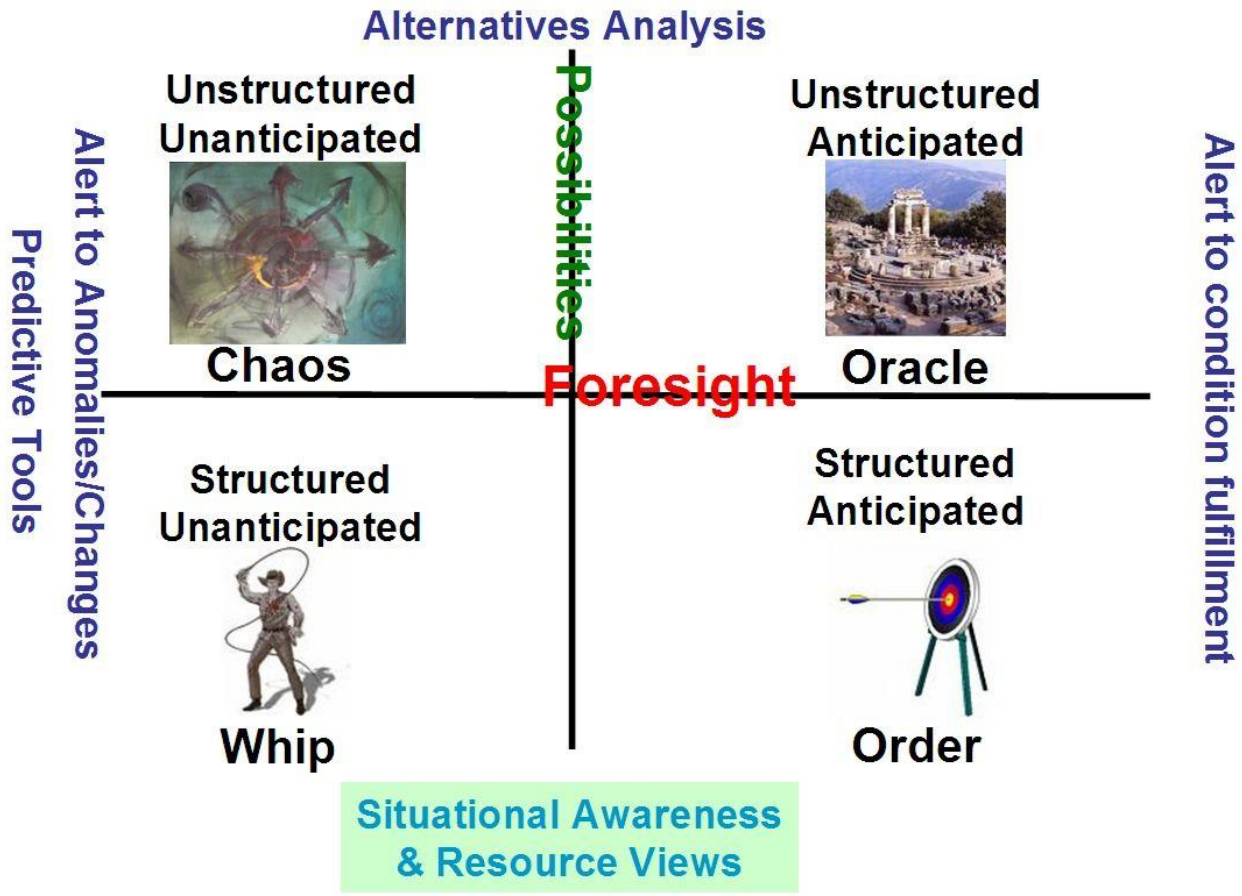
Bringing Order Out of Chaos



Effective Decision Making: An Art and a Science
Brigadier General Jeffery E. Marshall

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"If the doors of perception were cleansed every thing would appear to man as it is, infinite. For man has closed himself up, till he sees all things through narrow chinks of his cavern."
William Blake, The Marriage of Heaven and Hell

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Knowledge is the contextual application of information

"Plastic or paper?"

The first time I heard this question, I looked up from my wallet with a deer in the headlights look. "What?" I said.

The check out clerk answered, "Do you want paper or plastic bags?"

Suddenly, I was thrown from a simple shopping errand for a few quick items into a contemplation of world ecology. The essence of the question involved whether I wanted to use plastic bags that come from petroleum and do not decompose well or paper bags, that while they decompose well, contribute to deforestation. Which would it be?

A seemingly simple, two-fold choice was laden with uncertainty—or unconcern. If I didn't care, I could simply say it does not matter and let the clerk make the decision for me, using who know what kind of rules to make it. Or, I could be freeze, not knowing which to choose because of lack of knowledge governing the choices. Or I could draw upon what knowledge that I had and make the best decision that I could make, based on that knowledge.

The second factor that will influence my decision—or lack thereof—is my confidence level. If I have a lot of confidence in myself and my abilities, I may be far more likely to make a decision than if I have less confidence. This may be true, even if I have near perfect information on the state of landfills, forests and petroleum reserves. I could simply freeze and fail to make any decision—even to punt it. If I have too much confidence, regardless of my knowledge levels, I may make a poor decision.

Decision-Making

The decision-making described above is shown graphically below in Figure 1**Error! Reference source not found.**. As shown in our example, we can do several things. First, we can punt and let someone else make the decision. Second, we can freeze and fail to make any decision, even to punt. As our level of certainty increases, and confidence increases, we may eventually make a decision. But by then, the decision may be too late or the conditions may have changed markedly. Finally, we may make either a knowledge-based or a speculative based decision. The greater our confidence level, the more we may be inclined to speculate and fill in the gaps in our level of certainty.

Virtually every decision is made under some degree of uncertainty. Thus, virtually every decision involves some bit of speculation.

Speculation

So what is speculation? Perhaps the best definition is a conclusion or an opinion formed from contemplation. Which then leads to the question, what is contemplation? If we are not careful, contemplation could lead us into some heavy metaphysical woods. For our purposes here, let us first define contemplation as deep, focused thought upon a subject. Thus, along this line, speculation is a conclusion drawn from deep, focused thought.

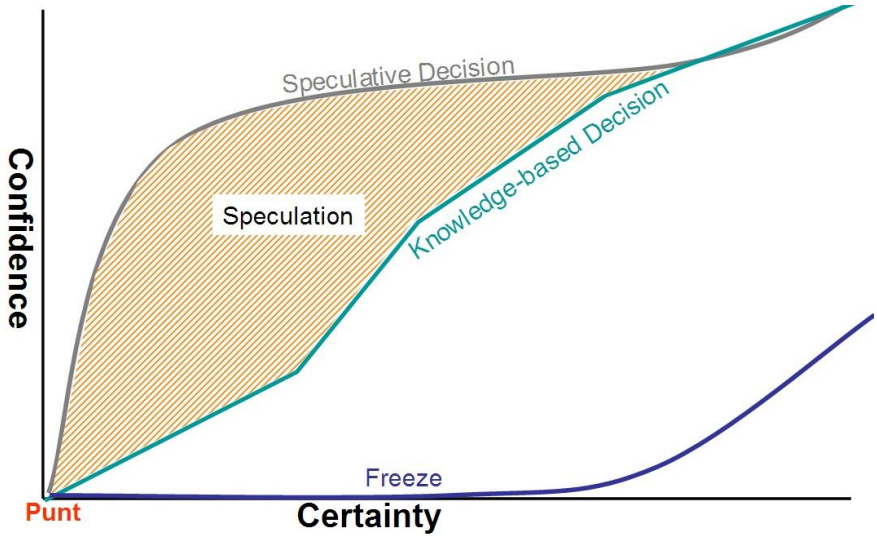


Figure 1 Decision Making

When we make decisions with informed speculation, it is really judgment, touched with a degree of inspiration. Judgment is a function of rational analysis and insight. Inspiration comes from the Muses, but may be linked to insight. Judgment is rational. Inspirational is, well other. It is perhaps more related to the artist than the scientist. And in solving difficult problems there is a much an element of the artist as there is of the scientist.

Rational Analysis and Logic

Rational analysis comes largely from logic and rules. Inductive logic looks at the general situation and infers the specific based on the general. Deductive logic is just the opposite. It infers the general from the specific. The most common form is the deductive syllogism. Both forms of logic can have problems. If the premises in deductive logic are faulty, the conclusions will likewise be faulty, no matter how "logical" it follows from the premises.

Inductive logic ultimately rests upon assumptions that the general will be like the specific. However, virtually all breakthrough and revolutionary change is a refutation of inductive logic. This is essentially the "black swan" situation that Nassim Taleb discusses in his book, The Black Swan. Just because we have never seen a black swan before does not mean that there are no black swans.

Logic is a valuable tool. However, it is a tool and like any tool can be used—or misused. The logical component of judgment needs to be paired with the more subjective component of insight.

Insight and Inspiration

Insight is the "feelings" and leaps of understanding that we get that seem to defy rational thought processes. But do they really? I suspect that intuition is just as rational as logic, it is just based on a different set of rules and processing. It is based upon pour experiential learning and tends to operate on our subconscious levels. The sub-conscious operates on rules and a form of logic as well—the conscious mind just does not understand this process.

I suspect that inspiration is related to intuition. They both work in processes that seem to transcend the conscious mind. However, as noted above, I think intuition does work on a set of rules, even if the conscious mind does not always fully grasp them. Inspiration transcends rules. It makes leaps and seems to defy logic.

Which leads into the connotative meaning of speculation that implies guessing. We cannot dismiss the impact of guesswork on making a decision under uncertain conditions. When we have imperfect information, we make guesses to fill in the gaps. These guesses are influenced by intuition, past history, where the information gap lies in the overall puzzle, and context. Yet guesswork is also influenced by confidence. The greater confidence we have in our abilities, the more we may guess, but not consciously realize the extent of the guesswork. If we make guesses that we really think are informed assessments, then speculation can lead to potentially faulty conclusions.

To avoid this problem, we need an accurate assessment of both ourselves and our knowledge base. We need to consciously realize when we are guessing, when we are engaging our intuition and when we employing sound, logical reasoning to fill in the missing gaps in our knowledge base. Speculation is vital in decision-making, but it must be informed speculation rather than guess work.

Ideally, these decisions are based upon judgment, with a clear understanding of the degree that inspiration and guesswork contribute. When possible, we need to do some testing to ensure we understand what assumptions we have made and the impact if the assumptions are wrong. We should know the assumptions that we logically made. However, our intuition, inspiration and guess will create implicit assumptions. We need to understand these implicit assumptions and try to test them as well.

Decisions

Now, let us turn back to the decision itself. Broadly speaking, there are two types of decisions.

First are structured decisions. These are decisions that can be codified by some set of rules. The rules define both the conditions that need to be operative to make the decision and the way the decision is made. In some ways, these rules can be expressed in an "if, then" format. However, this format could contain multiple conditions and nested decisions depending upon the complexity of the requirements.

For example, we can create a very simple rule-based decision: if the telephone rings, answer it. Then, we can add in a little bit of complexity. If the phone rings, check the Caller ID. If the

Caller ID is unknown, do not answer it, otherwise, answer it. We can even expand it further. If the Caller ID is anyone other than a select group, send the call to voice mail. If the Caller ID is in the approved list, then answer it. This simple example shows how a structured decision tree can get progressively more complex, yet remain structured and rule programmable. We can define both the conditions that must be met and the actions to take.

The second type of decisions is unstructured decisions. These are decisions that cannot be easily broken down into prescribed rules. They require judgment and subjective assessment. By nature, these are more complex issues that often involve multiple conditions and potential solutions. The decision-making task in these types of decisions is to understand the conditions, weigh the alternatives and then make an effective decision.

The "flavor" of a decision depends upon whether it is anticipated or not.

First are decisions that we anticipate making based upon conditions and how we expect the conditions to evolve. If we can anticipate a decision requirement, then we can project the conditions under which we will make the decision and establish either rules to make it or anticipate potential courses of action. We can pre-program the decisions and then make them when required. In other words, we understand the environment and can develop some parameters to make these types of decisions.

For example, say we own a stock. We can anticipate selling the stock if it rises above a certain price or falls below a certain price. This could be a simple rule-based decision. Or, it could be a far more complex decision if we factor in economic conditions as well the internal company conditions and perhaps consider derivative securities.

The second type of decisions is those that we cannot anticipate. They come about when conditions in the environment take unanticipated directions or new factors arise that change the environment. As a result, we may be confronted with a decision that we never expected.

As an example, consider getting a call from an attorney in a distant city telling you an old acquaintance that you have not seen for years left you a sizable inheritance. You never knew that your actions had greatly affected this person. Now, suddenly, you have a considerable sum of money. Do you invest it, buy a new car, take a vacation or give it to charity?

The types and flavors of decisions can be summarized in the matrix shown in Figure 2. The horizontal axis shows the amount of foresight. Can we anticipate conditions or do they come as a surprise. The vertical axis shows possibilities. Are our options constrained or are there multiple alternatives? The matrix also shows some of the issues surrounding the different combinations of decision types and flavors, as well as the requirement for Situational Awareness and Resource views to assist in making timely, effective decisions.

The upper left quadrant represents Unstructured and Unanticipated decisions—Chaos. We cannot readily predict events and conditions and when they do arise, the decisions that we must make require judgment rather than specific rules.

Another way to look at this quadrant is to think of a volcano. The volcano may look dormant and asleep, but underneath the surface, magma may be building. We do not know when, or even if, the volcano will erupt, but when it does, it will almost certainly change the environment considerably.

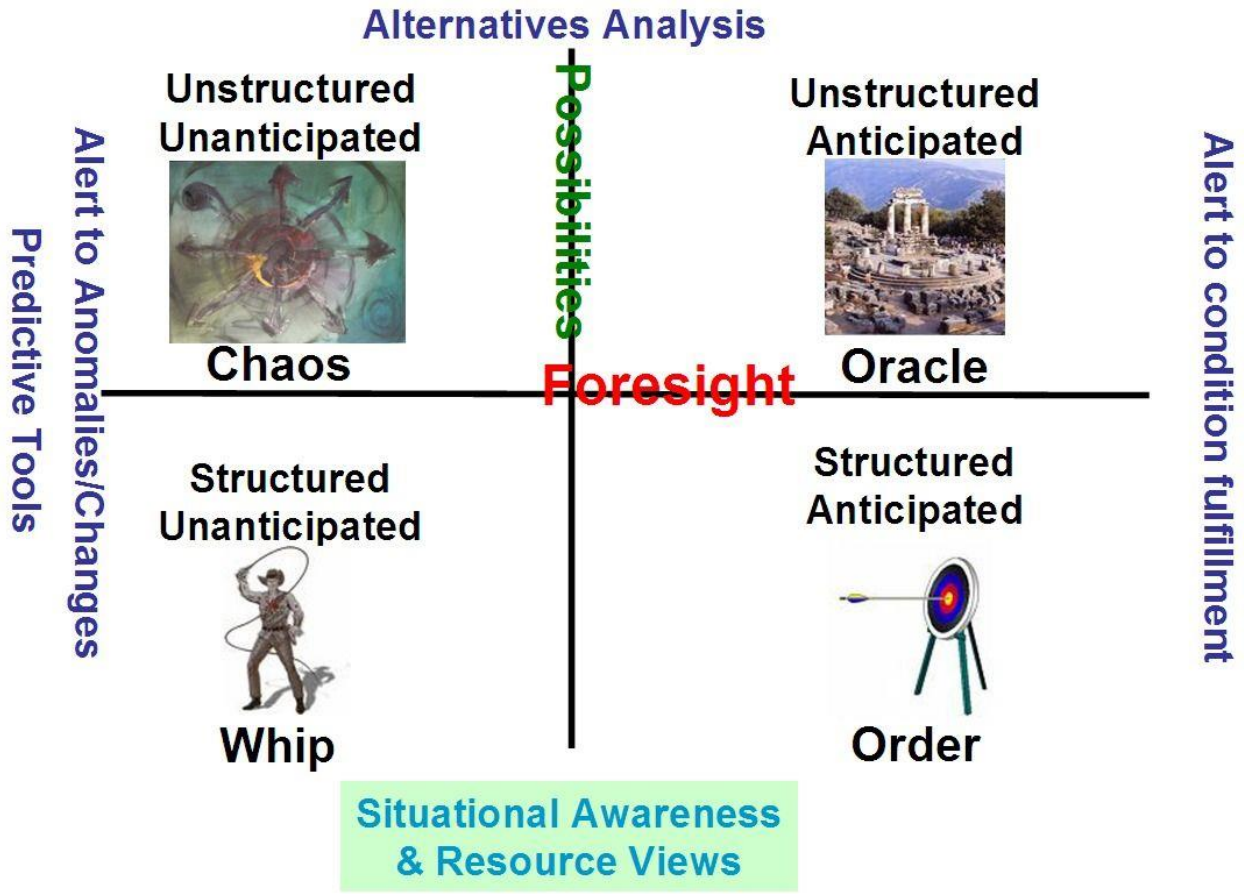


Figure 2 Decision Types

Also, chaos may not be quite as chaotic as many of us realize. Recent work on chaos theory indicates there may be patterns that govern chaotic situations. Just because the patterns are not discernable does not mean they are not there. Perhaps the best way to look chaos is the unknown. There may or may not be patterns. There may or may not be volcanoes waiting to erupt. Chaos is the field from which most creativity and opportunity emerges. Those that can navigate this field or anticipate or react to unanticipated changes will fare the best. We just do not know when or where these changes will emerge.

The future of nearly any organization lies squarely in this quadrant. It is where all growth and significant change originally occurs. Organizations that can master decision-making in this quadrant will be in a far better position to guide their own destiny than those that cannot.

This quadrant has the most risk, but also potentially the most reward—if we are smart about how we handle these decisions. This quadrant is where a prescient decision maker can break paths and patterns and profoundly reshape a market or even society.

The upper right quadrant shows Unstructured, Anticipated Decisions. This quadrant is titled the Oracle because we must deeply consider the alternatives, even though we can project the future conditions. There may be no clear alternatives and lots of missing information. We may need to develop heuristics and engage in pattern matching to make effective decisions, when the expected conditions arise. With experience, we can begin to identify patterns and perhaps eventually create some rules. If so, we may be able to translate these decisions to the Order Quadrant.

The lower left quadrant is Structured, Unanticipated decisions. We cannot predict the conditions, but when they arise, they can be handled by relatively straight forward rules. Once we see these conditions and develop the rules, the decision may move to the Order quadrant.

The lower right quadrant are Anticipated, Structured decisions—Order. These are decisions that are the best suited for traditional rule-based expert systems. For anticipated, structured decisions, we can pre-program a decision to automatically execute when the expected conditions arise.

However, we need to also understand that while rules may work in virtually all situations, there are some in which they do not. Consider Newtonian physics. The rules in Newtonian physics work rather well for just about all of our day-to-day activity. However, they break down at the nuclear and relativistic levels. Key breakpoints may appear to "normal" and entirely suited for the existing rules…and then present a twist which breaks the rules. We cannot be lulled into a false sense of security by ordered decisions. Entropy is always lurking. The decision system needs to understand the relevant range over which a rule is operable.

An adaptable, learning decision support system learns from the decisions made in the four quadrants and their successes or failures to move as many of the routine decisions to the Order quadrant. The decisions that cannot be perfectly structured are moved to the Oracle quadrant, with anticipated alternatives mapped out if possible.

The two primary variables are the degree of uncertainty and the number of potential alternatives. The goal is to reduce both the degree of uncertainty and the number of alternatives. The first sounds eminently reasonable, but the second may seem counterintuitive, at least on the surface.

The greater the number of alternatives that we have, the more complicated the decision will be as we try to evaluate the alternatives and compare them. While our consumer oriented society constantly tells us that choice is good, too much choice or the wrong choice alternatives may be worse than limited choices. The more uncertain the situation, the more difficult it will be to evaluate and compare choices.

Evaluating and comparing alternatives takes time. In many situations, the decision-maker may not have the time required to do a comprehensive analysis or may get so caught up in the

analysis that he or she loses sight of the time constraints and misses the window for an effective decision.

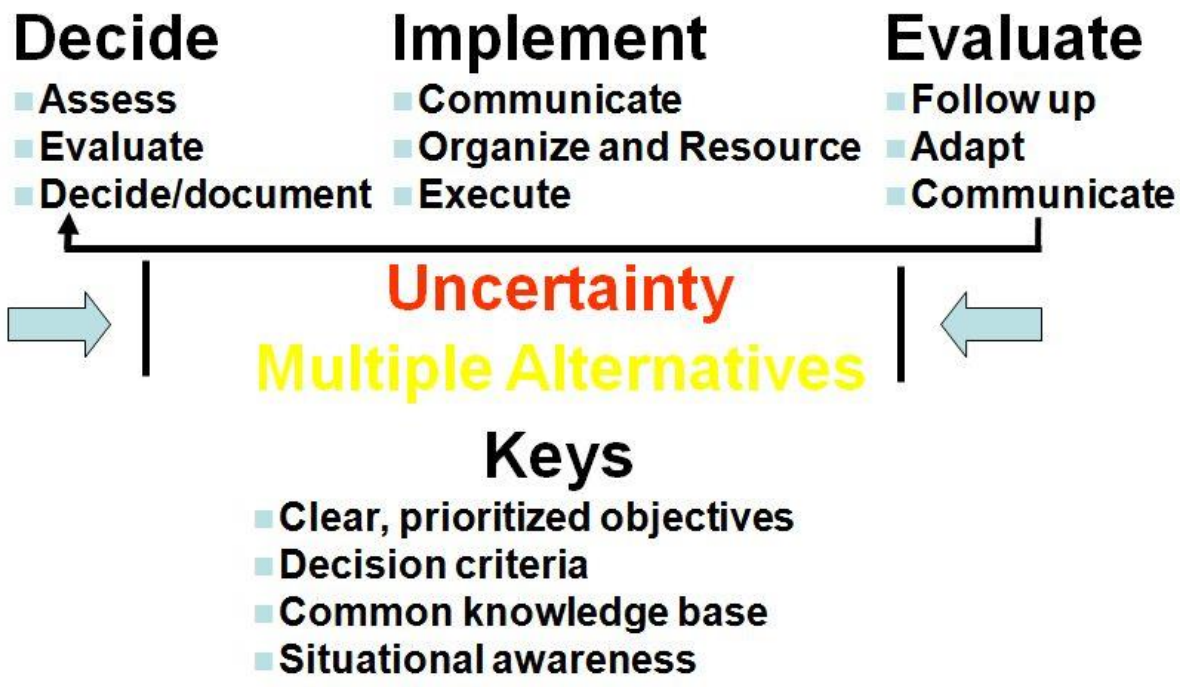
An effective decision is not necessarily the perfect decision. Rather, it is the best decision the decision-maker can make given constraints such as time and resources and information available. An effective decision is one made in a timely manner that solves the problem or achieves the purpose the decision-maker needs. A sub-optimal decision made in a timely manner may be more effective than a superb decision that is made too late.

Thus, to make an effective decision, the decision-maker needs to clearly understand the issues and to visualize success. He or she needs to work on solving the right problem and to know what a successful outcome will look like.

Making Decisions

Figure 3 shows a model for effective decision making and execution. There are three components.

Figure 3 Effective Decision Making and Execution



First, we must decide what to do. We need to gain and maintain situational awareness and couple it with a knowledge management system and decision support tools. These three components make up a robust decision support system to assist the decision maker to identify when a decision needs to be made and then to make a timely and effective decision. The decision maker must be able to quickly evaluate alternatives and then select the best one.

The Decision-maker

The decision-maker can be either a single person or a collaborative team. A single person can perhaps be more decisive and act more rapidly. A collaborative team decision-making body may take longer to reach a decision, but the consensus approach may make implementation easier. However, the collaborative approach, depending upon organizational dynamics could reduce a decision down the lowest common denominator and reduce effectiveness.

The effectiveness of the decision-maker structure depends both on the nature of the decision and on the nature of the organization. Key factors include organizational structure, organizational culture, cohesion and environmental variables. Organizations that are formed from an alliance of two or more organizations will almost certainly use a collaborative team decision-making body rather than a single decision-maker.

Execution

A decision is meaningless unless it is vigorously executed. The decision maker must mobilize the required resources to carry out the decision, implement any organizational changes—either temporary or permanent—and communicate the decision to the organization. These three functions are vital to the decision's successful implementation and execution. They are not sequential processes. All three must be done in conjunction and reinforce each other. Merely communicating a decision, without resourcing it and organizing for success will doom a decision to failure. A decision support system must include support for these functions.

Evaluation and Follow-up

Finally, the decision maker must evaluate the decision and follow up. He or she needs to ensure that the organizational changes and resources are adequate and supervise the implementation and execution. As conditions change, he or she needs to continually determine how best to continue with the implementation—or whether to abort it. Conditions will change. The decision maker needs to be flexible and adaptable, as does the decision support system. The system needs to alert the decision maker to changing conditions that could require a new decision.

Decision Support Systems

First, let me categorically state that decision support systems do not make decisions. Knowledge management systems do not create, or even really manage knowledge.

People make decisions. I suspect that most critical decisions are not made in a precise manner. Rather, they are made in a fairly messy manner that involves a lot of speculation and use of intuition. Most critical decisions arise from the Chaos quadrant and are difficult to predict and to forecast appropriate actions.

The goal of a decision support system is to help the decision maker detect the emerging patterns that will lead to these types of events and to ideally connect see ways to connect seemingly unconnected dots. It is science working to help facilitate art.

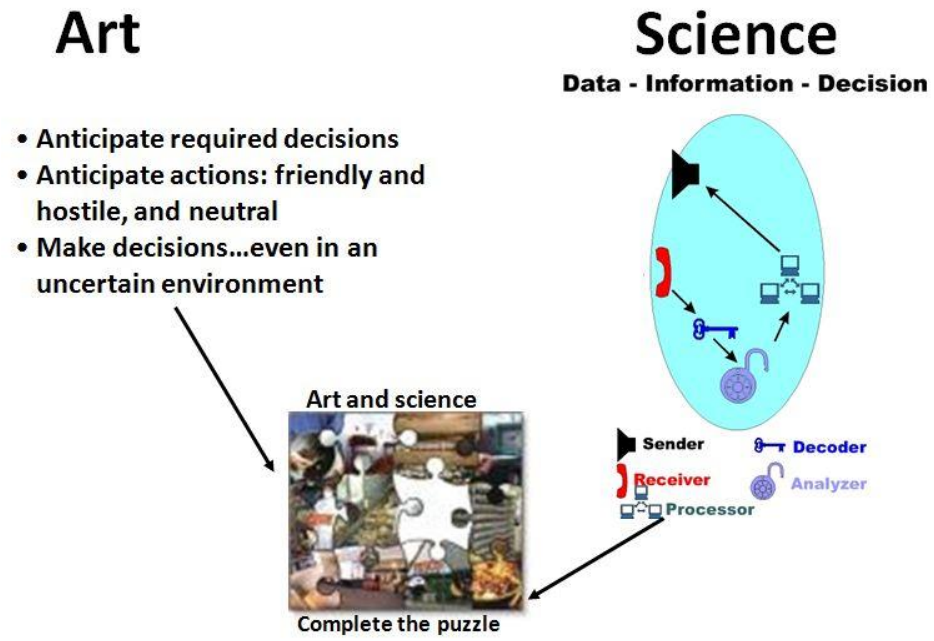


Figure 4 Decision Making - An Art and A Science

Knowledge Management

Likewise, knowledge is not something that can be boiled down to ones and zeros and stored in a system. Knowledge has two components—information and contextual application.

Information can be stored in a system. The system can gather data from multiple sources, asses it and correlate it into information. Information can be stored and retrieved. But that is not knowledge. What many systems call knowledge management is really information or content management. While this is a vital application, it is not knowledge management. Rather, it is a subset of a true knowledge management system.

The ability to look at a situation and apply information to it contextually is the second aspect of knowledge management. Knowledge transcends information by its contextual associations and the ability actually employ the information is some method to make decisions and to solve problems. Information does not solve problems. The contextual application of information solves problems.

Take a look at Figure 5. While this is a military example, it could just as easily be from many other applications. Data is a report of three armed men. The data by itself does not give any informational content. To add informational content, we need to provide some attributes. Where

are they, what are they doing, when did the report come in, what equipment do they have? With these attributes, the data becomes information that we can analyze. But we still cannot use the information yet as we do not have the broader context. As we start adding in the broader context, we can start to apply the knowledge and make effective decisions.

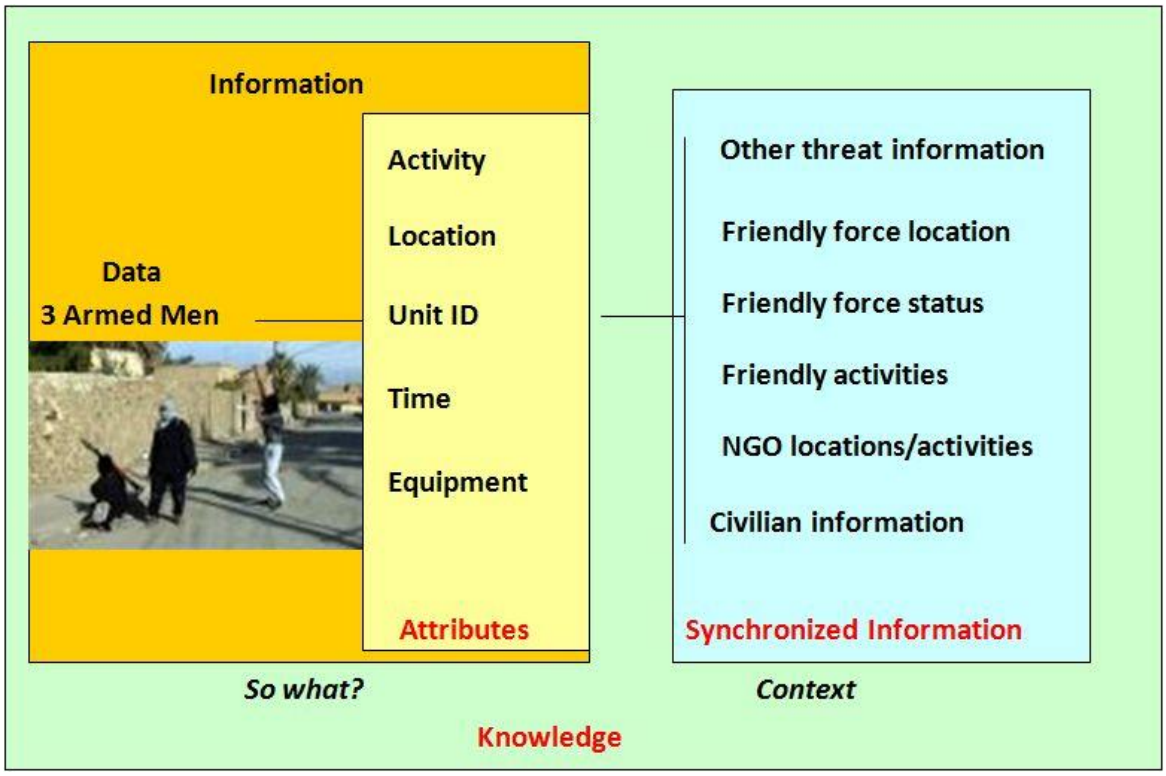


Figure 5 Data, Information and Knowledge

Thus, knowledge management systems need to not only store information, they also need to provide context for application. They need to provide situational awareness, situational based alerts and the ability to frame and ask questions, based on context.

Knowledge Management Architecture

To that end, knowledge management systems must go beyond content management and provide a far more robust architecture as shown in Figure 6.

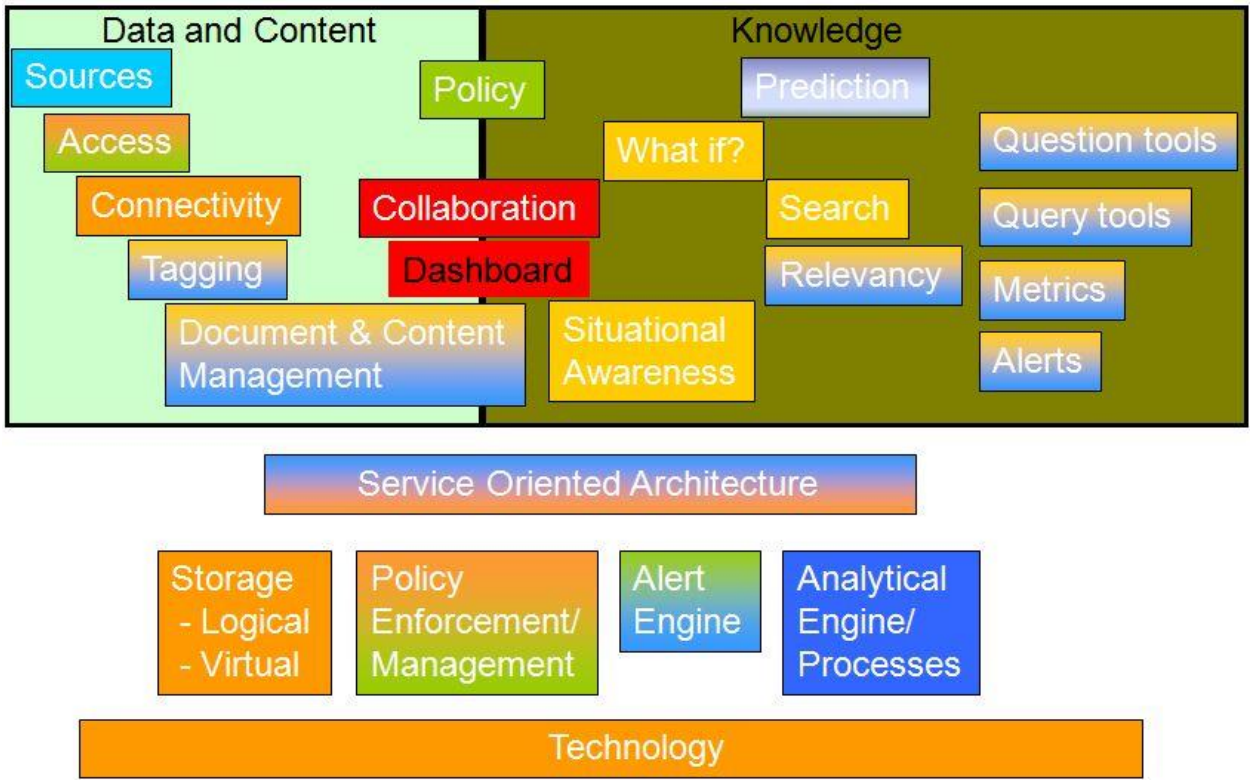


Figure 6 Knowledge Management Construct

This architecture must address not only what information do we store, but also key policy issues, situational awareness tools, query tools, collaboration tools and the alert users as appropriate.

Service Oriented Architecture (SOA)

The architecture should reside on some form of a SOA to tie system components together, facilitate data exchange, applets and policy management. SOA provides the capability to easily bring in content and applets from a variety of sources, many of which may be outside the physical system. SOA is the key to building virtual knowledge bases and extending capabilities.

Data and Content

Data and content will come from many different sources. Some sources may be internal to the system, while other sources may come from external systems. Key applications include databases, records management systems and content management systems and even Power Point files, Word files and email. Since data and content may come from many heterogeneous sources, SOA is critical to pulling all sources together into a virtual repository that can be seamlessly searched. Therefore standards and tagging are important to ensure a common way to pull in data/content and to search the virtual repository. Policy management is also important to ensure data/content access and control who can see and manage the data/content.

Knowledge

The knowledge part of the construct allows the user to intelligently search and query the data/content. In addition, it provides the capability for what if analysis and to construct alerts based upon workflow and rules.

Situational Awareness

The dashboard is the critical tool for situational awareness. Notice that is straddles the Data/Content section and the Knowledge section. It should be configurable to specific user requirements that reflect not only access privileges, but also the type of content and the display form. Content should be displayed a geo-spatial construct Where possible and appropriate.

> "We make facts by organizing appearances into reality-tunnels that suit our present needs, our problems-to-be-solved, our fears and fantasies, and our prejudices."
> Robert Anton Wilson

The dashboard, when connected to the other components of the Knowledge Management Construct manages and facilitates perception. Take a look at the quote from Wilson. Reality tunnels define what we perceive…and do not perceive. They color how we view data and manage our perceptions. If something is outside of our reality tunnel, we simply do not perceive it. Likewise, we can bend the data within our reality tunnel to meet our pre-conceived notions. We must ensure that our situational awareness is neither overly constrained by our notions of what is possible and what to expect nor biased to connect dots that simply do not connect. This is the art shown in Figure 4.

Collaboration

Collaboration tools are important to a knowledge system. Few, if any decisions are made in isolation by one person. While a single person may make the final decision, most important decisions will involve teams. Groups will analyze the situation and formulate recommendations and teams will execute the decision. Collaboration is required both before, during and post decision-making for effective decisions.

The collaborative environment must provide both synchronous and asynchronous collaboration tools. Synchronous tools allow for online video, voice and graphics collaboration. Asynchronous tools allow for blogs and similar asynchronous discussion boards. Ideally, the two means complement each other and provide a harmonious means to coordinate the decision-making process.

We'll return to collaboration later when we explore the social dimension of decision making.

Technology

The good news is that virtually all of the technology required is currently available in the market. There is little or no developmental work required to field a true knowledge management system.

The bad news is two-fold.

First, many of the systems that bill themselves as knowledge management systems are really only parts of a comprehensive knowledge management system. System architects will need to bring together the various components of a true knowledge management system and link them together into a cohesive architecture. That is another reason why a strong SOA is so important.

Second, organizations will need to set policies and manage policies on information sharing. This is the most complex part of the system for it most apply not only to native data, but also to fused information. As the knowledge management system brings information together in context, it could create situations where the individual components comply with established policy, but the fused components do not. Likewise, the policy management system must take into account the ability to share information in certain circumstances, but not in others. The knowledge management system must have a contextual basis for policy just as it has a contextual basis to create knowledge.

Decision Support

Decision-making involves the four key elements shown below in Figure 7, plus workflow as the glue that ties it together**Error! Reference source not found.**. The design supports the four decision types discussed above. Some decision requirements will be known in advance and others will emerge based upon unanticipated events. Likewise, some will be structured and some will be unstructured.

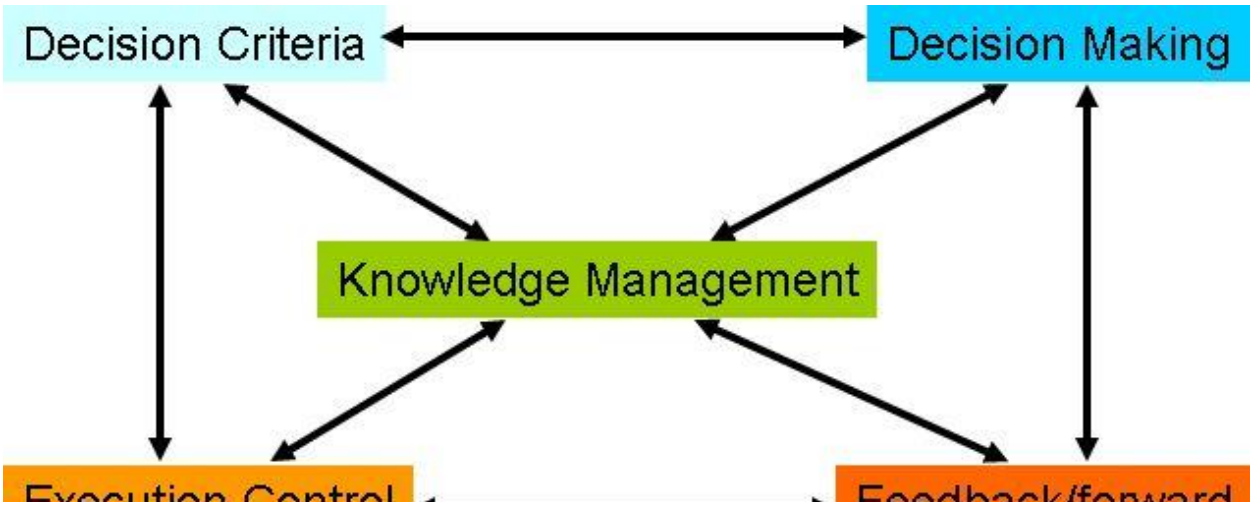


Figure 7 Decision Support System Components

First, the decision-maker needs to understand what decisions he or she will need to make and the conditions under which they will be made and triggered. Ideally, the decision support system will provide workflow engines to identify when these conditions are met and provide a link to the situational awareness displays within a dashboard to start working on making a decision.

Ideally, this component will also start connecting the dots to help the decision-maker to see emerging requirements that will trigger unanticipated decisions. Properly constructed elements

of the knowledge management system, especially the query and prediction components are vital to this capability.

Second, the decision-maker needs tools to assist in making a decision and to properly document it. These tools will provide alerts to new information, decision requirement alerts and analytical capabilities

The decision needs to take into account the actual current conditions and not simply the projected conditions when the decision was originally anticipated. The decision-maker needs to be able dip into the knowledge management system to ask questions and gain additional situational awareness to ensure that he or she is solving the right problem and understands the key situational dynamics, as well as the less then obvious underlying conditions. At this point, the knowledge management system will be critical to ensure that he or she can act on intuition and ask the right questions to fully develop the situation.

Once the decision is made, the decision-maker then needs to record the decision. This step is often taken for granted, which can cause potential problems down the road. The documentation needs to include not only what decision was made, but also why it was made and what effects it was designed to accomplish. Too often, months or years down the road, people wonder why a decision was made and are reluctant modify it or reverse it because they do not understand its context and dynamics.

Third, the system must have an execution component. Making a decision is only a third of the process. If we make decisions but do not have the means to execute them, then the decision is sterile.

The first step in execution is to ensure that the decision gets communicated to everyone that has a stake in it. This includes not only those that will execute the decision, but also those that will be affected by it (as appropriate—obviously a competitor will impacted by a decision, but we will not communicate the details to the competitor). The decision support system needs a robust workflow capability to ensure the decision is properly communicated—and that the message is received. The communications method needs to be appropriate to both the nature of the message and the recipient.

Next, the decision support system needs the capability to monitor the execution to ensure that the decision is properly implemented. This requires an execution plan that lays out the execution requirements and provides some control measures to ensure both performance and effectiveness. Again, workflow tools are essential to assist in managing execution.

Finally, the decision-maker must continually assess the execution to ensure the decision achieves its intended effects. As conditions continue to evolve and change, they will have an impact upon not only execution, but the decision itself. The decision-maker needs to understand when conditions change to an extent that will require either a new decision or a change in the execution plan.

As shown in Figure 7, the knowledge management system is the central component to the decision support system. It governs all four components of the decision support system. The technology and the SOA that underpins the knowledge management system is the same technology backbone that the four components of the decision support system will utilize. Likewise the dashboard and collaboration tools in the knowledge management system are equally critical in the decision support system. The products of the four decision support components likewise become content within the content management component of the knowledge management system. This content can then be leveraged for future decisions, after action reviews, litigation support and other requirements.

The Social Aspects

Decision making rarely exists in isolation. In most cases, many people contribute to the situational awareness, build up of information, and decision support. The collaboration piece of the Knowledge Management Construct (Figure 6) provides this social construct. Figure 8 expands this construct to include Social Networking and show how all of the pieces fit together.

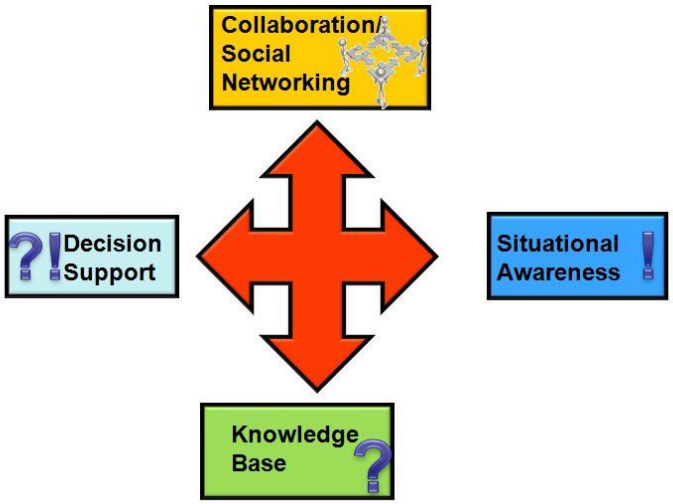


Figure 8 Putting it All Together

As social networking continues to evolve, the collaboration element of the construct will evolve as well and include many of the capabilities found in social networking sites such as My Space, You Tube, Twitter, and Facebook. A series of books, such as The Spider and the Starfish and Here Comes Everyone discuss how these applications will change how we communicate and operate. However, in some critical aspects, these applications are not all that new. For example, CompuServe was very much a social networking and community tool. The key difference between prior versions of social networking and the applications today are:

- The technology is more robust and easier to use
- More people are using the technology
- SOA and other architectures provides greater integration

Organizationally, the concepts discussed in these books really are not all that new either. Organizational theorists have discussed flattened organizations and the orchestra vs. the

hierarchy for many years. The military has a very distributed decision making capability embedded within its hierarchical style.

The game changer is not concept. Rather it is culture and technological integration. Social networking technology is now prevalent throughout the culture and is integrated though cell phones, PDAs, laptops and desktops. The technology is now as mobile and integrated as the people.

As social networking moves into an organization, it will change the decision making process. Decisions will become more collaborate and more decentralized.

The key to collaboration is to facilitate conversation and the sharing of ideas. It's both that simple and that complex.

It is simple because all we are doing is facilitating conversation and interaction.

It is complex because as social networking evolves, the dynamics will influence and change the decision making construct. The more collaborative the system becomes, the more open the decision making process becomes. This dynamic changes both situational awareness and the decision support systems. The interaction in the collaborative environment becomes part of the knowledge base, expanding situational awareness.

Social networking will transform the organization. Properly applied, it will provide better decisions. Improperly applied, it will freeze the decision making process. It is either lubrication or gum…

Squaring the Circle

So, it is paper or plastic? Our knowledge base can tell us how many green acres are left and the rate of deforestation. It can tell us oil production and reserve estimates. It can provide information on climate change and provide analysis that links climate change to both deforestation and carbon production. Our situational awareness portal can show this information in an easily digestible format. We can see the information in both a point in time view and a trend view. Decision support systems can provide projections on the rate of deforestation and the likely impacts as well as the estimates of when we will run out of oil. It can perhaps contain an algorithm that helps us balance the two competing dynamics and make a decision based on the relative changes in both sources. Social networking can give us video and others' opinions on the trade-offs.

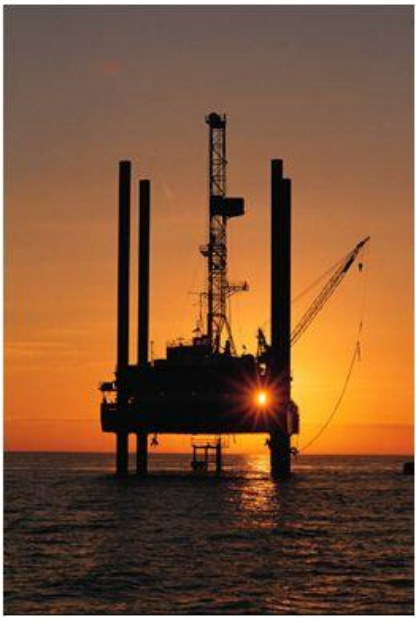


Figure 9 Paper or Plastic?

Or, I might provide a new alternative. I may present my cotton bag to the clerk and say neither, I'll use this bag. If we open our perceptive fields, we may have more choices than we realize and new alternatives may come along. Our situational awareness needs to continually expand to find new information.

In the end, it still comes down to a human decision. Never forget the human factor. Decision making is both an art and a science.