

Decision & Risk Analysis



TM

The ChemQuest Group, Inc. _____

8150 Corporate Park Drive, Suite 250 • Cincinnati, OH 45242 • Phone (513) 469-7555 • FAX (513) 469-7779

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The destiny of humans as an intelligent species lies in the gift bestowed upon them to have the freedom to deliberate, make decisions and to choose between alternatives. Survival is conditional on overcoming challenges brought on as a result of change.

Surviving today's business challenges is no different. Rapid changes in the present business environment require like actions on the part of modern day executives. Yet, such decisions are more complicated with more far-reaching implications than ever before. Success is predicted on the ability of an organization to adapt, invent new tools and to change tracks.

The challenge of creating and maintaining a successful business is rooted in consistently making the right decisions. When good decisions are made, businesses grow and careers soar. Obviously, the opposite is also true! When bad decisions are made, businesses stagnate or fail and careers are stalled or broken. As the decision has a greater impact on the organization, the implications of the decision tend to be more extreme.

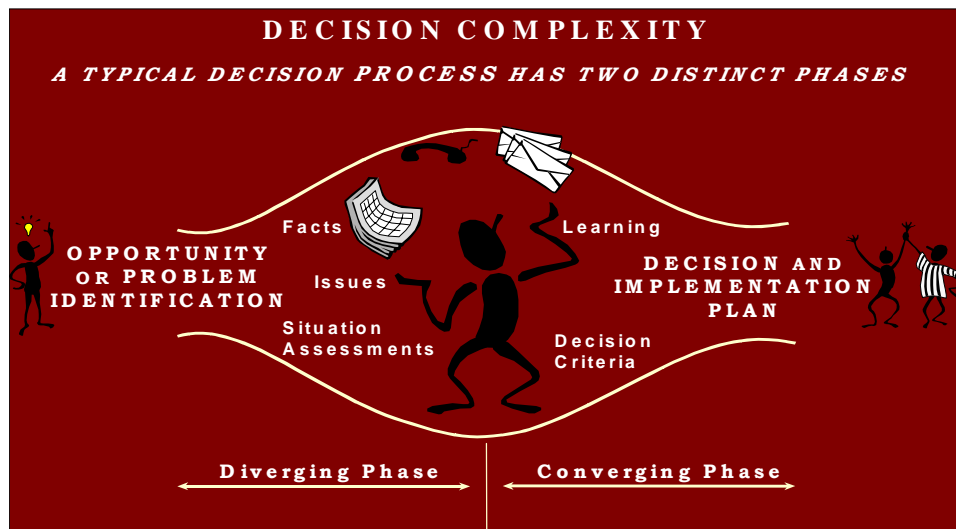
Today's executive faces a steady challenge to continually reinvent the corporation, in an endeavor to create more value and provide higher returns on stockholder investments. Corporate executives reach their positions partially because of their history of making good decisions. However, even the best decision-makers would

“Even if you think you’re on the right track, if you stay there long enough, you’ll eventually be run over by a train” Will Rogers

of decision making, especially in those decisions that will have a profound effect on the future of the business. Fortunately, this assistance exists in the “Decision & Risk Analysis” (D&RA) methodology described in this brochure.

In most cases, a decision must be made among several options, each of which has attractive features. Unfortunately, the number of variables that can influence the success of one option versus another can be staggering and too difficult for the human mind to comprehend without a method.

This methodology was originally designed for use in military strategies to assess changing conditions, battlefield strategies and the risks associated with the various options encountered. Over the past fifteen years, it has been modified and enhanced by DuPont and others for use in corporate decision making. In fact, D&RA is a DuPont “Best Practice” where many businesses utilize the model with great effectiveness on decisions of all types, and particularly on those capital decisions that require expenditures exceeding \$5 million dollars. The ChemQuest Group, Inc. recently obtained this methodology for use within the industries it serves.



Decision and Risk Analysis...an effective tool for new business paradigms

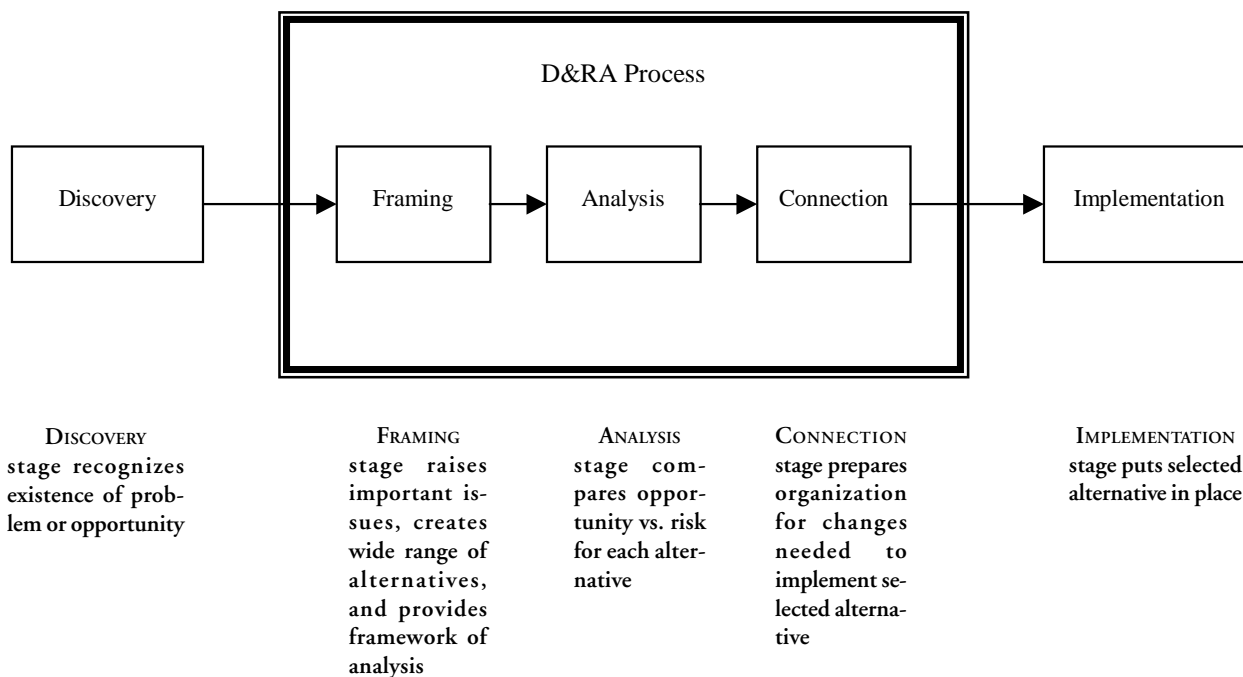
Decision and Risk Analysis (D&RA) is a rigorous process for creating and selecting business strategies. It is oriented to bottom line results, where all uncertainties are weighed against appropriate probabilities and converted into their impact on the decision criteria, i.e., earnings, cash flows, etc.

D&RA utilizes powerful algorithms and graphical

The establishment of a Project Team and a Decision Board initiates the D&RA process. The Decision Board oversees the process. It consists of policy and decision-makers responsible for allocation of resources and/or implementation of final recommendation.

The Project Team comprises multi-functional members who possess knowledge central to the critical issues regarding the decision. The Project Team reports to the Decision Board and receives direction and approval at critical stages. The Project Team has the authority

**Figure 1
STRATEGIC DECISION MAKING PROCESS**



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representations of proven analytical tools such as influence diagrams, decision trees and sensitivity charts to provide vigorous, comprehensive and insightful results.

The Strategic Decision-Making Process is depicted in Figure 1. D&RA encompasses the three stages between discovery and implementation.

- I. Framing
- II. Analysis
- III. Connection

to seek knowledgeable “experts” both inside and outside the organization to provide informed assessments of the uncertainties.

I. Framing the business situation is the most important stage in the process since it rigorously defines the problem that must be resolved, and forces consideration of all the issues that must be considered before making a decision. It comprises five steps as illustrated in Figure 2.

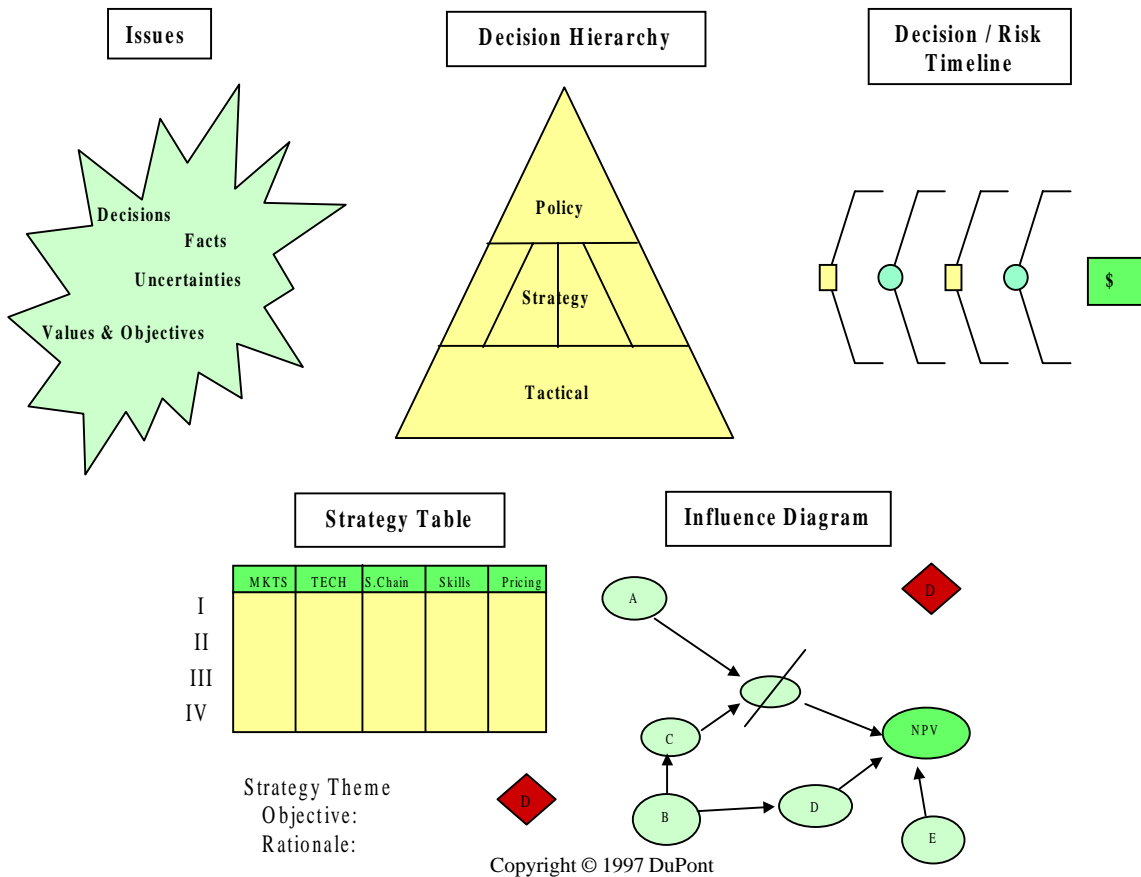
The problem is always broader than the analysis. Framing captures the essential problem structure and defines the analysis. Without proper framing, the quality of the decision is in question because organizations often jump into analysis utilizing assumptions, rather than assessing uncertainties, which often leads to making wrong decisions.

The framing stage raises important issues, creates a wide range of alternatives and provides the framework for analysis. The identification of issues prompts the business to consider all the issues (uncertainties, facts, objectives, etc.) impacting its decision. Such issues are

The two most important elements in the Framing process are depicted in the strategy table and the influence diagram. The strategy table is used to create imaginative alternatives. Alternatives are the raw material of decision making. Many people assume they already know the options open to them. As such, they make decisions from an overly narrow set of alternatives. The strategy table facilitates organizations to develop alternatives free of constraints. It challenges the organization to develop “out of the box” thinking.

An influence diagram depicts relationships among all the variables and decisions that will ultimately impact

Figure 2
FRAMING THE BUSINESS SITUATION



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then segregated according to their importance and dependence on outcomes, either strategic or tactical. The decision hierarchy is then established by encompassing the overarching policy values placed by the Decision Board.

Next, a timeline for the decision is established along with milestones and the agreed upon decision criteria (measurable criteria) for success.

the decision criteria. The influence diagram, in effect, structures the uncertainty. It depicts how uncertainties relate to one another and depicts those that are dependent variables vs. the independent variables. Howard Raiffa, author of Decision Analysis wrote, “The spirit of decision analysis is divide and conquer: Decompose a complex problem into simpler problems, get one’s thinking straight in these simpler problems, paste these analyses together with a logical glue, and come out with

a program of action for the complex problem”.

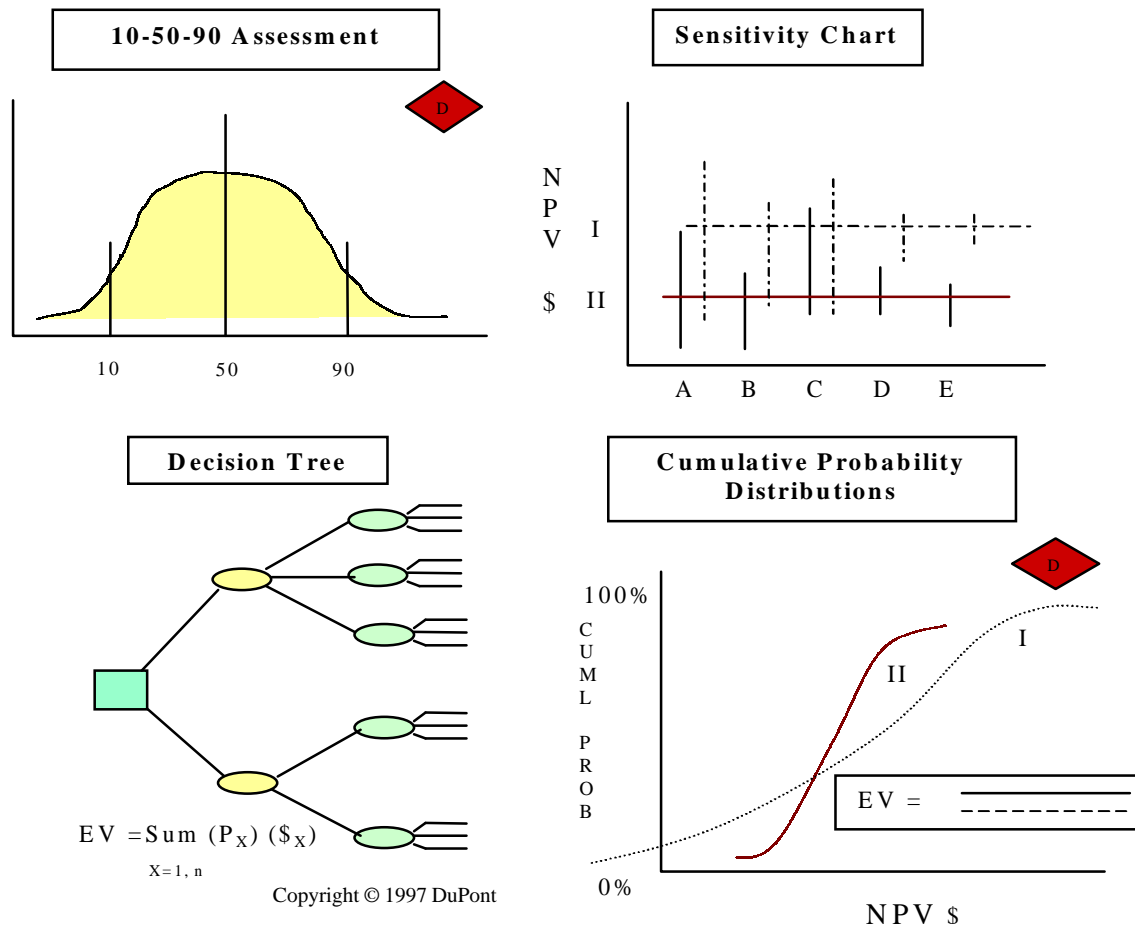
II. Analysis is the process of comparing strategies developed in the framing stage. It assesses and compares risk and return for each strategy and searches for improvement. The analysis stage is composed of four steps, as illustrated in Figure 3.

The Analysis Stage begins by assessing uncertainty. This process provides perhaps the greatest difference between conventional methods and D&RA. Conventional methods suppress uncertainty by making assumptions. The decision-makers and their respective

of uncertainty improves communication, reduces the frequency and severity of surprises and encourages contingency planning.

D&RA quantifies risks and uncertainties utilizing another tool called the “10-50-90” assessment. It requires experts to assess the range of outcomes for uncertain events. At a 10% probability, the expert’s estimate reflects a one in ten chance that the outcome of the uncertainty will lag his/her assessment. While at 90% probability, the expert’s estimate reflects a one in ten chance that the outcome of the uncertainty will exceed his/her assessment.

**Figure 3
THE ANALYSIS**



organizations often institutionalize assumptions because they embody the desired or selected business case and, hence, become facts.

But suppressing uncertainty is dangerous because it leads to unpleasant surprises, which the organization is unprepared to deal with. Whereas, explicit treatment

The final three steps perform sensitivity analysis, generate a range of expected outcomes and plot the effect of the full range of probabilities on the decision criteria. By conducting sensitivity analysis, the organization gains insight into sources of risk and value. The sensitivity analysis shows precisely how decisions change as outcomes and probabilities vary.

The sensitivity analysis focuses the entire organization on those variables that have the greatest influence on the bottom line. It directs effort toward resolution of a small number of critical uncertainties responsible for a large percentage of total risk. If the analysis reveals that uncertainty is not critical, then the initial assessment is considered adequate. On the other hand, if the sensitivity analysis reveals uncertainty is critical, then a more rigorous assessment will follow.

Another key decision making tool is the decision tree. The decision tree shows the expected value of each alternative commensurate with its probability. The decision tree defines the chronology in which decisions are made. Together, decision trees and sensitivity charts can help decision-makers evaluate possible strategies and scenarios to reach the best decision.

The final step applies the decision criteria to the full range of probabilities to develop a risk profile. It plots the distribution of the decision criteria, e.g., net present value (NPV), showing the probabilities associated with each profit level and calculates the expected value, i.e., the weight average NPV of all the probabilities.

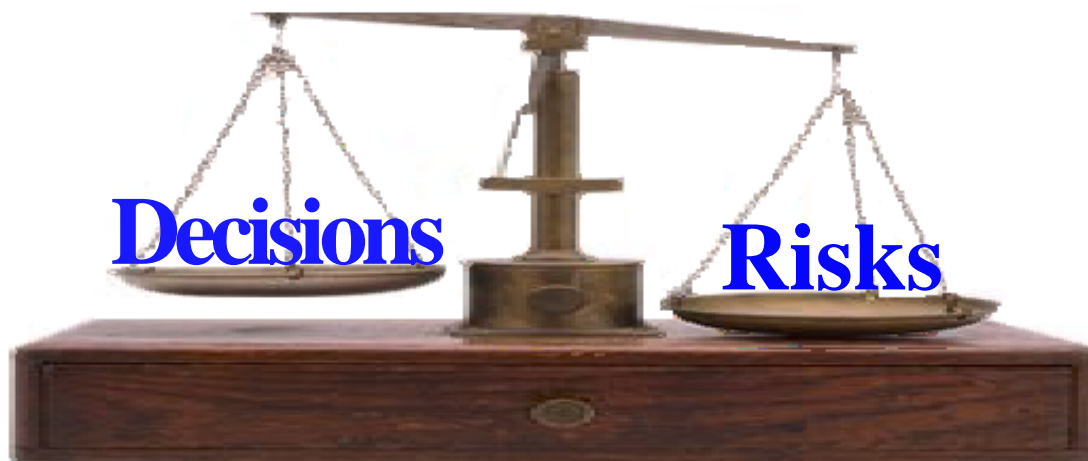
III. Connection is the process of linking the results of the analysis into insights and recommendations upon which the business may act. The connection stage prepares the organization for changes needed to implement selected alternatives. It is instrumental in developing a success template for the chosen strategy, complete with budget planning, contingency planning and tracking.

This step begins by exposing all of the organization's

functional managers to the output of D&RA. It is intended to "immerse" the business in the future vision. There are six fundamental elements to Connection:

1. Key events or "Milestones" that must occur between now and the future for the vision to become a reality.
2. A future assessment of the impact such milestones will have on the financial metrics associated with the alternative strategy selected - usually for each future year until the vision is realized.
3. Major challenges that stand in the way of the future vision - one again by year.
4. Year by year tactics that need to be implemented to address such challenges.
5. The Key uncertainties developed by D&RA's sensitivity analysis that have the greatest influence on the bottom line and this need to be further assessed and minimized - also by year.
6. A list of key metrics used to hold the business accountable to achieving the vision.

Once this snapshot is developed, it is compiled into a written plan. As each year unfolds, old uncertainties diminish as more is known, but new ones may emerge which need to be folded into the assessment. The plan is constantly updated with a look forward to the vision and a look back at the progress made relative to the



D&RA process.

Decision & Risk Analysis is a process that helps a business team make quality decisions and to give the business leader confidence that all issues were considered in a quality manner before making large commitments...

What do we mean by a quality decision? It, of course, means arriving at the best decision, given the state of knowledge at that time. It means other things, however. The best decision is the one that maximizes the agreed-to “bottom line”. It means that insights were gained into what contributes most to maximizing value, that buy-in and commitment to carry out the decision were created, and that a contingency plan was developed in case future events do not occur as planned. The D&RA process is designed with all these objectives in mind.

out business results and attribute to the project all sales volumes above current capacity. The analysis picks values for market growth, price, share and capital and calculates a positive NPV of over \$13 million and IRR of 17%. That meets the financial goals of ABC and the expansion project would be approved.

Now, let’s for the moment take as a given that the problem has been framed properly and that the decision board, made up of the business leaders, has agreed that Net Present Value is the correct decision criteria. Unlike the above analysis, the D&RA process does not permit any key assumptions to be made regarding future events. An influence Diagram is constructed to determine which key uncertainties need to be considered as illustrated in Figure 4.

In constructing the diagram, the team identified whether a new competitor might enter the market as an important

**Table 1
ABC COMPANY EXPANSION PROJECT
NEW OPPORTUNITY AND RISK ASSESSMENT**

	0	1	2	3	10
<i>New Investment (\$mm)</i>	20				
<i>Additional Capacity (mm lbs.)</i>	8				
<i>Existing Capacity (mm lbs.)</i>	30				
<i>New Capacity (mm lbs.)</i>	38				
<i>Market size (mm lbs.)</i>	100	105	110	116	163
<i>Share (%)</i>	29	29	29	29	29
<i>Volume (mm lbs.)</i>	29	30.5	32	33.6	47.2
<i>Volume due to Project (mm lbs.)</i>		0.5	2.0	3.6	8.0
<i>Price (\$/lb.)</i>	2.00	2.05	2.10	2.15	2.56
<i>Revenue (\$ mm)</i>		0.9	4.1	7.7	20.5
<i>Net Earnings (\$mm)</i>		-1.9	-0.8	0.4	4.2
<i>Delta Working Capital (\$mm)</i>		0.23	0.81	0.89	0.12
<i>Terminal Value (\$mm)</i>					42.3
<i>Cash Flow (\$mm)</i>	-20.0	-0.5	0.0	1.1	48.0
<i>NPV at 10% (\$mm)</i>	13.1				
<i>IRR</i>	17%				

Let’s use an example to illustrate how this process works. While highly simplified, this example is patterned after real business situations. The ABC business has been growing at 5% per year for the past 5 years and is now coming close to running out of capacity. A typical 10-year cash flow analysis to determine if new investment is justified might look like Table 1.

The typical framing for such an analysis is to project

uncertainty. The rigor imposed by constructing this diagram usually identifies some interesting issues previously not effectively addressed by the team. Uncertainties are represented by an oval; a slash line through an oval indicates it can be calculated given values for those uncertainties feeding into it.

The best experts available to the business must assess the uncertainties (not slashed out).

These discussions of uncertainty are led by a trained D&RA facilitator, whose role is to encourage a rich discussion about the uncertainties and to eliminate biases that everybody has when viewing the future. A range in which the expert(s) is 80% sure the actual outcome will in fact occur, describes uncertainty. The 10% and 90% values define that range. A 50% value is where the expert feels the actual outcome is just as likely to be above as to be below. The results of the assessments on the four uncertainties in the influence diagram are illustrated in Table 2.

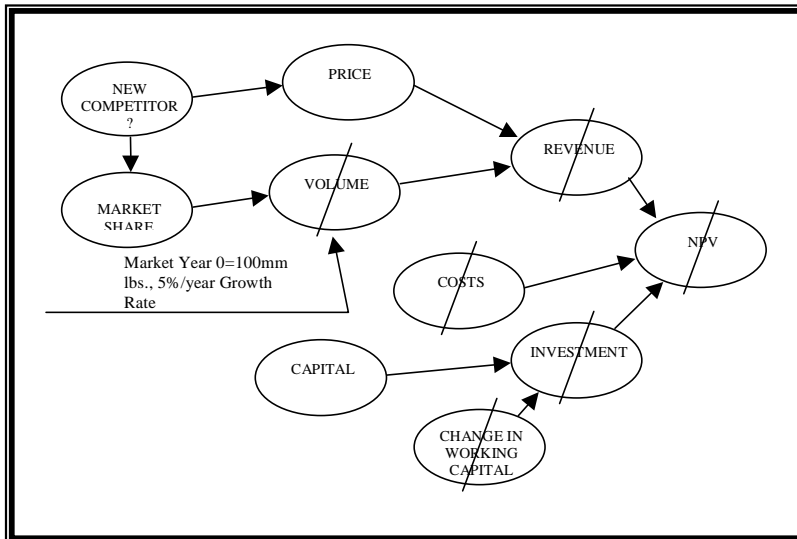
Just the discussion of these uncertainties was beneficial to the team. Some people learned about the range of what could occur. They also learned the possible reasons for those outcomes, which started the thinking process about ways to “control” and manipulate them to favor ABC.

The same model that was used to calculate NPV under the conventional analysis can be used here. The only difference is that a variety of results will be calculated corresponding to the various outcomes of the four

uncertainties. The following two charts are examples of the analytical results that come from the D&RA process.

Figure 5 displays a sensitivity chart showing the impact of each uncertainty on NPV. The horizontal line is at \$7.6million, which the

Figure 4
INFLUENCE DIAGRAM
ABC COMPANY EXPANSION PROJECT



model has calculated if all uncertainties are at their 50% median values. (This result is significantly below the \$13.1 million from the typical approach since the business team had used optimistic values for price and share.) There is no new competitor assumed in this

50% case, since there is only a 30% chance a new one will enter. The price bar shows what happens if the price grows at 1% instead of 3%. The impact on NPV is about \$14 million, which is extremely large when compared to the NPV of \$7.6 million with all uncertainties at 50%. This gives the team cause for concern and should start everybody thinking about any changes to the business strategy to more favorably change the probability of price outcomes.

Table 2
10-50-90 ASSESSMENT OF UNCERTAINTIES

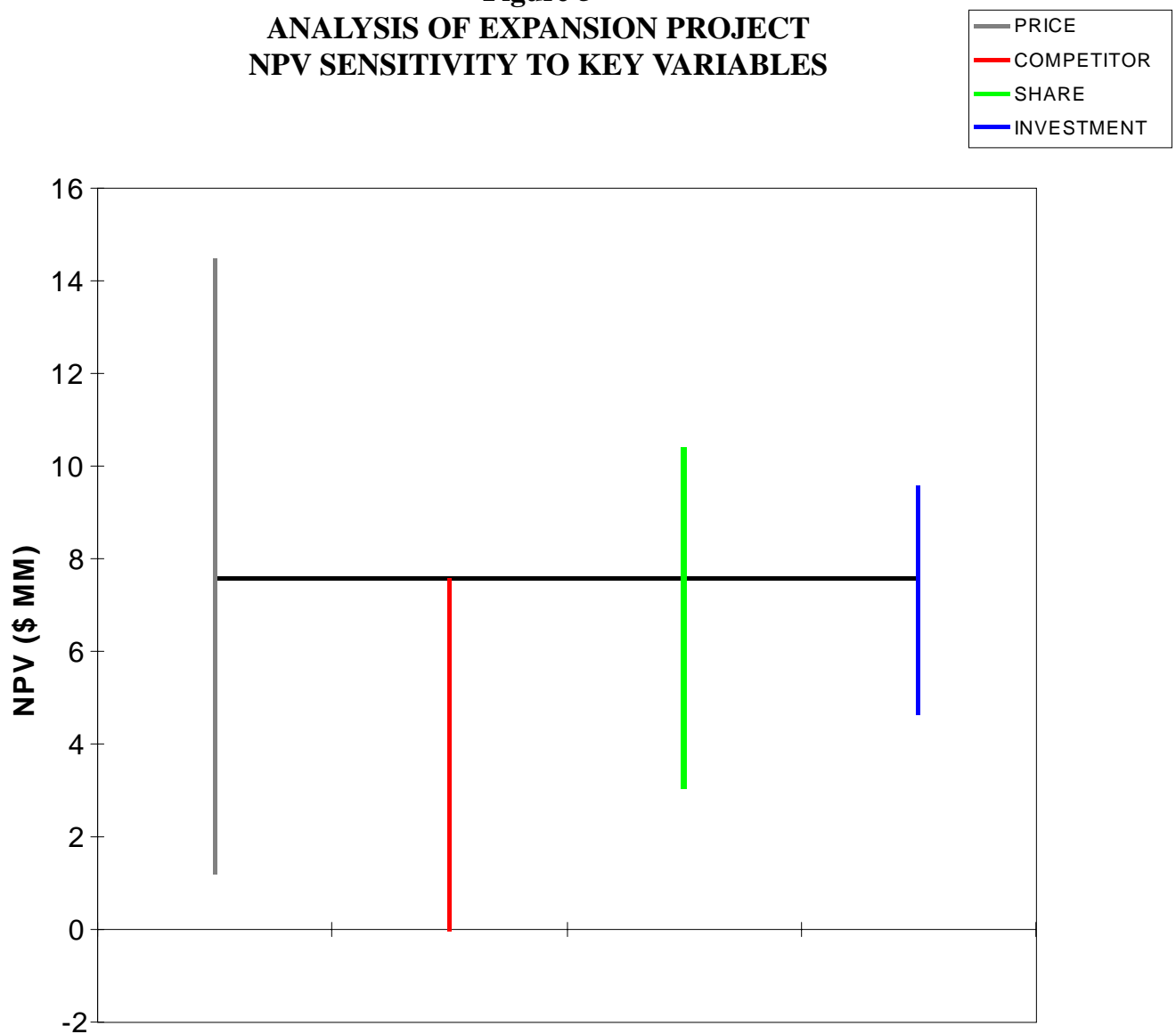
•New Competitor Enters?	Yes – 30% probability						
•Year 5 Results							
	<u>Now</u>	<u>10%</u>	<u>50%</u>	<u>90%</u>	<u>10%</u>	<u>50%</u>	<u>90%</u>
Share	29%	24%	27%	30%	19%	24%	28%
Price/Growth	\$2.00	1%	2%	3.5%	0%	1.5%	3%
•New Capital (\$mm)		<u>10%</u>	<u>50%</u>	<u>90%</u>			
		\$26	\$20	\$16			

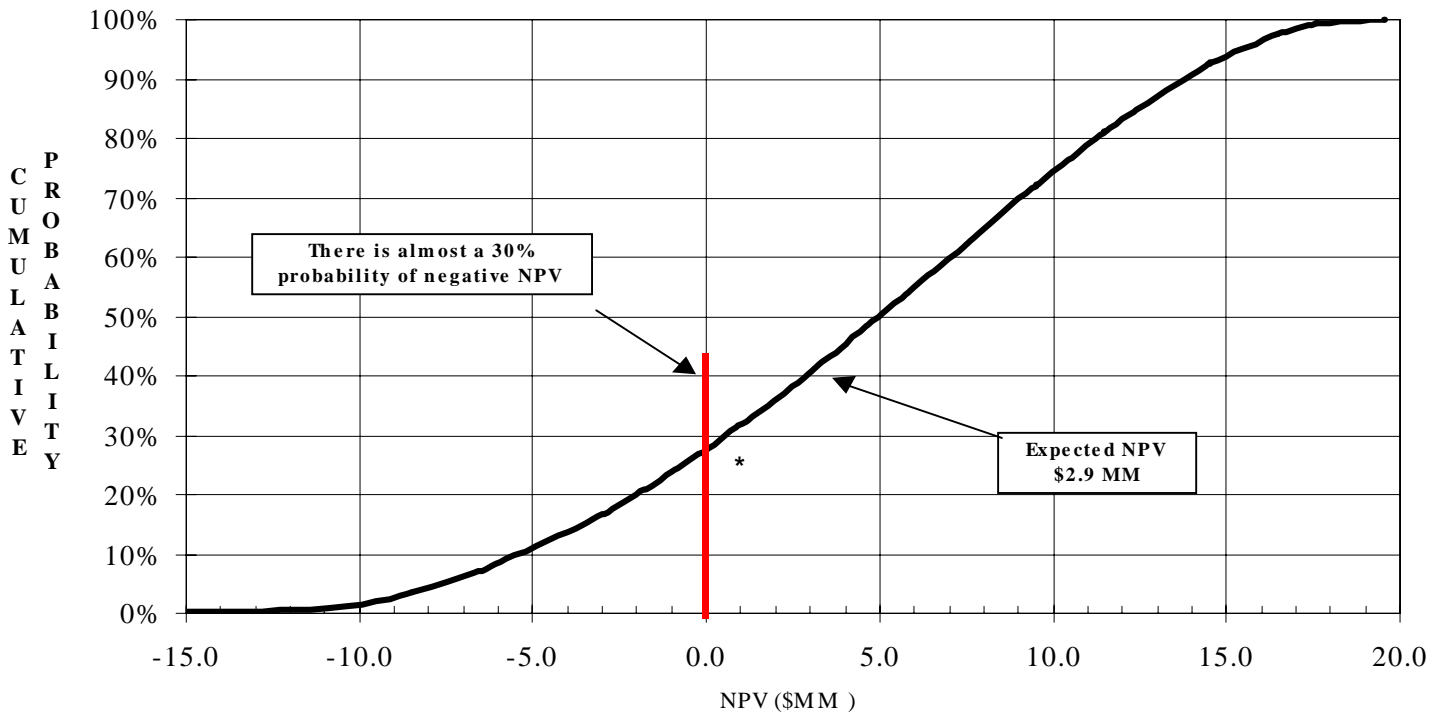
Another extremely useful analytical tool is the curve shown in Figure 6 which plots the entire range of NPV outcomes based on all combinations of how the four uncertainties could turn out. This chart shows, to the surprise of the team, that NPV can range from \$-10 million to over \$15 million and that there is almost a 30% chance that the

NPV of the expansion will turn out to be negative! Even though the expected value (Expected Value is the probability weighted average of all the NPV outcomes) of the project is about \$2.9 million, these insights will stimulate further team discussion on ways to improve results. The power of the disciplined D&RA process is in the discussions that come from it.

The ABC expansion example is relatively simple, and did not allow for any creation, evaluation and discussion of alternatives. This usually leads to a “hybrid” solution, which combines the best features of the initial alternatives. Most real problems have alternatives. Such cases utilize the power of the D&RA process to its fullest extent.

Figure 5
ANALYSIS OF EXPANSION PROJECT
NPV SENSITIVITY TO KEY VARIABLES





* Probability that the outcome will be this favorable or less.
 Please note that the 50% point is the median value, not the expected value.

D&RA can be applied to any decision where the complexity warrants a process. Below are a few examples of the variety of applications of this process:

D&RA analysis shows that:

- * Weighted average NPV over the curve is \$2.9MM rather than the \$13MM calculated in the conventional method
- * There is a 30% probability of failure
- * There is considerable value (\$) in eliminating risk

THE VALUE OF D&RA IS WELL JUSTIFIED

outcome as objectively as possible and to give the team a head start on thinking about how the two entities will come together.

Capital Projects

The ABC expansion project discussed above is an excellent example of this class of decision. This example was simplified. In a real situation, the framing stage of D&RA would have explored further for alternatives. The problem would have been framed as at least two business strategies. One being how the business would be run if there were no expansion, the other with an expansion. Even the expansion alternative probably would have variations, such as with a JV partner, whether to place the expansion in a new country, etc.

Acquisitions

Acquisitions or other forms of alliances normally take a company into new markets or new technologies. The uncertainties of this as well as how the two entities will work together often receive inadequate attention in the haste and excitement of creating the deal. The D&RA process allows the team to step back and view the

Pilot Plants

Should the business take the time and money to build and operate a pilot plant or should it build a commercial plant directly? The value of the information obtained from a pilot plant is not always worth the cost. And, there needs to be a thorough check on the commercial value of the process, even if it turns out to perform technically at goal levels. With a disciplined decision process, all of these issues can be explored to arrive at the best decision.

Market Repositioning

Competition has been effective in tracking your markets and has eroded your market share and price. Can the business reposition itself to gain competitive advantage? Clear strategic thinking and thorough analysis of the alternative strategies can help the business find its optimal new position in the market.

D&RA CONTINUUM

ORGANIZATIONAL APPLICATIONS FOR D&RA

BASIC

COMPLEX

**Make vs. Buy
Litigate**

**R&D
Project
Pilot Plant
Maintenance
Strategy**

**R&D Portfolio
Plant Siting
Facility Plan
Going Down Value Chain**

**Business Strategy
Expansion Plans
Financing Plans**

**SBU Strategy
Acquisition**

CHEMQUEST OFFICES

CORPORATE HEADQUARTERS

8150 Corporate Park Drive, Suite 250
Cincinnati, OH 45242
Phone (513) 469-7555
Fax (513) 469-7999

COLUMBUS OFFICE

5839 Rothesay Ct.
Dublin, OH 43017
Phone (614) 792-3673
Fax (614) 791-9373

ILLINOIS OFFICE

84 Burning Bush Trail
Crystal Lake, IL 60012
Phone (815) 356-8907
Fax (815) 356-9524

MASSACHUSETTS OFFICE

207 Quail Run
Marshfield, MA 02050
Phone (781) 837-0222
Fax (781) 837-0165

DELAWARE OFFICE

306 Bartram Lane East
Hockessin, DE 19707
Phone (302) 235-2217
Fax (302) 234-9418

LONDON OFFICE

3 Cambridge Road
New Malden, Surrey
KT3 3QE
United Kingdom
Phone +44 (0) 208 949 0945
Fax +44 (0) 208 942 4441



The ChemQuest Group, Inc. _____