Managing Decision Risk — The ARMED Decision Process

By Barry Mallis

Barry Mallis consults as a business adviser in organizational development and is a frequent leader of CQM courses and workshops. He has conducted courses and workshops in Singapore, Mexico, Germany and across the U.S., and he is fluent in Spanish, French and Russian.

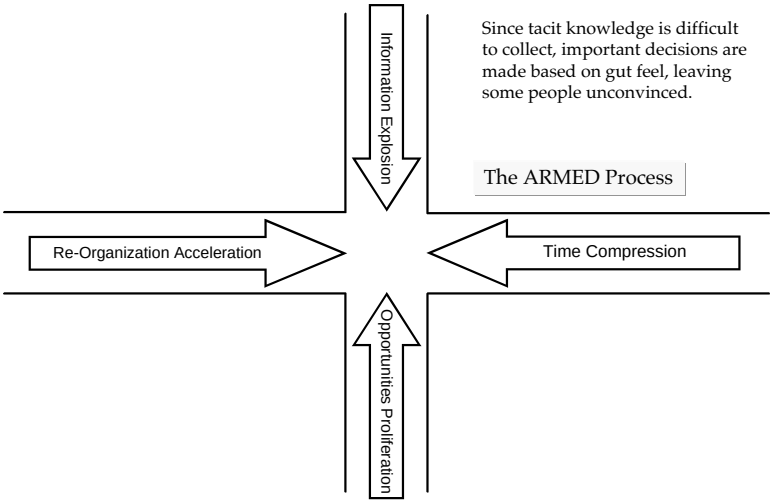
Barry's background includes fifteen years of classroom teaching and an equal time in sales and manufacturing. He first came in contact with CQM while with MARKEM Corporation, where he directed their TQM effort as Manager of Training and Development.

Barry is based in Keene, New Hampshire.

As described in the introductory paper by Gary Burchill in this issue, an increase in management complexity results from at least four sources: information explosion, time compression, proliferation of opportunities, and accelerating organizational change. These are shown as the four arrows in Figure 1. This paper focuses on making complex decisions, the skill required to address two of the axes bounding the top right quadrant of the figure:

- Time compression — the speed at which critical choices must be made in order to effectively solve and resolve internal and external opportunities and challenges.
- Information explosion — how does one separate significant signals from the noise?

Figure 1. Sources of Complexity



In 1999, the Center for Quality of Management (CQM) formed four study groups and conducted design activities to address the issue of managing business complexity. One of those activities, a study group of individuals associated with the CQM Cambridge chapter,[1] addressed the issue of decision-making complexity (and thus the pair of issues represented by the arrows describing the top right quadrant of Figure 1). This team spent about 18 months developing an approach to address the issues of decision-making complexity (the top right quadrant of the figure). The result of this work is called ARMED, standing for Accelerated Rational Method for Effective Decision-making.

In the acronym, *accelerated* refers to an increased rate of synthesis for identified information. *Rational* has to do with rationalizing the decision-making process so it relies not only on traditional emphasis on facts, but also makes explicit:

[1] Study group members, in alphabetical order, were Gary Burchill (CQM), Stephen Downes Martin (then a consultant and now employed by the U.S. Navy), Christine Duvivier (CQM), Ann Gray (Harvard Business School), Steve LaPierre (CQM), Barry Mallis (Markem), Tammi McVey (employed by the U.S. Navy), Marci Sindell (Haemonetics), Ash Rao (Babson College), Anita Tucker (Harvard Business School PhD candidate).

- Which facts are or are not to be considered?
- How can a decision-making team ensure it maximizes its consideration of the breadth and depth of information required?
- Understanding how team members know what they don't know.

Efficacy (*effective*) will be determined by generating activities which contribute to the desired outcome.

The ARMED process supports decisions to irrevocably commit resources at a point where they contribute to competitive advantage, because accelerating the decision point has come with increased understanding, as shown in Figure 2.

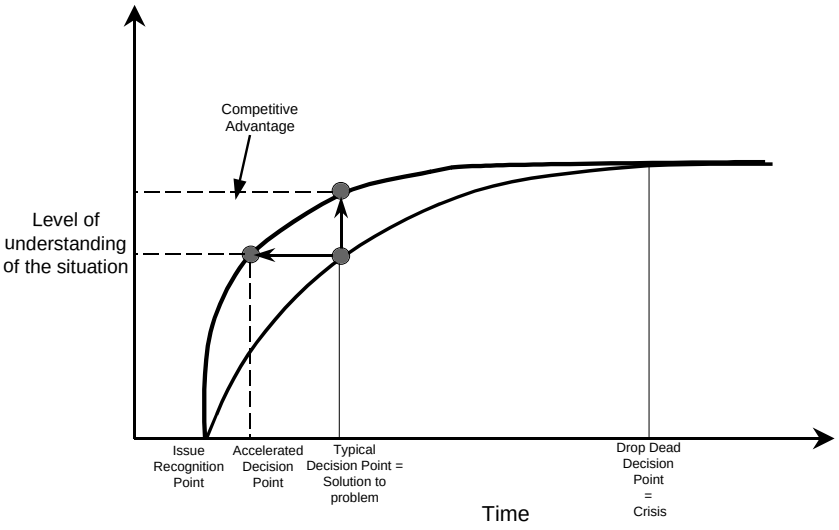


Figure 2. Benefit of Accelerated Decision Making

In training situations, the ARMED process in conveyed in one of two ways: as a two-day workshop using a Harvard Business School case study[2] to show application of the step-by-step ARMED method; or as a just-in-time application to a company's specific problem (the Sears example is still used to help describe the method). In the latter case, a company team leaves with a clear understanding about how to proceed with their specific problem or opportunity.

The ARMED decision-making process that resulted from the CQM study group has seven stages. Some of these stages have more than one substep and use specific tools, as shown in Table 1 (next page).

From the second stage on, as shown in Figure 3 (next page), the process alternates between stages that expand the team's knowledge and stages that focus or clarify what the team is learning, what it will recommend, and how recommended actions should be undertaken.

In what follows, we look at each of the ARMED process stages in turn, using the hypothetical application of ARMED to the Sears auto repair case to reinforce the concepts and methods of ARMED. The Sears example is based on a real-life situation in which the Sears auto repair business suffered from declining revenue and profit. The management of that business was challenged to solve the problem and turn the situation around.[3]

While reading the following detailed descriptions of the stages, refer back to Table 1 and Figure 1 as necessary to clarify where you are in the overall process and for an outline of the stage you are reading about.

[2] Lynn Sharp Paine and Michael A. Santoro, *The Sears Auto Centers Case* (Boston, Massachusetts: Harvard Business School Press, May 31, 1996), product number 394009.

[3] Regarding the CQM courses using the Sears case study and in this paper: Sears did not use the ARMED process. For pedagogical purposes, CQM applied the ARMED process to what we read about in the Sears case study. Thus, all of the examples in this paper where we show ARMED analysis of Sears data, the analysis is hypothetical.

Table 1: ARMED Stages, Sub-steps, and Tools

I. Decision statement and scope
   1. Formulate an initial statement of the decision to be made
   2. Create a decision scope tree diagram
   3. Assess decision complexity (decision complexity assessment matrix)

II. Build a broad perspective (identify relevant lenses)

III. Create an in depth perception
   1. Analyze root causes (5 Whys diagram)
   2. Assess impact (impact assessment bar chart)

IV. Understand the interactions
   1. Root cause factor naming
   2. Create causal loop diagrams
   3. Use causal loop diagram to increase understanding of each lens
   4. Combining causal loop diagrams for lens with more than one diagram
   5. Create integrated causal loop diagrams
   6. Use causal integrated diagrams to understand system dynamics

V. Make the decision
   1. Create a (Pugh) decision selection matrix
   2. Compare alternatives
   3. Select best alternative
   4. Iteratively redo decision selection matrix with new datum(s), improving the alternatives through iteration
   5. Evaluate risks (causal loop diagrams; risk factor characterization grid)

VI. Plan the implementation
   1. Select appropriate project planning tool (four gears method and goal deployment, 7 infrastructures and goal deployment, four gears method and 9 steps, or 7 infrastructures and 9 steps)
   2. Plan the implementation

VII. Reflect (improve use of the ARMED process)

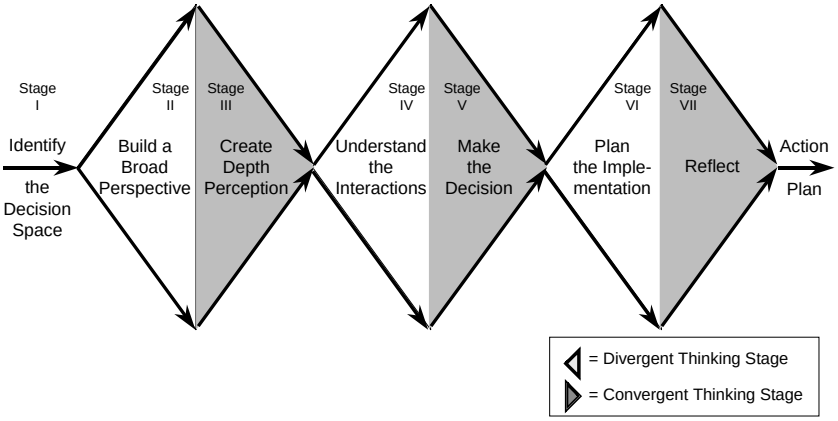


Figure 3. Stages of the ARMED Decision Making Process

Stage 1 — Decision statement and scope

The hardest part of solving a problem is figuring out what problem to solve. Stage I requires utmost care and consideration. Thus, prior to embarking on stage I, the company forms a team of individuals who are likely to have important perspectives on the problem at hand. At the outset, everyone involved in this process comes in with one or more solutions in pocket. All ideas are legitimate in this awareness phase, where participants consider if the decision space has enough breadth. Concept awareness, trust and psychological acceptance each play a key role.

Using a decision scope tree diagram, participants determine the decision-making direction. By considering time pressure and level of complexity factors, they determine whether to use the full ARMED approach or a subset of tools within ARMED.

In the example, we formulated the initial statement of the decision into one-sentence: "Decide on what actions should be taken in order to rapidly increase automotive sales profitability." With this statement in hand, one can then scope out tentative solutions for consideration, creating a decision scope tree diagram such as is shown in Figure 4.

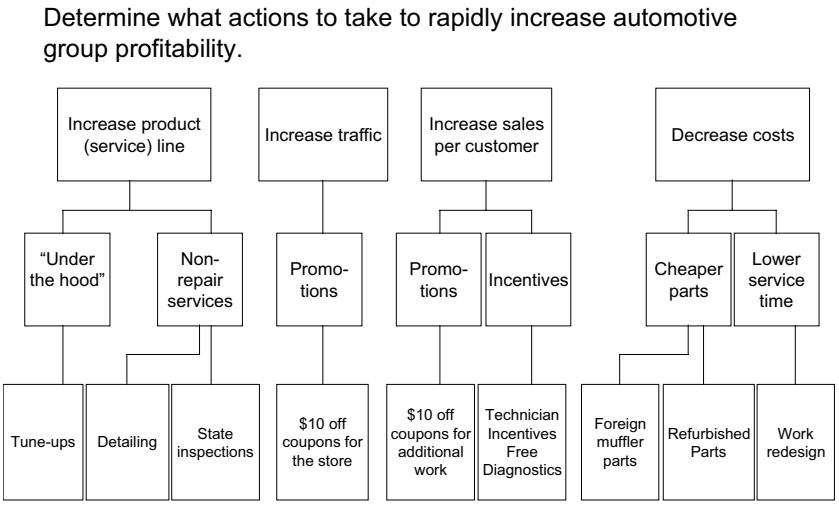


Figure 4. Decision Scope Tree Diagram Example

From this, one can see that competitor response, effects on future business, and career jeopardy — combined with negative impact of slow decision-making (tight time constraint) — could doom the automotive service business entirely. When the Sears dilemma was analyzed using a decision complexity assessment matrix, the clear result was a go-ahead for deploying the full ARMED process.

Stage II — Build a broad perspective

This stage develops frames of reference for better understanding the problem space. These frames are:

- business environment
- strategies and goals
- internal capacity (capabilities and competencies)
- stakeholders
- finance
- organizational bias

Just as eyeglass frames can hold myriad lenses, so, too, can our ARMED frames. The CQM study group identified thirty lenses and provided space on the lens selection grid for additional lenses a team may deem appropriate in their business context. An example of five lenses for one frame is shown in Figure 5.[4]

[4] The concept of the frame and lens comes from Steve Kerry of GE Crotonville, who presented the concept at a CQM seminar in the spring of 1999.

Frame	Lens	In the context of this decision, consider the impact of:
Business Environment	Competition Supply Chain Marketplace Technology Regulation	● The response from existing and potential competitors ● Participants upstream and downstream from you in the value delivery chain ● Changes in the marketplace from your customer's perspective ● Your ability to use existing or future technology in this problem space ● Any constraints, risks, costs, or opportunities posed by the regulatory environment

Figure 5. Business Environment Lens Example

Frame	Lenses		High Potential Impact	Explanation
Business Environment	Competition	1	✓	Unexpected sources of new competition
	Supply chain	2		
	Marketplace	3		
	Technology	4		
	Regulation	5		
		6		
Strategies and Goals	Execution time horizon	7	✓	Need to have fast impact on the bottom line
	Consistency with core values	8		
	Consistency with long term objectives	9		
		10		
Internal Capacity Capabilities = sum of processes	Development capabilities	11	✓	Consider developing under the hood capabilities
	Production/service capabilities	12	✓	Complexity of repair tasks
	Sales/marketing capabilities	13	✓	Need for using promotional blitzkrieg
	Distribution capabilities	14		
		15		
Competencies = sum of skills	Functional task skills	16	✓	Under the hood skills do not exist now
	Process management skills	17		
	Project management skills	18		
	Change management skills	19		
	Relationship management skills	20		
		21		
Stakeholders	Employees	22	✓	New skills will require new employees
	Customers	23	✓	Maintaining brand image with customers
	Suppliers	24		
	Shareholders	25	✓	
	Community	26		
	Partners	27		
		28		
Finance	Capital requirements	29		
	Time to positive cash flow	30	✓	Need for improved profitability
	ROI	31	✓	Need for improved profitability
		32		
Organizational Bias	History of similar decisions	33		
	Risk tolerance	34		
	Damage control desires	35	✓	Turnaround situation
	Business model assumptions	36	✓	"Cross-selling" of auto and retail store
		37		
		38		
		39		

Figure 6. Lens Selection Grid Example

The team generates a broad perspective for consideration from which to attack the issue at hand by using the lens selection grid and agreeing on which frames and which of their lenses have a high impact on the decision to be made. As part of this, the decision team reviews its membership: are all significant lenses represented by a member with expertise in that area. If not, who should be added to the team?

Sears used the lens selection grid as shown in Figure 6 (previous page) to identify high potential impact lenses and to communicate succinctly and graphically their relationship to the critical decision under investigation. Notice, for example, how lens #23, Customers (in the Stakeholders frame) illustrates Sears' underscoring the importance of the company's renowned image.

Stage III — Create an in depth perspective

With diversity of views accounted for, and perhaps new team members added as a result of the consideration of frames and lenses in Stage II, the decision team must dive deep into the issue in order to clarify perceptions. The root cause of the factors of concern related to the decision is made explicit for use in further analysis in Stage III.

1. Why is (Lens)_____Customers_____ a concern?

	Why	Key Idea	Factor Name
2.	Sears brand recognition for value		
3.	Expect high quality/low cost effective repairs		
4.	No rip-offs		
5.	Collateral damage to Sears brand		
6.			
7.			

What is the "STORY" behind the concern?

Customers' perceptions of Sears' brand equity cannot be damaged.

How significant is the concern?

not much 1 2 somewhat 3 4 serious 5 X

Figure 7. Root Cause Factor Analysis Example

Using root cause factor analysis tables[5] (see the example in Figure 7), the team selects high-potential-impact lenses and asks, "Why?" five times in order to complete the table. Then, the team writes the one sentence "story" that best describes the concern relevant to the selected lens. Finally, as a result of the insight gained from this analysis, the team rates the significance of the concern.

Figure 7 shows a completed root cause factor analysis table for customers. In this case, brainstorming five levels of *Why?* led to the conclusion that the customers' perception of Sears brand equity must not be damaged — a serious concern.

Because a root cause factor analysis table is developed for each lens, the meeting room walls will be covered with the root cause factor pages generated by the team.

[5] The approach of asking *Why* five times to find the root cause of a problem came to CQM in 1990 via Shoji Shiba. Gary Burchill of CQM developed the factor analysis table format.

Stage IV — Understand the interactions.

Although by this stage in the ARMED process, the team has some breadth and some depth of understanding, the inter-lens connections typically will not be clear. Thus, perhaps the most striking tool in the ARMED process, the causal loop diagram, comes into play.

Systems thinking provides us with the causal loop diagram to understand the complexity created by the interaction among the identified factors of concern. Causal loop diagrams also provide a view of the impact of feedback on decision results and helps identify unintended, unfavorable consequences.[6]

At its simplest, a causal loop diagram graphically displays dynamic cause-and-effect action in a network of loops. Imagine, for instance, two facts relating to your bank savings account. Label one factor "savings account bank balance." Label the other factor "interest on savings." Create a causal loop involving these two factors by connecting the factors together with an arrow going each way. You read this loop as follows: the greater the savings account balance, the greater the amount of interest that accrues on the savings; the greater the accrued interest, the greater the savings account balance; and so on. Each factor reinforces the other.

Sometimes such reinforcing situations result in an upward spiral, ever increasing your nest egg. However, as we know all too well, it also can frequently result in a downward spiral — the less you have in your savings, the less interest, the less you accrue, and so on (assuming no intervention).[7]

Let's look at how causal loop diagrams are created and used in the ARMED method and in particular in the Sears example.

1. Why is (Lens)_____Customers_____ a concern?

	Why	Key Idea	Factor Name	
2.	Sears brand recognition for value	Brand equals value	Brand equity value recognition	23A
3.	Expect high quality/low cost effective repairs	Customer expectations	Integrity of Work Performed	23B
4.	No rip-offs	Customers not getting value	Risk of Unnecessary Work	23C
5.	Collateral damage to Sears brand	Damage to brand name	Collateral damage	23D
6.				
7.				

What is the "STORY" behind the concern?

Customers' perceptions of Sears' brand equity cannot be damaged.

How significant is the concern?

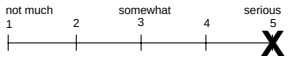


Figure 8. Root Cause Factor Naming Example

On the root cause factor analysis sheets, the team follows a set of guidelines for developing, writing and numerically labeling factor names for each "Why?" on each sheet. These factors form the heart of the individual loops and of a large integrated loop. In the Sears example, Figure 8, note how the factor names for the "customers" lens are noun phrases. It is sometimes useful, when creating these factor names, to insert the phrase "the level of" in front of the prospective factor name. If the resulting statement makes sense when you read it, you probably have a good factor name; if not, you probably need to change the factor name until you find a statement that makes sense.

[6] The literature on systems thinking, including causal loops, is massive. A good introductory reference may be found in the section on Systems Thinking, chapters 13-24, pages 87-190, of Peter Senge et al., *The Fifth Discipline Fieldbook* (New York, New York: Currency imprint of Doubleday, 1994). For an example of causal loops applied in the context of the CQM curriculum, see Gary Burchill, "Structural Process Improvement at the Naval Inventory Control Point," *Center for Quality of Management Journal*, Vol. 5, No. 1 (Spring 1996, Special Issue on Design and Planning in Organizations) 22–31.

[7] Such upward and downward spirals are often referred to as a virtuous cycle and a vicious cycle.

LENS: CUSTOMER (#23)
STORY: CUSTOMERS' PERCEPTION OF SEARS' BRAND EQUITY CANNOT BE DAMAGED.

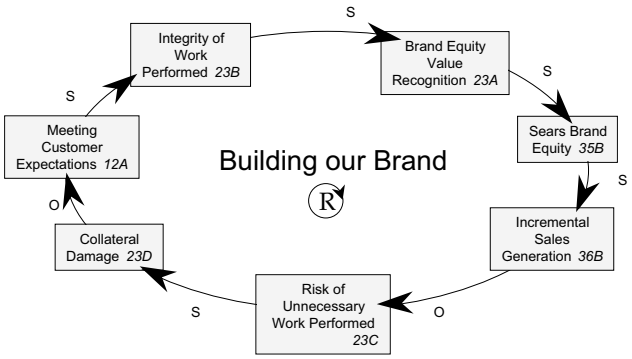


Figure 9. Customer Lens Causal Loop Diagram Example

With all the root cause factor analysis sheets displayed before the team, the ensuing construction of a causal loop diagram may incorporate not only factors from one analysis sheet, but factors from others, including some which may be created on the spot to close a gap in internal or external consistency and logic. See, for example, Figure 9. Factors 23A, 23B, 23C, and 23D (Figure 8) appear in the causal loop shown in Figure 9. However, factors 12A, 35B, and 36B in Figure 9 come from other root cause factor analysis sheets.

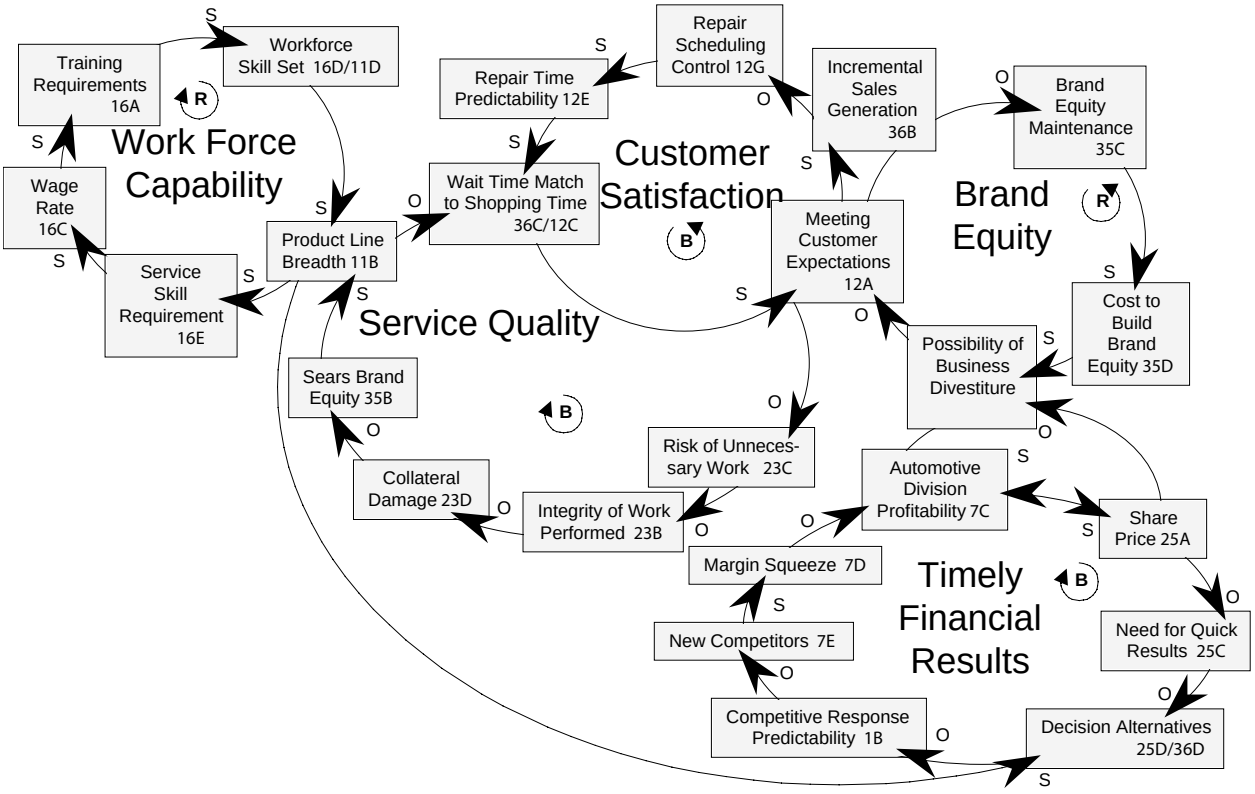
Figure 9 also shows the causal loop diagram convention of labeling causal arrows S when one factor causes the next factor to go up (or vice versa) — the factors move in the Same direction. A causal arrow labeled O means that when one factor goes up, the next factor goes down (or vice versa) — the factors move in Opposite directions. Another causal loop diagram convention is to label the entire loop as reinforcing (upward or downward spiral, indicated by an R in a circle-arrow), or balancing (in equilibrium, indicated by a B in a circle-arrow). Finally, loops are typically given labels that try to succinctly describe the essence of what the loop represents, i.e., "Building our Brand."

As the team develops causal loops for each of the high-rated lenses, it will begin to notice that one or more factors are shared among the causal loops. These are integration points for the causal loops. For instance, factor 36B occurs in the causal loop of Figure 9, and it also occurs in another causal loop. Thus, bits and pieces of the two causal loops can be merged together with factor 36B as an intersection point. See Figure 10 for an example of a complete integrated causal loop diagram.

With this integrated causal loop diagram, the team can study the dynamics of the entire system. Arrayed in Figure 10 are both reinforcing loops (Work Force Capability and Brand Equity) and balancing loops (Service Quality, Customer Satisfaction, and Time Financial Results). The presence of an O (opposite) causal arrow in a loop enables the loop to be a balancing loop rather than a reinforcing loop. For example, at the top center in the Customer Satisfaction Loop, we observe that the more of the factor titled "incremental sales generation," the less of the next factor, "repair schedule control," indicated by the O on the causal arrow. Following this same loop in the direction of the causal arrows from "repair schedule control," we repeat as follows: the less of the factor "repair schedule control," the less "repair time predictability" (remember, the letter S next to the causal arrow indicates the same quantitative effect (less=less).

An overall analysis of the causal loop diagram of Figure 10, shows several balancing loops whose outcomes oscillate. For example, the Service Quality loop goes up and down with over- or under-capacity

Figure 10. Analyzing Integrated Causal LoopDiagrams Example



utilization. There are two reinforcing loops, though: Brand Name and Workforce Capability. These can be viewed as potential engines for growth, where building them builds positive financial results.

Stage V — Make the decision

Stage V combines the decision statement from Stage I with solution concepts through use of a Pugh concept selection matrix.[8] Developed in the early 1980s, this concept selection process compares alternatives against selection criteria (which in the ARMED process are carried forward from the causal loop labels of Stage IV). The Pugh matrix is a tool that works by comparing choices and depends on the expertise and creativity of the decision-making team who use the tool iteratively to achieve an optimum choice.

An example Pugh matrix is shown in Figure 11. The elements of each alternative are compared against the elements of one alternative selected as the datum (or benchmark). The elements of each non-datum alternative are rated better than (+), worse than, (-) or same as (**S**) the parallel element of the datum. Based upon the results from the first Pugh matrix, the alternatives can be run again against another selected datum, paying particular attention to the strengths (and weaknesses) of an apparently strong alternative so as to generate a hybrid solution incorporating as many of the best characteristics as possible from the full range of alternatives.

When a solution has been picked based upon iterations of the Pugh matrix process, the team evaluates the solution based upon a scan of the integrated causal loop diagram to reveal potential undesirable conse-

[8] Stuart Pugh, *Total Design* (Reading, Massachusetts: Addison-Wesley, 1990). Pugh's selection matrix has been used extensively by CQM companies as part of Concept Engineering, as described in *The Concept Engineering Manual* (Cambridge, Massachusetts: Center for Quality of Management, 1991, revised 1997), and in numerous case studies reported in the *Center for Quality of Management Journal*.

Figure 11. Compare Alternatives Example

Decision Alternatives

Decision Criteria		Raise prices on existing services	Close losing operations	Reduce cost through process improvement	Increase sales by putting mechanics on incentive	Open additional facilities	Expand services offering to include under the hood	Lower prices in exchange for higher volume
Maintain customer satisfaction		DATUM	S	+	–	+	+	+
Build brand equity			+	+	+	+	+	+
Achieve speedy financial results			+	–	+	–	–	–
Control service quality			S	S	S	–	–	S
Expand workforce capability			S	S	+	S	+	S
As compared to Datum →	+ Better	+	2	2	3	2	3	2
	– Worse	–	–	1	1	2	2	1
	S Same	S	3	2	1	1	–	2

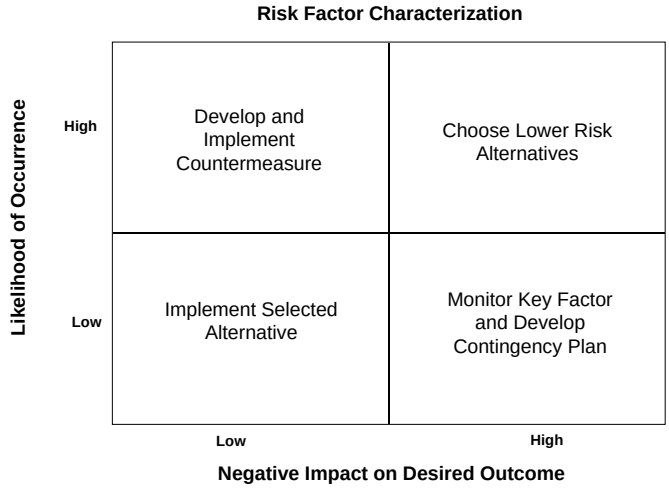


Figure 12. Risk Factor Characterization Grid insert

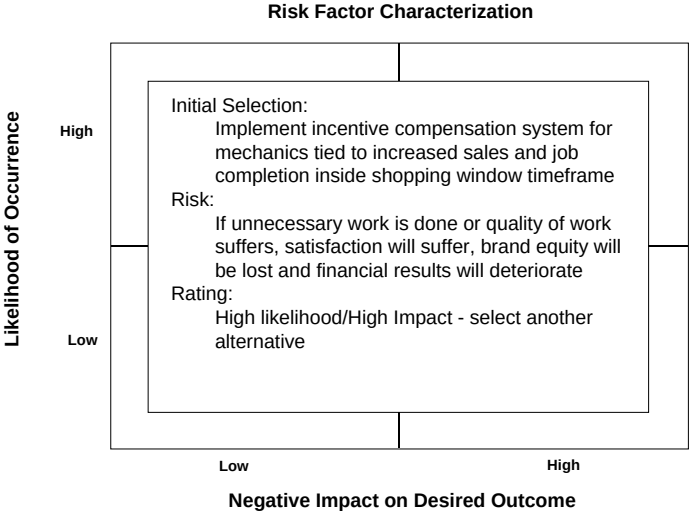


Figure 13. Evaluate Risks Example

quences. Using the integrated causal loop diagram, the team identifies the causal loop factors most directly affected as a result of the Pugh-selected alternative. Within the diagram, the team then traces how the predicted intervention at the level of this factor propagates through the loop and interacts with the other parts of the system (the other loops in the integrated diagram), identifying and recording possible, unfavorable dynamics (that is, risks).

Once key causal loop factors are identified along with the associated risks, the risk factors are placed in a risk factor characterization grid (see Figure 12).

If countermeasures are necessary, the causal loop diagram helps locate intervention points to counteract the unfavorable dynamic. Note in the example of Figure 13 how the initial selection from the Pugh process received a "high likelihood/high impact" rating, suggesting to the team that a different alternative should be considered.

In the example we have been following, ARMED has provided the decision-making team with extensive insight into the problem and done so in a very short period of time. Feedback from teams using the ARMED process indicated that the entire process to this point typically can be completed in one work day.

Stage VI — Plan the implementation

This stage of the ARMED process involves developing and deploying a good implementation plan. How the plan develops will depend on the time constraint as well as the scope of implementation — whether individuals involved will come from within or outside the span of control of the team. For these considerations, well-established planning and deployment tools are available (for example, 4W1H1C Table, 7 Infrastructures, 9-Step Planning.[9]

Stage VII — Reflect

No process is complete without a final stage of reflection. The accelerating speed of change, competition, and information requires accelerating the rate of improvement in how we make decisions. Better decisions require assessing the decision process. At the point a decision is reached using ARMED, the process includes time for reflection using a plus/delta format for consideration of the ARMED method's strengths, weaknesses and changes required in its next deployment so as to ensure its best fit in the organization.

The three interviews at the end of this special issue include some descriptions of people's experiences using the ARMED process.

[9] See, respectively: *The 7-Step Problem Solving Method* (Cambridge, Massachusetts: Center for Quality of Management, 1996, revised 1997), p.45; *Mobilizing Change Using the 7 Infrastructures* (Cambridge, Massachusetts: Center for Quality of Management, 2001); and *9-Step Project Planning System* (Cambridge, Massachusetts: Center for Quality of Management, 1997).