Integrity at the Moment of Choice: Navigating Uncertainty in New Product Development [1, 2]

Tina Small

Introduction

In research and development, engineers must often make critical decisions based on incomplete information, creating uncertainty. The challenge for the engineering project manager lies in determining whether they have sufficient data to commit to a course of action, eliminate alternatives, and proceed, or if deferring the decision could lead to greater risk. Relying on heuristics – mental shortcuts – could lead to biased and non-optimal decisions, while waiting for analysis could lead to an impasse. Acting with integrity is being consistent with a standard, especially in the domain of decision- making. This paper explores the concept of integrity at the moment of choice as a response to the pervasive uncertainty in new product development. Concepts from systems engineering guide the selection of appropriate tools.

Decision-making is critical in new product development. The inherent uncertainty along with time and resource limitations means that we can't simultaneously live out all the possible scenarios, unless we have the ability to travel the multi-verse like Dr. Strange. Choices must be made. To have integrity at the moment of choice, we should be confident that our decision-making methodology is the best that it can possibly be.

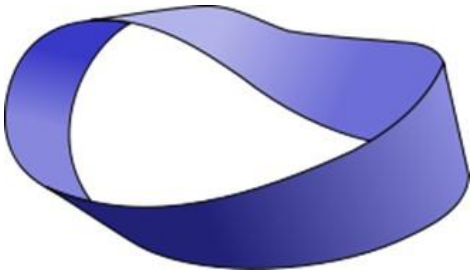

Figure 1 - A Mobius Strip

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Looking at the decision-making process, one can see two sides. One side is analytical and rational, where data-based models provide confidence that the decision will produce the expected outcomes. The belief is that empirical measurement tells us the right thing. Another way of making decisions is intuitive, which may incorporate a subtler analysis. There may just be a gut feeling that something is or isn't right. Subjective judgment guides the right choice. This paper follows the path of a Mobius strip, examining both sides of the decision-making process, hoping to demonstrate that they are part of an inseparable path. Integrity is wholeness: We can go with our gut, or break down problems to analyze them, but we must have both to get the full picture.

As humans, we are constantly modeling causal relationships. This ability helps us survive threats, achieve our goals, and develop subject matter expertise. Subject matter expertise is cited multiple times in the PMBOK Guide. Experts can draw on models, both mental and expressed, to make decisions that reflect their beliefs about cause and effect. Expertise adds value by making more accurate predictions about outcomes. New experiences can help update models or reinforce those prior beliefs. Collaborating with diverse subject matter experts can build even better decisions if the effort is put forth to develop shared models. Unstated assumptions may show up as nuanced differences between models. In some situations, those differences may not impact the decision or predicted outcome. In other cases, those differences may mean a preference for one decision over another.

A project manager has a job to do because there is a gap between the current situation and the desired outcome. Holding that tension can be uncomfortable. Two ways of dealing with that tension – resolve it quickly or pursue perfection. The balance is again seen in the whole of the Mobius strip. Neither outcome is correct by default. To act with integrity, the decision-makers need to be sure that their stakeholders are robust to the consequences. The moment of choice is also an important consideration. Navigating complexity may mean there are competing values that need to be weighed. Conceptually clarifying the decision-making process ensures organizations remain adaptive and resilient.

Inc. Magazine quoted Warren Buffet saying, "Somebody once said that in looking for people to hire, you look for three qualities: integrity, intelligence, and energy. And if you don't have the first, the other two will kill you. You think about it, it's true. If you hire somebody without [integrity], you really want them to be dumb and lazy." (Schwantes, 2024)

Limitations of Judgment in Decision-Making

Acting with integrity is being consistent with a standard, especially in decision-making. One who acts with integrity is trustworthy. They do the right thing. But science shows that we have bounded rationality and therefore our judgment can't always be trusted, despite our best intentions. Limitations on our awareness can distort our decisions as well. Errors in judgment can arise when we rely on heuristics to make decisions instead of using an optimal decision-making process. Heuristics are mental shortcuts or rules of thumb used to simplify decisions based on past experience. In *Judgment in Managerial Decision Making*, Bazerman and Moore introduce several categories of heuristics. Some of these include the availability heuristic, the representativeness heuristic, the confirmation heuristic and the affect heuristic. (Bazerman & Moore, 2013) Often, these heuristics generate common biases, which guide our decisions towards non-optimal outcomes.

The availability heuristic helps us judge the likelihood of an event based on how easily examples come to mind. However, this may not be accurate. For example, the risk of an airplane crash may be overestimated compared to that of a car crash as an airplane crash gets more news coverage. Facebook feeds could bias us toward thinking that cats are cuter and more entertaining than is experienced by real cat-owners.

The representative heuristic is a cognitive shortcut that helps us estimate the probability of an event based on how similar it is to a prototype, rather than on actual statistical data. Using this heuristic may make us insensitive to base rates and sample size, leading to mistakes in estimating chance.
Stereotyping is one problem arising from unintentional use of this heuristic.

The confirmation heuristic is the tendency to look for information that validates a prior belief. That initial piece of information serves as an anchor which simplifies mental analysis. However, this can lead to biased decisions when a person sticks to the initial model even when evidence to the contrary is shown.

The affect heuristic reflects the use of emotion as a guide for making decisions rather than more rational analysis. If I'm in a sour mood because of bad traffic on the way home, I might decline an offer to go out to eat, which I would enjoy and may actually improve my mood.

In addition to these cognitive shortcuts, we also filter information unconsciously. Inattentional blindness and change blindness can eliminate inputs to our decisions. Focalism –

overemphasizing a single factor in a decision – can skew the weighting that should be given to the inputs leading to a non- optimal decision.

Although imperfect, heuristics are a valuable way of making subjective judgments. They save time and mental energy and have helped mankind survive for millions of years. But, if we know we can make mistakes by relying on these heuristics, is there a better way to make decisions with integrity? Certainty comes at a cost. With analysis, time and energy are spent. As project managers, we expect a return on that investment. Without analysis, we can only hope that our judgment is good enough to make us trustworthy. One way to expedite decision-making is to rely on subject matter experts in many of the performance domains of project management. Another way is to leverage diverse viewpoints.

Systems Thinking in Project Management

In new product development, where the team is always making decisions, time to market is essential. So, when we consider the case of complex or incomplete information, how does one act with integrity? Is the right thing to make a fast decision or to do an accurate analysis? Heuristics are one method of reducing complexity, but there are also tools from systems engineering that we can apply to manage uncertainty and complexity. In some cases, putting forth the extra analysis is the right thing to do. The PMBOK 7th edition states that "Knowledge of systems thinking, complex adaptive systems… leads to the project team's increased ability to navigate complexity when it emerges." (PMBOK, 2021) A systems thinking approach in problem-solving fosters integrity in every decision, enabling teams to navigate the unpredictable dynamics of new product development.

In systems thinking, the systems architect looks at the interactions within the system and the environment and creates models of the expected behaviors. We do this innately. Heuristics are mental models of how the world works. But when the system architect makes these models explicit, she makes them visible to others to use, compare, and critique. This enables the collaboration in decision-making, not just a single point of experience.

The next section highlights some key lessons from research in systems thinking and takes a deeper look at their limitations.

Principle Role of the Architect

The role of the [system] architect is to resolve ambiguity, focus creativity and simplify complexity. The architect seeks to create elegant systems that create value and competitive

advantage by defining goals, functions and boundaries; creating the concept that incorporates the appropriate technology; allocating functionality; and defining interfaces, hierarchy and abstractions to manage complexity. (Crawley, 2016)

In new product development, there are two related systems: the product and the project. The product owner focuses on the system, form, and function of the end product that is sold to the customer. The program manager focuses on the system, form, and function of the project. In many cases, the project's system has been set by the firm in the standard product development process, which captures the best practices and standard ways of working. In cases where the project is well within the capabilities of the firm, no system changes are needed. The project manager can rely on the best practices with confidence that they will guide decisions in an optimal fashion. After all, the best practices should have been created and maintained with all the collective experience of prior projects. However, innovation or the lack of a standard product development process can require the project manager to be a system architect as well.

Innovation may take the standard product development process into new territory, where what worked in the past hasn't been proven in the current circumstances. The lack of a standard development process leaves the project manager relying on her own individual experience or, at best, the collective intelligence of her team. Bazerman and Moore state that overconfidence is the mother of all biases. A little humility is good to help project managers act with integrity. But too much humility and the project manager doesn't add any value. Each of these opposing extremes brings us back to the same point of ineffectiveness. It's like trying to find the end of a Mobius strip, where trying to avoid one outcome by heading in the opposite direction leads right back to that outcome. How does one escape this Alice in Wonderland conundrum? One tool of the system architect is that of decomposition.

Decomposition

Decomposition is the process of breaking an entity into smaller, manageable parts. This is done in many aspects of project management: work breakdown structure, schedule model, organizational charts, etc. It is also done on the product side: features, modules, and components. Decomposition helps organize a system architecture into components that can be understood more easily than the whole system. One important reason to use decomposition is that it helps us to predict outcomes and set expectations.

Schedule estimation is one application of decomposition. The waterfall model of scheduling can be seen as a linear system. Let's say that we have a project where we can divide the tasks among

the team so that they can all work independently, and we want to complete the project in *n* days. We can solve this problem. We "simply" multiply the rate at which each person can work by the time they can work and add it up to show that their capacity is greater than *n* days of work. In this situation, adding an independent feature to the scope would mean that we could add one more person to the team to complete the work in time. However, the waterfall model may not capture the interdependencies in the workflow. Decomposition to a lower level may be needed to help clarify the potential outcomes if they can't be solved quantitatively. For example, a new feature may mean that the test regression needs to be updated, and the design iterated until both are working.

There is a limit to the ability to predict outcomes when a system is broken down into components. Some problems are linear and can have an analysis done on components independently and then recombined to get the answer. Others have non-linear interactions between the components, that you can't solve analytically. (Strogatz, 2018) The difficulty in decomposition is often in reconstituting those components back into the whole; the interactions between the components could induce another level of cause-and-effect relationships in the form of emergence. This poses another decision for the systems architect. What level of decomposition is the right one? A useful level of decomposition is to describe at one level below the measurable outcome. This helps provide understanding and qualitative models where it may be hard to model quantitatively.

Understanding decomposition and emergence helps project managers simplify complexity where it can be reduced and manage complexity when it can't be reduced. Again, the image of the Mobius strip is brought to mind. If you decompose a Mobius strip into a two-sided strip, you will miss the twist.

Reuse

Reuse is another system engineering skill that is leveraged in product development and project management. It can be more efficient to reuse existing components than to invent new ones. Existing components have already sunk development costs and have proven benefits. However, the challenge comes from the context in which they are applied. There may be constraints in the existing components that don't meet the requirements of the product or project at hand. In project management, tailoring is the process of assessing whether the existing components can be applied to drive the desired outcomes.

For example, one of our manufacturing software systems has a limitation of 6 steps in a

sequence. When we reuse this system for a product that has 7 manufacturing steps, we need to join two sequences together to capture the manufacturing flow. This increases complexity, adds no value, but avoids additional development costs. Customizing the manufacturing software system is outside the scope of the project.

Deciding when a component is "just good enough" demands that competing values be weighed. And again, we visit the opposite side of the Mobius strip. Expert judgment can come into play when making this decision. Overconfidence can strike when planning reuse. If the mental models have not been made explicit, then the assumptions that the situation is "another one of these" could be way off base. By documenting the assumptions, the differences between the former situation and the present one are made clear. The project manager can act with integrity, distinguishing knowns from unknowns.

Robustness

There's a reason why existing firms invest in new product development. It helps the corporation survive in the face of environmental changes. Therefore, the system concept of robustness is relevant to managing new product development projects. Using a system view impacts integrity at the moment of choice. A system has a form and a function. A project's function is to deliver value to the stakeholders. The project management methodology is its form. The project system doesn't exist in isolation. It is related to its environment and requires tailoring to the context. Analysis helps define the boundary between the system and the environment. Changes, either in the environment or in the system, can affect the outcome. Even without unexpected change, it is near-impossible to model and predict the behavior of a complex non-linear system. With each decision, the project manager must ask, "What is the right thing to do, given the context?"

Now we arrive at the existential question of a system – robustness: What system are you trying to make robust to the consequences? In new product development, is it the product or project deliverable? The team? The new product development methodology? The corporation? Your job? Which stakeholders' interests are prioritized? The answer to these questions will set the risk tolerance. U.S. corporations exist in perpetuity, meaning they can continue even with changes in ownership until legally dissolved.

The risk tolerance in an established firm is very different than that of a startup. Building resilience in a team is different than building resilience at the corporate level. For example, if there are 50 new products under development in an established firm, it might not threaten the company's survival if one of those projects was canceled and the team reallocated. However,

if a startup firm's very existence depends on the successful launch of a single product, the project's robustness is paramount. What needs to endure? The project, the team, and the product are all temporary compared to the potential lifetime of the corporation. Stakeholder analysis can help map out all of the known concerns. Without setting boundaries to the scope, this could go too far. Judgment is required to set the boundary of relevance.

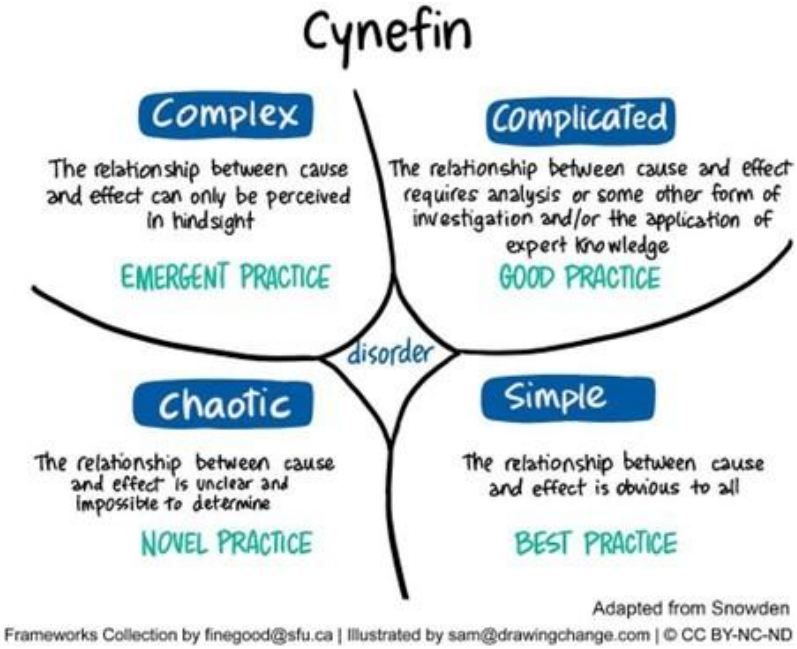
The challenge is to model the boundary of the system so that the project manager and project team can influence the system with integrity. Going back to the limitations of human judgment, bounded awareness affects our ability to make optimal decisions. Modeling the project scope as the system boundary helps clarify the stakeholder requirements and allows the team comprehend the right thing to do within a given scope. If a boundary is not set, even arbitrarily, the ever-expanding scope of interactions can lead to analysis paralysis.

With awareness of risk tolerance and the system/environment boundary, the project manager curates the decision process with integrity at the moment of choice through standard risk management techniques. There are plenty of resources on risk management. The general methodology is to determine risk tolerance and apply risk management techniques.

Robustness can be defined as the ability of the system outcome to hold for a variety of different scenarios. Resilience is another way to look at the project system architecture. If the current state of the project results in a setback or failure, can the outcome still be attained by adapting? These two factors – robustness and resilience – will guide the project manager in making critical timing decisions. We want to know, in the face of uncertainty, whether to commit with available knowledge or defer at the cost of lost opportunity.

In new product development, where we are trying to transform a concept into revenue, being first with the solution is typically an advantage. Accelerating the right actions helps accomplish this goal. The project manager can push the team to accelerate a decision. You can accelerate a response when you know that the models are capable of predicting an outcome. If the system is robust to the consequences or resilient enough to accept a setback, accelerate. However, if the team doesn't know which are the *right* actions, it makes sense to try a different approach.

The Cynefin framework or Stacey Matrix is a model to guide the choice of approach. The right side of the figure below shows the Simple and Complicated domains. These domains are solvable systems where cause-and-effect relationships can be known. The left side shows the Chaotic and Complex domains. In these domains, it is difficult to know cause-and-effect relationships ahead of time. Knowing what domain the system falls in will determine an appropriate choice in driving to a response.



As shown below, a project can have aspects that fall into different domains, requiring the project manager to leverage systems thinking to model the project as a system of systems.

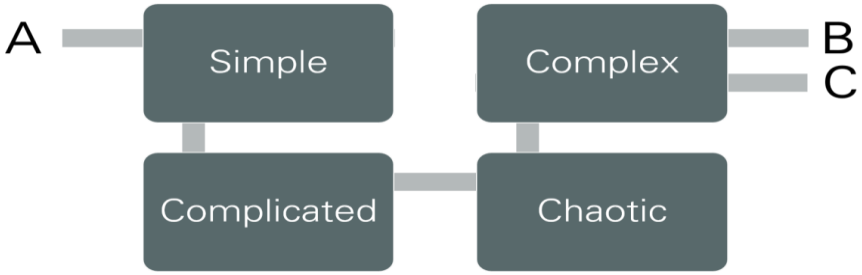


Figure 2 - A System of Systems

As stated earlier, acting with integrity is being consistent with a standard, especially in the domain of decision-making. Systems thinking can provide the clarity to know what is easily knowable and what must be teased out through trial and error.

Summary

In summary, a system view of projects can provide additional tools for acting with integrity in project management. Some systems can be complicated, but predictable to a degree. Other systems are beyond the current capabilities of prediction. As project managers, predicting

outcomes would be our superpower! A key point is knowing the system and adapting behavior accordingly. As a project system architect, the project manager begins by identifying the gap between the current situation and the desired outcome. This may induce a feeling of tension that could drive non-optimal decisions. By applying systems thinking the project manager defines the boundary and risk tolerance of the system and its environment. Tools such as decomposition and reuse and frameworks such as the Cynefin framework identify the relevant approach to resolve that tension.

Decision-making is challenging when we know that our judgment can be mistaken and our reliance on empirical measurement is still subject to judgment. Integrating both heuristics and analysis can help us at the moment of choice.

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About the Author

Tina Small

North Texas, USA

Tina Small's LinkedIn bio says, "Program Manager at Texas Instruments", but it doesn't begin to convey the curiosity she has about how it all works! Although she's been transforming ideas into reality as a PM for semiconductor products since 2006 – and as a development engineer before that – she finally got around to pursuing a Master's degree.

She chose an M.S. in Systems Engineering and Management from the University of Texas at Dallas (UTD) to shore up her understanding of both the engineering systems and the people systems that are critical to her projects.

She's been PMP® certified since 2008.

Tina can be contacted at cmsresearcher@gmail.com