side in this debate is best represented by a newer project management approach popular within the software industry. Called the agile method, it asserts that project success requires enormous flexibility throughout the project's life. However, even proponents of the agile approach acknowledge that this approach is best suited to small projects and teams.[4]

Our studies, employing experiential data collected from more than 150 successful project managers affiliated with more than 20 organizations, indicate that today's successful project managers cope with unexpected events by a combination of the traditional and agile approaches, assuming four roles. (See "About the Research.") Two of the roles are intention-driven and two are event-driven, with each role assumed on its own time schedule throughout the life of the project. The first role, developing collaboration, is performed early on during the project. The second role, integrating planning and review with learning, is performed periodically. The third role, preventing major disruptions, is performed occasionally. The fourth role, maintaining forward

ABOUT THE RESEARCH

In recent years, many researchers have concluded that one reason for the widespread poor statistics about project results is the wide gap between research and practice.[i] The overall objective of our research was to develop a practice-based theory of project management.[ii] To this end, we used three complementary approaches to collect firsthand data on the practices of successful project managers. Believing that management is best learned by emulating exemplary role models, we focused our studies on a selective sample of the best practitioners in their respective organizations.

Our first approach consisted of field studies and structured research tools, particularly 40 interviews (two to four hours each) and 20 observations (four hours to a week each) of practitioners in the following organizations: AT&T, Bechtel (the San Francisco-based construction and civil engineering company), DuPont, General Motors, IBM, Motorola, PPL Electric Utilities (an electric utility company based in Allentown, Pennsylvania), Procter & Gamble and Turner Construction Company (a construction services company headquartered in New York City).

For our second approach, we convened project teams and facilitated reflective dialogues in which participants shared their stories and practices from recent projects. We collected most of the cases, stories and practices through our role as the facilitators of the project management knowledge-development and -sharing communities in three organizations.[iii] In this capacity, Laufer and Hoffman worked for five years with NASA, Laufer and Cameron worked for three years with P&G and Laufer and Russell worked for two years with Boldt (a construction services company based in Appleton, Wisconsin). Project managers from the following organizations participated in these community of practice meetings: AeroVironment (a technology company based in Monrovia, California), Boldt, The Johns Hopkins University Applied Physics Laboratory, Lockheed Martin, NASA, Procter & Gamble, Raytheon and the U.S. Air Force.[iv]

To make sure that the principles we developed were a valid interpretation of the stories we had collected, we adopted a third approach — testing our interim results in real-life situations. Through consulting engagements with four project-based organizations — Boldt, Parsons Brinckerhoff (the multinational engineering and design firm headquartered in New York City), Skanska (the Scandinavian construction and property development group) and Turner Construction — we validated and refined our understanding and developed the four-role framework presented in the current article. We then tested and refined this framework in our work with the Boldt project management knowledge-development and -sharing community. The model presented in this article is the result of a final refinement process, which included a series of interviews with 10 project managers and 10 senior managers. We held these interviews (two to three hours long) with a carefully selected group of practitioners from companies that represented a variety of industries, including Cedars-Sinai Medical Center, NASA, PricewaterhouseCoopers, P&G and the U.S. Air Force.

THE FOUR ROLES OF THE PROJECT MANAGER

Our research found that today's successful project managers assume four roles that help them cope with unexpected events.

ROLE	DRIVEN BY	TIMING	KEY ACTIVITIES
Develop collaboration	Intention	Initially	•Select the right people •Develop mutual interdependence and trust
Integrate planning and review with learning	Intention	Periodically	•Develop stable short-term plans and flexible long-term plans •Conduct learning-based project reviews
Prevent major disruptions	Events	Occasionally	•Anticipate and cope proactively with a few major problems
Maintain forward momentum	Events	Continuously	•Resolve problems by hands-on engagement •Update and connect through frequent face-to-face communication •Move about (walk the floor) frequently

momentum, is performed continuously.[5] (See "The Four Roles of the Project Manager.")

1. Develop Collaboration

Since project progress depends on the contribution of individuals who represent different disciplines and are affiliated with different parties, collaboration is crucial for the early detection of problems as well as the quick development and smooth implementation of solutions. The importance of collaboration can be demonstrated by the following two examples in which projects failed.

Tim Flores analyzed the causes for the different outcomes of three Mars exploration missions initiated by NASA's Jet Propulsion Laboratory: Pathfinder, Climate Orbiter and Polar Lander. Although all three projects were conducted under the same guiding principles, were of comparable scope and shared many elements (even some of the same team members), Pathfinder was a success, whereas the other two missions failed. Flores expected to find that the Pathfinder project differed from the other projects in a variety of factors, such as resources, constraints and personnel. Although this was true to some extent, he found that the primary factor distinguishing the successful mission from the failed missions was the level of collaboration. The Pathfinder team developed trusting relationships within a culture of openness. Managers felt free to make the best decisions they could, and they knew that they weren't going to be harshly punished for mistakes. That trust never developed in the other two projects.[6]

A different NASA project, the Wide-Field Infrared Explorer (WIRE) mission, was designed to study the formation and evolution of galaxies. Its telescope was so delicate it had to be sealed inside a solid hydrogen cryostat. When, shortly after launch, a digital error ejected the cryostat's cover prematurely, hydrogen was discharged with a force that sent the Explorer craft tumbling wildly through space, and the mission was lost.

Jim Watzin, a project manager at NASA and a member of the WIRE project team, had this to say regarding the official report that NASA issued following the WIRE failure: "WIRE failed because people could not or would not communicate well with each other. … Individuals … simply were uncomfortable allowing others to see their work." Watzin added: "The real [lesson] from this loss is that any team member that does not participate as a true team player should be excused [from the project]."[7]

In the next two examples, project success can be attributed to the project manager's deliberate attempt to develop collaboration. (Note that in the discussions that follow, we use only the project managers' first names.)

Allan, the payload manager for NASA's Advanced Composition Explorer project at the Jet Propulsion Laboratory, has described how he developed trust between his team and the 20 groups of scientists developing instruments for the project, who were based at universities throughout the United States and Europe. Allan devised a three-stage plan. First, he selected team members who could operate in a university environment — people who knew when to bend or even break the rules.

Second, he relocated his JPL team to a university environment (California Institute of Technology), recognizing that it might be difficult to develop an open, flexible culture at JPL. Third, he came up with an uncommon process for interacting with the scientists.[8]

The challenge, with regard to interaction, was getting the scientists to regard his JPL team as partners. Having dealt with NASA before, they tended to believe that someone coming from JPL would demand a lot of paperwork, lay out sets of rules to be followed and expect things to be done a certain way. In fact, many of the scientists weren't sure they should share with Allan's team the problems they were encountering along the way — problems that could slow down the project's progress.

The primary role of Allan's team was to review the development of the instruments, and Allan believed that the best way to do this was by focusing on trust and convincing the scientists that his team was there to help them solve their problems. To facilitate this, Allan and his team of five to eight members traveled to each university and stayed on site for an extended period of time. By spending days and nights with the scientists and helping them solve their problems — not as auditors but as colleagues — the JPL team gradually became accepted as partners.[9]

Most projects are characterized by an inherent incompatibility: The various parties to the project are loosely coupled, whereas the tasks themselves are tightly coupled. When unexpected events affect one task, many other interdependent tasks are quickly affected. Yet the direct responsibility for these tasks is distributed among various loosely coupled parties, who are unable to coordinate their actions and provide a timely response. Project success, therefore, requires both interdependence and trust among the various parties.[10]

However, if one of the parties believes that project planning and contractual documents provide sufficient protection from unexpected problems, developing collaboration among all the parties may require creative and bold practices.

This was the case in a large construction project that P&G launched at one of its European plants. After the contractor's project manager, Karl, brushed off numerous team-building efforts, Pierre, the P&G project manager, finally found an opportunity to change Karl's attitude. Three months into construction, the contractor accidentally placed a set of foundations 10 inches inside the planned periphery and poured about 600 lineal feet of striped foundation in the wrong place. Instead of forcing the contractor to fix his mistake and start over — a solution that would have damaged the contractor's reputation and ego — Pierre chose a different approach. Through several intensive days of meetings and negotiations with the project's users and designers, he was able to modify the interior layout of the plant, thereby minimizing damage to the users without having to tear down the misplaced foundations and hurt the project's schedule. The financial cost of making the changes incurred by the contractor's mistake was significant, but the loss in reputation was minimal. As a result, Karl gradually embraced Pierre's working philosophy — namely, "If they fail, we fail." The realization that the organizations involved in the project are all interdependent led to the development of a collaborative relationship.

2. Integrate Planning and Review With Learning

Project managers faced with unexpected events employ a "rolling wave" approach to planning. Recognizing that firm commitments cannot be made on the basis of volatile information, they develop plans in waves as the project unfolds and information becomes more reliable. With their teams, they develop detailed short-term plans with firm commitments while also preparing tentative long-term plans with fewer details. To ensure that project milestones and objectives are met, these long-term plans include redundancies, such as backup systems or human resources.[11]

One key difference between the traditional planning approach, in which both short- and long-term plans are prepared in great detail, and the rolling wave approach becomes evident when implementation deviates from the plan. In the traditional planning approach, the project team attempts to answer the question: Why didn't our performance yesterday conform to the original plan? In the rolling wave approach, project managers also attempt to answer the question: What can we learn from the performance data to improve the next cycle of planning? In particular, they attempt to learn from their mistakes — to prevent an unexpected event from recurring.[12]

Successful project managers do not limit the learning process to the planning phase but also use it for project reviews. For example, after a review session in the midst of a project at NASA's Goddard Space Flight Center, Marty was a frustrated project manager. The existing review process may have fulfilled upper management's need to control its operations, but Marty felt it did not fulfill his team's need to learn. Therefore, he modified the process to give his team the best input for identifying problems and the best advice for solving them. This meant doing away with the usual "trial court" atmosphere at NASA review sessions, where team members' presentations were often interrupted by review board members' skeptical comments and "probing the truth" questions. In its place, Marty developed a review process that provided feedback from independent, supportive experts and encouraged joint problem solving rather than just reporting.

The first thing Marty did was unilaterally specify the composition of the review panel to fit the unique needs of his project, making sure that the panel members agreed with his concept of an effective review process. The second thing he did was change the structure of the sessions, devoting the first day to his team's presentations and the second day to one-on-one, in-depth discussions between the panel and the team members to come up with possible solutions to the problems identified on the first day. This modified process enabled Marty to create a working climate based on trust and respect, in which his team members could safely share their doubts and concerns. At the end of the second day, the entire panel held a summary meeting. It was agreed that the review session had been a big success. In fact, other NASA project managers quickly adopted Marty's process, including it in their managerial tool kits.[13]

Successful managers of more traditional projects, such as designing and building manufacturing facilities, also practice learning-based project reviews. P&G has replaced review panels composed of external experts or senior managers with peer-review panels. These last four to eight hours and follow a simple protocol: First, the project team concisely communicates its technical and execution strategies, and then the floor is opened to all the invited peers for comments, critique and clarifying questions. Out of the numerous notes documented throughout the review process, five to 10 "nuggets" usually emerge that the project team uses to improve the technical, cost and scheduling aspects of the project. Sometimes, the invited peers even take one or two of the "nuggets" back to their own projects.[14]

3. Prevent Major Disruptions

In their book *Great by Choice*, Jim Collins and Morten T. Hansen describe one of the core behaviors of great leaders as "productive paranoia." Even in calm periods, these leaders are considering the possibility that events could turn against them at any moment and are preparing to react.[15] Similarly, successful project managers never stop expecting surprises, even though they may effect major remedial changes only a few times during a project. They're constantly anticipating disruptions and maintaining the flexibility to respond proactively.[16] The following two examples illustrate that, when convinced that a change is unavoidable, a successful project manager acts as early as possible, since it is easier to tackle a threat before it reaches a full-blown state.

NASA's Advanced Composition Explorer project, discussed earlier, was plagued from the start with severe financial problems arising from internal and external sources. Internally, the development of the nine scientific instruments led very quickly to a $22 million cost overrun. Externally, the project, which was part of a larger NASA program, inherited part of a budget overrun in an earlier project. As a result of these internal and external factors, the ACE project experienced frequent work stoppages, forcing the manager to constantly change his contractors' and scientists' work priorities.

Don, the project manager, believed that without immediate changes the project would continue down the same bumpy road, with the likely result that cost and time objectives would not be met. To prevent this, he made an extremely unpopular decision: He stopped the development of the instruments, calling on every science team to revisit its original technical requirements to see how they could be reduced. In every area — instruments, spacecraft, ground operation, integration and testing — scientists had to go back and ask such questions as: How much can I save if I take out a circuit board — and how much performance will I lose if I do take it out?

At the same time, Don negotiated a new agreement with NASA headquarters to secure stable funding. To seal the agreement, he assured them that, by using descoping tactics, the project would not go over budget. With the newly stable budget and the project team's willingness to rethink its technical requirements, the ACE project gradually overcame its technical and organizational problems. Completed early and below budget, the spacecraft has provided excellent scientific data ever since.

The second example of preventing a major disruption from occurring took place during the Joint Air-to-Surface Standoff Missile, or JASSM, project. In this case, the Pentagon had decided to make another attempt to develop JASSM after the first attempt was aborted due to a cost overrun of more than $2 billion. The original project manager for the second attempt was dismissed in midcourse due to poor performance, and a new project manager, Terry, replaced him.

To keep costs under control, Terry decided to have two contractors compete for the final contract. Terry quickly realized that both contractors were approaching the development too conservatively and that unless he took a more radical approach, the project would be canceled again. Therefore, he told the contractors to completely disregard the military standards and adhere to only three key performance parameters. One of the contractors, Lockheed Martin, took this directive seriously and changed its approach dramatically. It decided to build the missile fuselage not out of metal but out of composites. And to accomplish this, it found a company that made baseball bats and golf club shafts. The company had never built a military product, but it knew how to weave carbon fiber and was open-minded. Following trials with several prototypes, this company was able to manufacture a product of the highest quality. Lockheed Martin transformed this small company from a baseball bat provider to a cruise missile supplier, which led to Lockheed Martin winning the contract — as well as to remarkable cost reductions.

4. Maintain Forward Momentum

As noted earlier, when unexpected events affect one task, many other interdependent tasks may also be quickly impacted. Thus, solving problems as soon as they emerge is vital for maintaining work progress. As Leonard R. Sayles and Margaret K. Chandler wrote in their 1971 book *Managing Large Systems*, "In working to maintain a forward momentum, the manager seeks to avoid stalemates. ... Another penalty for waiting is that in a good many situations, corrective action is possible only during a brief 'window.' … The heart of the matter is quickness of response." In a study of project managers on construction sites, it was found that they addressed (not necessarily solved) 95 percent of the problems during the first seven minutes following problem detection.[17]

In a recent knowledge development meeting, a group of 20 project managers at The Boldt Company, a construction services company based in Appleton, Wisconsin, focused on how best to cope with unexpected events. It became evident that most of the managers employed three complementary practices: hands-on engagement; frequent face-to-face communication; and frequent moving about.

Regarding hands-on engagement, one project

> When unexpected events affect one task, many other interdependent tasks may also be quickly impacted. Thus, solving problems as soon as they emerge is vital for maintaining work progress.

manager, Charlie, said that to solve problems he often engaged in activities such as making phone calls, convening urgent meetings and taking trips to local retail stores to purchase missing parts. Documenting the time it took him to resolve 10 recent problems, Charlie reported that three were resolved within 30 minutes, three within 60 minutes, and three in less than one day; one problem took two days until it was resolved. Charlie also said that, because of his quick responses, he made one mistake. However, he was able to quickly repair its damage the following day. The entire group at Boldt agreed that maintaining forward momentum was more important than always being right.[18]

The second practice, frequent face-to-face communication, was described by Matt, one of the project managers, in terms of "daily 10-minute huddles" with all the on-site team members (the superintendent, field engineers, project coordinator and safety officer). Matt used these informal morning meetings to share the latest instructions from the client and to ensure that team members understood one another's current workloads and constraints and understood how they could help one another. Very often, the meetings enabled the team to identify and resolve conflicting priorities before they became problems. Matt noted that, while the primary purpose of the huddle was to update everyone, it also reinforced a spirit of camaraderie and a sense of shared purpose. As a result, these meetings turned out to be very valuable for sustaining teamwork.[19]

As for the third practice, frequent moving about, one project manager, Tony, described the three primary outcomes of spending 30 minutes a day roaming around the project site. First, he was able to develop rich and open communication with his team members. Tony explained that while many workers did not feel safe asking him questions during various formal meetings, they felt very comfortable interacting with him freely during his on-site visits, which had a great impact on their motivation. Second, receiving immediate information, and in particular a greater range of information, enabled him to identify problems early on. At times, he was able to detect conflicts before they actually became an issue. Third, Tony developed a much better understanding of where the project was with respect to the schedule, rather than having to take someone's word for it. He found that coming to the weekly and monthly planning and scheduling meetings equipped with firsthand, undistorted information allowed him to address questions and solve problems much better. The Boldt project managers did not agree on the preferred timing for moving about and, in particular, whether one should schedule the visits, as Tony did, or leave their timing flexible. However, they all agreed that moving about is a most effective practice that should be applied as often as possible.[20]

These three practices are not limited to construction projects. For example, in the previously mentioned JASSM project, which was geographically dispersed, all three practices necessary to maintain forward momentum were employed by the various project managers at each production site. Additionally, Terry, the customer's project manager, spent much of his time moving about between all the different production sites.

Implications for Senior Managers

Although every project manager tries to minimize the frequency and negative impact of unexpected events, in today's dynamic environment such events will still occur. Acknowledging the emergence of a problem is a necessary first step, allowing the project manager to respond quickly and effectively. Some organizations assume that almost all problems can be prevented if the project manager is competent enough — resulting in project managers who are hesitant to admit that they are facing an emerging problem. In fact, a recent study indicates that project managers submit biased reports as often as 60 percent of the time.[21] When upper management fosters an organizational climate that embraces problems as an inherent part of a project's progression, project managers are able to detect and resolve problems more successfully.

Management scholar Henry Mintzberg argues that today's managers must be people-oriented, information-oriented and action-oriented. In contrast, the two prevailing project management approaches, the traditional approach and the agile approach, do not require project managers to encompass all three orientations. The traditional approach (primarily intention-driven) stresses information, whereas the agile approach (primarily event-driven) stresses people and action.

By assuming the four roles discussed in this article, the successful project managers we studied are both intention- and event-driven and embrace all three orientations. Developing collaboration requires them to be people-oriented. Integrating planning and review with learning requires them to be information-oriented. Preventing major disruptions requires them to be action-oriented. Finally, maintaining forward momentum, which is pursued throughout a project, requires them to adopt all three orientations. Senior managers must ensure that all three orientations are considered when selecting project managers and developing project management methodologies.[22]

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The 2008 opening of Terminal 5 in London's Heathrow Airport was full of unpleasant surprises for British Airways — including hundreds of canceled flights and thousands of misplaced bags.

Reducing Unwelcome Surprises in Project Management

Many project challenges and failures catch executives by surprise. But not all such surprises are truly unforeseeable — if you know where to look.

BY TYSON R. BROWNING AND RANGA V. RAMASESH

THE LEADING QUESTION
How can you reduce the number of "unknown unknowns" a project faces?

FINDINGS

- **Modeling a project's subsystems helps expose risk areas.**
- **Scenario analysis and checklists are well-suited to uncovering unknowns.**
- **Long interviews and data mining can also provide valuable insights.**

WHY DO SO MANY projects fail to meet their goals for time, cost and performance? Regardless of the answer, many project managers and their executive sponsors seem to be surprised when a new project gets off track: "Why didn't we see that coming?" Even projects that employ sophisticated techniques for risk management can encounter surprising derailments. Those methods, while powerful, can only manage *known* risks. But projects are new and unique. What about the things that we don't even know that we don't know? These "unknown unknowns" — often called "unk-unks" — are lurking in every project, just waiting to emerge, surprise and derail plans. To what extent are they inevitable? What could we do better?

Project knowledge comes from learning about the project — its overall context, its goals and objectives, the process for achieving them, the people, tools and other resources to be deployed, and how all of these affect one another. This learning begins in the planning stages. One might think that planners would consider all of the scenarios, evaluate all of the options and identify all of the risks — but that is seldom the case. Many planners resist wasting resources on planning projects that may never happen. Even after a project gets the green light, a typical attitude of many managers is: "We're already behind. We know what we need to do. Let's get started!" As a result, the distinction between what is *knowable* about a project and what is actually *known* can be quite large.

Many so-called "unk-unks" aren't really unk-unks at all. Rather, they are things no one has bothered to find out. Indeed, there are two kinds of unknowns: unknown unknowns (things we don't know we don't know) and known unknowns (things we know we don't know). (See "Converting Knowable Unk-Unks to Known Unknowns.") Every project has some of both. The techniques of conventional risk management apply only to the known unknowns. Yet some unk-unks are *knowable* and can be converted to known unknowns through a process of *directed recognition*.

This article provides an overview of the targets, methods and tools — the where, why and how — of directed recognition. (See "About the Research.") First, we introduce six *project domains* in and around a project where uncertainty resides (and where recognition of that uncertainty should occur). Second, we describe six characteristics that increase uncertainty in projects and explain *why* they make unk-unks more likely. Finally, we present 11 techniques for converting knowable unk-unks into known unknowns. The goal is to reduce the unwelcome surprises in project management.

Where the Unk-Unks Are: Six Project Domains

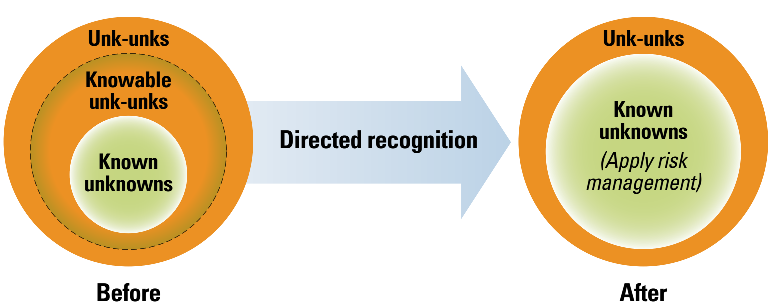
Projects operate as systems. Project outcomes and performance result not only from individual project elements but also from how the elements work together. Every project has at least five key subsystems,[1] which are enmeshed in the project's broader context or environment. These five subsystems plus the project's context comprise six important domains, each of which contains both known and unknown unknowns.

Result Subsystem The desired result of most projects is a product, a service or some other deliverable. Results have many components, all of which must work well together to deliver success. Problems in one area can spill over into other areas, causing a cascade of problems. For example, the HealthCare.gov project at the heart of the Affordable Care Act of 2010 was more than just an e-commerce site selling insurance; it was a system with complex interfaces to other government systems across a wide range of departments. In October 2013, when there were serious issues with the launch, it was evident that the project had run into messy integration problems with its key product.

Process Subsystem The work required to execute and manage a project is another type of system, one made up of activities, tasks and decisions related by the flow of information, work products and deliverables.[2] Efficient and effective processes depend not only on the activity content but also on the relationships among those activities. For example, a lean, value-adding activity could fail to add value if it receives bad inputs (which in turn could impact other activities and cause problems later). Because the network of activity relationships and its implications can be hard to see and manage, the process subsystem is often rife with latent unk-unks.

CONVERTING KNOWABLE UNK-UNKS TO KNOWN UNKNOWNS

Some "unknown unknowns" are actually knowable. With directed recognition, they can be converted to known unknowns — to which the conventional techniques of risk management can then be applied.



In March 2008, for example, British Airways and the British Airport Authority suffered a huge embarrassment at London's Heathrow Airport Terminal 5. After the project's use of the latest thinking in lean project management had been touted, the opening of BA Terminal 5 turned out to be a debacle, with hundreds of canceled flights and thousands of lost bags. BA lost $32 million, and two senior managers lost their jobs. While the BA project team had focused on the technical side of the project (such as getting the building equipped and testing the building's services), it neglected operational logistics and staff training. On the opening day, many staff were late for work (they couldn't find parking) and weren't able to log into the computer system. BA's experience underscores the fact that many unk-unks lurk within the complex network of tasks and relationships composing a project.

ABOUT THE RESEARCH

Our research develops the theory of knowable unknowns by synthesizing transdisciplinary theories and findings. We began by positing a conceptual framework composed of key factors that drive unk-unks, as proposed in the scholarly literature on operations management, project management, systems engineering, product development, complexity and risk management. We explored the subfactors of each of the factors, their relationships to each other and additional factors that should be added. Specifically, we conducted an extensive literature search of papers about areas including complexity theory, systems engineering, economic theory, behavioral psychology, knowledge management, software development and process engineering; keyword searches of "disasters," "technological failures," "knowledge gaps" and "unpredictable surprises," which led us to broader, relevant literature on the economic theory of contingencies and contracts, sociology and behavioral psychology of individuals and groups, chemical processes, and knowledge management; and a Google search of "unknown unknowns." Our objective was to see if there was something about a project that prevented its managers from recognizing that there could be potential unk-unks. While finding many sources and drivers of unk-unks, we also came across a variety of methods and tools for detecting knowable unk-unks. Our explorations uncovered many factors, indicators and circumstances contributing to the likelihood of unk-unks in projects. In response, we iteratively reconfigured our initial framework by revising our conceptual groupings.[i]

Organization Subsystem The people, teams, groups, departments and functions collaborating on a project represent another type of system. In many cases, this system breaks down due to what is often referred to as "poor communication." However, the solution isn't for everyone to communicate with everyone else. Rather, it's necessary to strike a balance between effective information transfer and information overload. When the organization subsystem is suboptimized by miscommunication, a lack of communication or information overload, the risk of unk-unks grows.

Tools Subsystem To manage activities and transfer information, people in organizations need tools, facilities and equipment. Today, most tools needed for activities such as information exchange, compatibility and service support are software-based. Unfortunately, many software tools are unable to transfer data due to various incompatibilities and organizational decisions. For example, computer-aided design tools can work well in some settings but not in others. When an aerospace design project wanted a certain CAD tool so it could collaborate easily with its partners, the project's parent organization said it had already standardized around a different brand. Adversities in the tools subsystem can be a significant source of unk-unks for a project.

Goals Subsystem Most projects have goals for time, cost and performance (functionality, capability provided, quality, scope, etc.). These three areas compete with each other: Improving on functionality, for example, often means increases in cost and/or time. The same often goes for performance: Increasing one capability usually requires a trade-off with another. The goals subsystem influences what is and is not possible, permissible, desirable and effective. As these trade-offs become more pronounced, the possibilities for unwelcome surprises increase.

All five of these project subsystems are related to each other. To accomplish the project's goals, the organization uses the tools to do the work (execute the process) and produce the desired results. All of these relationships imply no small amount of complexity — which, as we will see, provides a fertile breeding ground for unk-unks.

Context Every project exists within a larger context. A project may be part of a larger portfolio of projects, or it might have multiple stakeholders who have competing visions and requirements for success. A project's ideal software tools might be consistent with its parent organization's standards for multiproject commonality, or they may be completely incompatible. The project context contains a mix of known and unknown unknowns, and it interacts with elements in each of the five subsystems. As managers look to convert unk-unks to known unknowns, they need to consider all six of these domains and their relationships.

Six Factors Driving Uncertainty

Several characteristics of a project's subsystems and context make surprises more likely. Although unk-unks are by definition specific things we don't realize we're missing, it's possible to look at a project and its context and come to the realization that unk-unks are likely to exist — and why. For example, a large, complex project is more likely to encounter unk-unks than a small, simple project. An organization that is actively looking to uncover unk-unks is more likely to convert them into known unknowns. We have identified six *factors* — characteristics of a project and its context — that tend to increase the likelihood of unk-unks.[3] (See "Factors Contributing to Unknown Unknowns.") By evaluating a project in terms of these factors, managers can learn *why* their project might encounter unk-unks — and thereby justify why they should invest in taking a closer look for them.

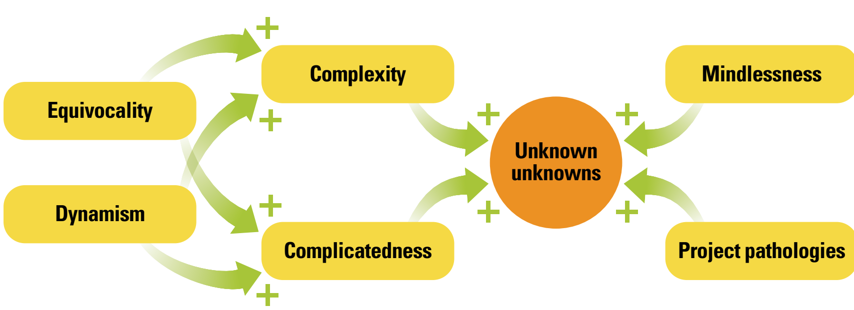
Complexity A complex system contains many interacting elements that increase the variety of its possible behaviors and results. The five project subsystems described above each have many elements (components, activities, people, tools and goals) that interact in various ways to generate many kinds of outcomes. All else being equal, the complexity of a project (or a subsystem) increases with the number, variety, internal complexity and lack of robustness of its elements. A project with more tasks, more people and/or more requirements is usually more complex than a project with fewer. When a project's elements have greater variety (for example, they do three different tasks rather than doing the same task three times, or have a team with representatives from four different functional organizations versus a team with four people from the same function), complexity also increases. The internal complexity of an element (for example, a project composed of five huge tasks versus a project composed of five small ones) also matters. Furthermore, if a project's elements are robust in the face of change (such as engineering design changes, requirements changes, etc.), then they can act as change absorbers, preventing the propagation of change throughout the system, whereas elements lacking this robustness will amplify complexity.

Other aspects of project complexity depend on the relationships among the project's elements. As the number, variety, criticality and internal complexity of these relationships increase, so will complexity. For example, a project to develop a product with many interconnected parts (for instance, some requiring close proximity, some needing to transfer energy) is extremely complex — and that is just the product subsystem. Collectively, the subfactors of element and relationship complexity can increase the level of complexity significantly, thereby adding to a project's likelihood of encountering unk-unks. (See "Situations That Increase the Likelihood of Unknown Unknowns.")

Complicatedness Regardless of its complexity, a system may appear more or less complicated depending on one's point of view. In contrast to complexity, complicatedness is more subjective and observer-dependent. For example, an automobile with automatic transmission is more complex than one with manual transmission; it has more parts and intricate linkages. To drivers, it is less complicated (even though it can be more difficult to fix).[4] Similarly, a software application may seem more or less complicated depending on the simplicity and elegance of its user interface, regardless of the complexity of its underlying code. A project's complicatedness depends on

FACTORS CONTRIBUTING TO UNKNOWN UNKNOWNS

The six factors shown here tend to increase the likelihood of unk-unks (surprises) in projects.



SITUATIONS THAT INCREASE THE LIKELIHOOD OF UNKNOWN UNKNOWNS

The six factors (shown in the left-hand column) that increase the likelihood of unk-unks can operate through six project domains.

	RESULT	PROCESS	ORGANIZATION	TOOLS	GOALS	CONTEXT
Complexity	Specifications for the project deliverables entail complexity; for example, product parts must fit into a tight space or some are tightly coupled while others must be separated	Integrating work from multiple suppliers who must mutually agree on many design parameters	Several involved functions, suppliers and geographic locations have not yet established norms for interaction	A variety of software tools from different vendors must seamlessly interact	Needing to satisfy thousands of competing requirements, making the range of mutual acceptability small to nonexistent	Multiple stakeholders have different agendas and visions of success
Complicatedness	Product or service design is unprecedented or unintuitively structured	Activities are not clearly organized and managed by an integrated scheduling system	Participants are new to the type of work, have not worked together before or are not fluent in the same language	Reliance on new, nonintuitive software tools	Requirements are unfamiliar or unclear	Working with new types of clients or customers
Dynamism	Product or service design is still evolving and may change with the availability of new technologies	Activities change due to the availability of new process technologies	The project calls for new talent and approaches to address changes over time	Technological developments necessitate adoption of new software and hardware systems	Goals change as stakeholders' needs and values change over time	Working in a highly volatile or high-velocity, hypercompetitive environment
Equivocality	Different perspectives on design of deliverables leads to vagueness about their features and attributes	Different perspectives suggest multiple ways to accomplish key tasks, obscuring a clear choice	Decision makers must balance multiple, often divergent viewpoints	Indecisiveness in tool selection or use	Multiple issues and divergent perspectives blur understanding of the project's goals	Susceptibility to macro socioeconomic issues such as environmental regulations, mass transit or sustainability
Mindlessness	The project's final deliverable is very similar to prior projects, yet it differs in some small but critical aspects	Activities similar to past experiences and traditions, leading to overconfidence and insensitivity to nuances	Participants lack the mindset and skills to think "outside the box" and critically examine small deviations or weak signals	Software tools are used without regard to seemingly minor incompatibilities	Single-minded focus on a narrowly defined result — for example, staying within time or cost constraints	Similarity to earlier projects, yet with novelty in some key aspect such as scale-up or a new application
Project Pathologies	Some product components do not have a clear connection to a responsible organizational unit	Some activities do not have a designated doer or supporting tool	Expertise is fragmented into subspecialties and silos; broad, experiential knowledge is squeezed out	Overreliance on a single line of in-house tools; failure to use appropriate outside resources	Obsession with consensus building and suppression of cogent, diverse views	Stakeholders are large bureaucracies or multiple national, cultural or geographic agencies

the participants' abilities to understand and anticipate the project. That depends on subfactors such as the intuitiveness of the project's structure, organization and behavior; its newness or novelty; how easy it is to find necessary elements and identify cause-and-effect relationships; and the participants' aptitudes and experiences. The more complicated a project seems to the project manager and other participants, the greater the likelihood that something important will be missed, thus increasing the likelihood of unk-unks.

Dynamism A project's dynamism — its volatility or the propensity of its subsystems' elements and relationships to change — adds to its complexity. A project's external dynamics are especially likely to affect its goals. Regulatory agencies may impose new rules, customer preferences may change or competitors may alter their strategies. Changes in goals may lead to changes in a project's results (the product or deliverable) and its means of achieving them. Portions of a project might be outsourced, customers or suppliers might become formal partners and so on. Such changes realign the components and relationships considered to be "part" of the project. And increasing complexity and complicatedness increases the likelihood that a project will encounter unk-unks.

Equivocality Project work requires a lot of sharing of information. If the information is not crisp and specific, then the people who receive it will be equivocal and won't be able to make firm decisions. Although imprecise information itself can be a known unknown, equivocality increases both complexity and complicatedness. For example, some projects require a number of participants to attend meetings "just in case" an issue comes up that might affect them. The inability to pin down exactly who needs to be at any particular meeting increases scheduling complexity and the length of meetings and makes for "too many cooks in the kitchen." In such cases, an attempt to avoid one area of unk-unks ironically increases the likelihood of other types of unk-unks.

Mindlessness We refer to the perceptive barriers that interfere with the recognition of unk-unks as mindlessness (as opposed to mindfulness). Examples include an overreliance on past experiences and traditions, the inability to detect weak signals and ignoring input that is inconvenient or unappealing. By mindlessly relying on past data, book inventories and existing documentation or components instead of requiring physical verification, managers may be inviting unk-unks. Individual biases and inappropriate filters can keep periphery-dwelling knowledge in the shadows. A project manager's limited "bandwidth" requires filtering out the "noise" while letting important information through. Unfortunately, filtering is prone to errors, and the information that gets screened out, willfully or not, can be critical. Although it can be tempting to suppress or dismiss negative information while accentuating the positive when promoting a project, that can be a slippery slope. Mindlessness increases a project's susceptibility to surprising unk-unks.

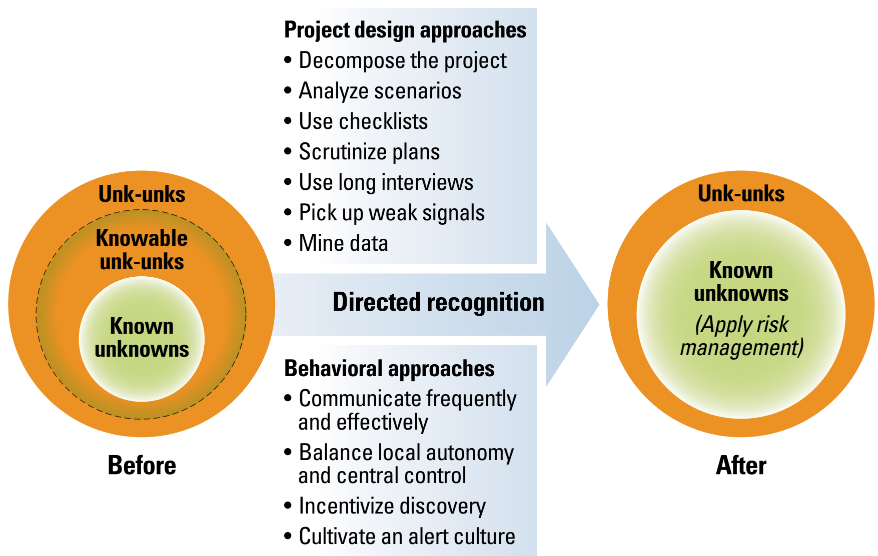
Project Pathologies Whereas mindlessness pertains largely to the individuals associated with a project, project pathologies represent structural or behavioral conditions in and around projects as a whole that allow unk-unks to remain hidden. Project pathologies include mismatches among the project subsystems and context (for example, goals for which no organizational unit is responsible), unclear expectations among stakeholders and dysfunctional cultures. A dysfunctional culture can manifest itself in numerous ways: information

"Although it can be tempting to suppress or dismiss negative information while accentuating the positive when promoting a project, that can be a slippery slope.

asymmetries (for instance, some stakeholders have key information about a risk that others lack), shooting messengers, covering up failures, discouraging new ideas and making some topics taboo for discussion. A manager might interpret a lack of active opposition as positive support, but in many organizations people who harbor doubts keep quiet, knowing that opposing views (either negative or positive) simply aren't welcome. Each of these project pathologies can make unk-unks more likely by decreasing the likelihood of uncovering them before they become unwelcome surprises.

FROM UNKNOWN TO KNOWN UNKNOWNS

Directed recognition, which can entail both project design and behavioral approaches, can convert knowable unk-unks to known unknowns.



How to Reduce Unk-Unks

Each of the six factors that increase the likelihood of a project encountering unk-unks can affect each of a project's six domains, yielding 36 places to look more specifically for knowable unk-unks. How should a manager go about looking? What techniques can a manager use to shine a light on these areas? We have identified 11 tools that can help managers with directed recognition: seven are project design approaches and four are behavioral approaches. (See "From Unknown to Known Unknowns.")

1. Decompose the project. Modeling a project's subsystems — to understand their structures, how their elements relate to one another and the subfactors of complexity — builds knowledge that helps expose unk-unks. Decomposition should begin with the natural structure of the overall purpose of the project (the "problem"), identifying the subproblems relating to key areas (such as customer need, product functionality and the venture team) and complementing it with experience and experimentation. For example, one company was able to decompose a project[5] by:

a) Identifying the problem's goals, context, activities and cause-effect relationships

b) Breaking the domains into smaller elements — such as product modules, process activities and stakeholders

c) Examining the complexity and uncertainty of each element to identify the major risks (known unknowns) that needed managing and the knowledge gaps that pointed to areas of potential unk-unks

d) Managing the selected pieces of the project in parallel with different project management methods — for example, treating various project threads as "options" and determining further actions contingent on the outcomes.

2. Analyze scenarios. Scenario planning involves constructing several different future outlooks.[6] Unlike many approaches to forecasting, it accepts uncertainty, tries to understand it and builds it into the reasoning. Rather than being predictions, scenarios are coherent and credible alternative futures built on dynamic events and conditions that are subject to change. Scenario analysis looks at how indirect threats or situations affect stakeholders, competitors, suppliers and customers,[7] and it is particularly suited to uncovering unk-unks in projects.

3. Use checklists. Codified learning from past projects can enlighten future planning. This often shows up in the form of checklists or prompt lists. Of course, providing such tools won't help if they are viewed as obstacles rather than facilitators of success. Checklists and categories need to be viewed as helpful prompts, not substitutes for thinking.

Although some professionals such as doctors have sometimes resisted using checklists, airplane pilots have long known that a good checklist helps smart people free up thinking for higher-level problems.[8]

4. Scrutinize plans. Project plans are merely a hypothesis for how success will occur. At a minimum, plans should contain information about the expected work (for example, when it should start and finish, projected costs, anticipated results, responsibilities and resource requirements). These expectations need to be scrutinized closely by project participants and other stakeholders. The scrutiny can come in the form of reviews, audits and even formal verifications of how the content was generated.[9] Just as reliable products may require some redundancy, project plans may need predefined contingencies. An independent board of overseers composed of experienced experts, empowered to obtain all kinds of project information, can help reduce potential unk-unks lingering from planners' entrapped mindsets. In a well-known case in 1992, NASA's Mars Observer was lost due in part to a lack of independent verification and validation.[10]

5. Use long interviews. Long interviews with project stakeholders, subject matter experts and other participants can be effective tools for uncovering lurking problems and issues.[11] However, interviewers need to be careful not to be too enthusiastic about the projects they're examining and not asking "yes or no" questions. The best interviews probe deep and wide and ask "out of the box" questions, which can help managers identify latent needs that project stakeholders are unable or unlikely to articulate readily. Consider Silverglide Surgical Technologies, a Boulder, Colorado-based company specializing in nonstick electrosurgical instruments.[12] It came up with what it thought was a novel product — a nonstick surgical probe. Although surgeons were intrigued by what the new product could do, they weren't accustomed to using a probe to operate, so the product bombed. Subsequent studies revealed that had the surgeons been asked, they would have preferred nonstick forceps to a probe. That was a knowable unk-unk.

6. Pick up weak signals. Weak signals often come in subtle forms, such as unexplained behaviors, confusing outcomes or a realization that no one in the organization has a complete understanding of a project. Recognizing and interpreting weak signals requires scanning local and extended networks, mobilizing search parties, testing multiple hypotheses and probing for further clarity.[13] It's also helpful to include tools we have previously discussed, such as long interviews and diverse scenarios.

7. Mine data. When vast amounts of data are available from a plethora of databases, electronic data mining can be a particularly powerful tool for extracting implicit, previously unknown and potentially useful information. By simultaneously reviewing data from multiple projects, data mining could enable project managers to identify the precursors of potential problems. The NASA Engineering and Safety Center (NESC) was established to improve safety by proactively identifying precursors to potential problems hidden in NASA's diverse databases. The NESC found electronic data mining to be a particularly promising tool for the nontrivial extraction of implicit, previously unknown and potentially useful information toward accomplishment of this goal.[14]

8. Communicate frequently and effectively. Regularly and systematically reviewing decision-making and communication processes, including the assumptions that are factored into the processes, and seeking to remove information asymmetries, can help to anticipate and uncover unk-unks. The 1998-2004 Ladera Ranch earth-moving

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project in California, for example, needed to find a way to deal with any unk-unks related to discovery of prehistoric Indian ruins or rare animal or plant species the dig might uncover.[15] The project manager and the team met weekly to discuss whether the project or its current plan needed to be revised and how. Effective and frequent communication is essential for project adaptability and agility. However, this doesn't necessarily mean communicating large volumes of information, which can cause information overload. Rather, the key is knowing how to reach the right people at the right times.

9. Balance local autonomy and central control. Many unk-unks are obscured by the relationship complexity and dynamism of a project — dictated by diverse technologies, geographic sites, interests and external influences. Such confusion makes the project management team vulnerable to unwelcome surprises. Using decentralization of control to grant autonomy to the local nodes of a multinodal project facilitates adaptation and innovation as well as recognition of unk-unks (such as the effect of regulatory changes and customer preferences). Although decentralization helps project managers compensate for their knowledge gaps, it creates challenges for governance. Local nodes are less willing to report problems. To achieve adequate control, project managers may adopt an approach that combines bottom-up empowerment to correct errors with top-down efforts to embed learning across the project.[16]

10. Incentivize discovery. Some of the most promising ways to identify unk-unks include timely and honest communication of missteps, anomalies and missing competencies. Offering incentives for candor can show people that there are advantages to owning up to errors or mistakes in time for management to take action. At the same time, it is imperative to eliminate any perverse incentives that induce people to ignore emerging risks.[17] Among the most common perverse incentives are organizational tendencies to stress short-term over long-term results — a key contributor to the financial crisis of 2008.

11. Cultivate an alert culture. An alert culture is made up of people who understand how unk-unks can derail projects and who strive to illuminate rather than hide potential problems. Managers can cultivate a culture of alertness in several ways. First, they can emphasize systems thinking, which recognizes that deciding what to do in a complex system is not simply a matter of repeating what was successful before. Systems thinking also emphasizes the use of multiple perspectives to reach a decision, does not expect to be completely right and changes course in the face of contrary evidence. Second, managers can stress the limits to what can be known about a project, especially at its early stages. They can cultivate a culture of healthy skepticism about projects purporting an absence of risk. Third, managers can seek to include and build a wide range of experiential expertise — intuitions, subtle understandings and finely honed reflexes gained through years of intimate interaction with a particular natural, social or technological system. Fourth, they can seek to develop the characteristics of a high-reliability organization: preoccupation with failure, reluctance to simplify, sensitivity to operations, commitment to resilience and deference to expertise.[18] And fifth, managers can attempt to learn from surprising outcomes. In their eagerness for resolution and clear explanations in reviews, managers should eschew the rhetoric of justification and hold out for the possibility of a deeper understanding of the causes of failure.

PROJECTS ARE COMPLEX and complicated. A project's desired results, planned process, performing organization, tool suite, goals and context all lend

> Managers can stress the limits to what can be known about a project, especially at its early stages. They can cultivate a culture of healthy skepticism about projects purporting an absence of risk.

themselves to complexity and complication. What's more, any of these areas can harbor unk-unks, the undetected problems that are buried in the morass of elements and interactions in and around a project. Some unk-unks are actually knowable, but individuals and organizations acting in mindless or pathological ways will allow the unk-unks to remain hidden, where they can fester into even bigger problems before becoming evident. Fortunately, there are tools and strategies to help managers. The 11 approaches described above give managers a tool kit for directing recognition toward uncovering the knowable unk-unks lurking in projects and converting them to known unknowns. By providing guidance on where and why unk-unks exist in projects and how to recognize their clues, managers can reduce the number and magnitude of unwelcome surprises.

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