Engineering Management Meeting the Global Challenges 2nd edition Chang Solutions Manual

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ANSWERS TO CHAPTER 2 QUESTIONS

ANSWER 2.1

This is where planning makes a lot of sense. Stacy Engineer should do the following:

A. Conceive of a set of mutually exclusive and collectively exhaustive objectives which on attainment will lead Joe Engineer to an exciting and happy life. Examples include: (a) money/ wealth, (b) respect and recognition by peers, (c) professional/ technical achievements, (d) social support, and (e) health.

B. Define tasks to be completed in the next 5 years which aim at accomplishing parts of the following:

(a) Learn to save and invest - setting up an internet trade account and using automatic deposit to start saving money and practicing prudent investment.

(b) Look for a job in a prestigious firm where learned skills can be best applied for both the company and for oneself. Demonstrate technical excellence and establish oneself as a worker who is capable, reliable and a fast-learner.

(c) Apply herself to learn, produce, innovate and excel.

(d) Get a mate who has earning power and start a family. Stay in contact with college friends and acquire new friends constantly. Exercise and eat healthy foods.

C. Specify tasks to be completed in the next 5 to 10 years which aim at accomplishing parts of the following:

(a) Continue to save and invest. Maximize savings in 401(k) and IRA accounts. Set up savings accounts for children's college education and invest more in stocks. Try options trading.

(b) Practice the principles of engineering management and get promoted into a mid management position with a large company. Become active in professional societies. Seek opportunities to publish technical papers and/or develop patents. Write a long term career plan so that the needed preparations are initiated in a timely manner.

(c) Practice leadership skills to excel at work. Get training to acquire new skills. Seek opportunities to broaden one's own experience base. Request a transfer to another department if doing so will broaden one's own exposure to other important managerial functions.

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(d) Continue to network with old friends and make new friends, both professionally and socially.

(e) Exercise regularly and eat healthy foods.

(f) Spend quality time with family and manage relationships.

D. Identify tasks to be completed in the next 10 to 15 years which aim at accomplishing parts of these objectives:

(a) Actively manage one's own savings and investment programs.

(b) Seek promotion to Director's level. Continue to broaden one's own experience base to prepare for bigger and better jobs, either inside or outside the company.

(c) Present papers at professional conferences, get more patents, and become active in societies and industrial committees.

(d) Achieve recognition by peers in industry.

(e) Continue to manage one's network of friends and acquaintances.

(f) Cultivate an active network of business contacts and relations.

(g) Exercise and eat healthy foods.

(h) Manage family relationships.

E. Determine tasks to be completed in the next 15 to 20 years which aim at accomplishing parts of the following: -----

ANSWER 2.2

Obviously, the company must find ways to protect its current market share in the high-price, high-quality niche. Without protection, this niche could become slowly eroded by the anticipated introduction of a new low-price, low quality product by the competition. Time is of essence and the company must act quickly. Thus, the strategic plan to protect company's position should include:

A. Explore the option of importing a low-price and low-quality product to the market and make inquiries about cost, performance, delivery and logistics.

B. Follow the competition closely to understand their new products and evaluate the market reaction to them.

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C. If the market exhibits signs of accepting the competition's new products, then the company should introduce the imported products to compete directly at a discounted price. The purpose is to reach and understand customers in this new low-price, low-quality niche so that they may be served better in the future.

One obvious alternative is for the company to drive out the competition using the imports, based on a "second brand" strategy.

D. If the company registers a decline of sales in the high-price and high-quality market niche, then it should consider the development of new medium-price and medium-quality products in order to recover some of its lost customers.

ANSWER 2.3

1. INTEL CORPORATON

A. Our mission – Do a great job for our customers, employees and stockholders by being the preeminent building block supplier to the computing industry.

B. Discipline – The complexity of our work and our tough business environment demands a high degree of discipline and cooperation. We strive to: (a) properly plan, fund and staff projects; (b) pay attention to detail; (c) clearly communicate intentions and expectations; (d) make and meet commitments; and (e) conduct business with uncompromising integrity and professionalism.

C. Quality – Our business requires continuous improvement of our performance to our mission and values. Examples include: (a) setting challenging and competitive goals, (b) doing the right things right, (c) continuously learning, developing, and improving, and (d) taking pride in our work.

D. Result Orientation – We are results-oriented. We strive to: (a) set challenging goals, (b) execute flawlessly, (c) focus on outputs, (d) assume responsibility, and (e) confront and solve problems.

E. Customer Orientation – Partnerships with our customers and suppliers are essential to our mutual success. We strive to: (a) listen to our customers, (b) communicate mutual intentions and expectations, (c) deliver innovative and competitive products/services, (d) make it easy to work with us, and (e) serve our customers through partnerships with our suppliers.

F. Risk Taking – to maintain an innovative environment, we strive to: (a) embrace change, (b) challenge the status quo, (c)

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listen to all ideas and viewpoints, (d) encourage and reward informed risk taking, and (e) learn from our successes and mistakes.

G. Great Pace to Work – A productive and challenging work environment is the key to our success. We strive to: (a) respect and trust each other, (b) be open and direct, (c) work as a team, (d) recognize and reward accomplishments, (e) be an asset to our community, and (f) have fun.

2. SATURN CORPORATION

A. The Mission of Saturn

- To market vehicles developed and manufactured in the United States that lead in quality, cost, and customer satisfaction through the integration of people, technology, and business systems.

- To transfer knowledge, technology and experience throughout General Motors.

B. The Philosophy of Saturn

We the Saturn Team, in concert with the UAW and General Motors, believe that meeting the needs of Saturn customers, members, suppliers, dealers, and neighbors is fundamental to fulfilling our mission.

- To meet our customers' needs, our products and services will lead in value and satisfaction.

- To meet our members' needs, we will create a sense of belonging in an environment of mutual trust, respect and dignity. We believe that all people want to be involved in decisions that affect them. We will develop the tools, training, and education that each member needs. Creative, motivated, and responsible team members who understand that change is critical to success are Saturn's most important asset.

- To meet our suppliers' and dealers' needs, we will create real partnerships with these suppliers and dealers. We will strive for openness, fairness, trust, and respect and we will work with them to help them feel ownership of Saturn's mission and philosophy.

- To meet our community neighbors' needs, we will be good citizens and protect the environment as well as seek to cooperate with government at all levels.

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By continuously operating according to this philosophy, we will fulfill our mission.

C. The Core Value of Saturn

As a final complement of Saturn's mission and philosophy statements, the founding team has enunciated five core values: commitments to customer enthusiasm, excellence, teamwork, trust and respect for the individual and continuous improvement.

ANSWER 2.4

A typical set of operational guidelines may emphasize the following:

A. Employees are the most important asset to our organization (respect and listen to them).

B. Quality of our product/service must never be compromised (this is based on the total quality concept as measured by customers).

C. The system must continuously advance all aspects of its operation (seeking a stream of incremental emendation while not neglecting innovation for major step-change in performance).

D. Each action that is taken should add value to the final product or service (eliminating wasteful and unnecessary steps).

E. Timely response of the system to changing external conditions is paramount to success (time to market is a key competitive factor in today's marketplace).

F. Integrity in all actions by all employees is paramount (all shareholders must have confidence in the enterprise).

ANSWER 2.5

All new ventures have inherent uncertainties. In deciding to take the risks of going forward with the venture, several questions need to be answered first:

A. Should it luckily turn out to be successful, what is the maximum pay-out (e.g., value) of the venture?

B. Why is the venture deemed to be risky? How likely are all risk factors expected to play out in reality? What contingency steps are available to minimize the impact of these risky factors? Answers to these questions will lead to an assessment of the probability of success for the venture.

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C. Should the venture fail (e.g., time delay, reputation, company bankruptcy, loss of market share, etc.), what is the adverse impact on company?

A typical set of guidelines for avoiding taking unwarranted risks may include the following:

A. The cost of going forward with the venture must be much smaller than the expected value of the risky venture (the probability of success multiplied by the maximum pay-out of venture).

B. The adverse impact on company must be smaller than the maximum pay-out of the venture.

ANSWER 2.6

The steps she should take include the following:

A. Collect critical market information (e.g., market research, competitive information, customer feedback, technology development, business alliance, and forecasting) - in need of staff support.

B. Analyze available data (verification of data accuracy, interpretation, what-if analysis, financial projections, risk analysis, search on external databases, SWOT (strengths, weaknesses, opportunities and threats) analysis, etc.) - in need of staff support.

C. Apply judgment to data and formulate strategies, to be performed by the Director himself.

D. Get staff feedback, in order to benefit from the different viewpoints and broad experience they may have, - in need of staff participation.

E. Devise the plan (graphics, project plan preparation proof reading, printing, binding) - in need of staff support.

ANSWER 2.7

The company is facing a major threat and must consider several strategic options. These options include: stay the current course, expand software offering to run on computers of common platforms, and continue to market the software products but abandon the bundling with the hardware.

A. **Staying the course**

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Marketing the original hardware-software bundle has several advantages. The system works well as a group partly because the company offers maintenance services using technicians who are knowledgeable about both hardware and software. Customers can count on the high system reliability of the integrated package. An additional possibility is for the company to constantly upgrade the system, both hardware processor and software features, so that its customers can always enjoy the latest technology.

The company can of course continue to innovate by adding new functions and features to serve the law firms better (e.g., Internet access, document search, data mining, and others). The company may also have to refocus its marketing on mid- to large-size law firms which prefer and can afford a centralized hardware-software system. Some erosion of the company's market share may be likely.

B. Marketing two versions of the software

Generally speaking, it is quite easy to develop a second software version. Doing so allows the company to expand its customer segment to include law firms which have existing computers running on common operating systems. This segment is potentially very large as the computers of common platform enjoy a very extensive installed base. Some law firms can thus avoid the initial investment of purchasing a hardware-software bundle, also making such software attractive to some new and small size firms.

The question of system reliability is unresolved at this time.

Customers who purchase hardware and software from different sources do not have a single point of contact to turn to for services. System reliability may be important to some, but not to others. For law firms involved in criminal court cases, it would be a disaster if their ERP systems broke down during a trial. On the other hand, if the law firms work primarily on patent and copyright assignments, then an occasional delay of a few days due to the system failure may still be manageable.

C. Pursue the software products only

This option of abandoning the hardware business is useful only if the company wants to refocus its energy on competing directly against the new competitors. The sense of urgency could spark the innovative talents of the company in adding new software features to make the company increasingly more competitive.

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Some existing customers may feel betrayed by such a move. Accordingly, the company needs to extensively restructure its hardware and service divisions.

Which option should the company pursue? To answer this question, there is one more piece of information missing, namely the customer's perception and preference.

Thus, it is strongly advised that the company conduct a customer survey (e.g., focus group, web-based survey, and phone interviews) to determine the relative value of these options to them. Specifically, XYZ Company needs to know how important the issues are to customers regarding system reliability and services channeled through a single point of company contact. Based on the results of these surveys, the company should plan its counter strategy and implement action steps accordingly.

ANSWER 2.8

Sandy Smith's plan should include the following elements:

1. Assure the clear objective of becoming an Operations manager in 10 years and understand the associated personal benefits and sacrifices.

2. Define the interim positions which lead to an Operations manager position. These include:

   (1) Project team member/associate (1- 2 years)
   (2) Project Team Leader (3- 4 years)
   (3) Project Manager (5-6 years)
   (4) Plant Manager (7-8 years)
   (5) Operations manager (9 - 10 years)

3. Be aware of the qualifications and work experience required for reaching each of these job functions and set up action plans to ready herself in a timely manner. Implement the action steps so that she could reasonably expect to be promoted into these interim positions as scheduled.

4. Develop the necessary personal and professional networks in support of her career progression.

5. Learn constantly to acquire new technical knowledge, improve interpersonal skills in dealing with people, and enhance her leadership qualities.

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Case #2

"BMW AG: The Digital Auto Project (A)"

Harvard Business School Case: #9-699-044 (Rev. Nov. 1, 2001)

Academic instructors who are registered with the publisher's website (http://www.hbsp.harvard.edu) may download the Teaching Note #5-603-117 (March 5, 2003) for this case free of charge.

ABSTRACT

BMW is known for its hand-craftsmanship in automotive styling and high standards of product excellence but they also have the longest product development process of 60 months as compared to 30 to 40 months by US and Japanese automakers. Since the time to market has become an increasingly competitive factor in auto industry, BMW took steps to shorten the product development cycle through computerization, concurrent engineering, and reengineering to minimize process steps. This case describes how BMW decided to select a specific car model as the "digital car" to refine the new product development process and how their design department struggled with the computer aided styling (CAS) technology over its traditional physical prototyping-driven styling process.

TEACHING OBJECTIVES

The objective of this case is to address issues related to the "redesign" of product development processes. It offers students the opportunities to talk about the competitive needs for higher development performance (time, cost, and quality) in the automotive industry, the use of technology enablers to speed up development processes, and challenges and efforts associated with balancing the emotional needs of designers with the reduction of development time dictated by the marketplace.

SUGGESTED QUESTIONS FOR CLASSROOM DISCUSSION

1. What are the competitive challenges in the automobile industry in 1997 and beyond? In what ways do these challenges affect BMW?

2. How would you evaluate the product development process at BMW? Why was the target objective of 50 percent reduction in development time set by BMW senior management?

3. What should BMW do with respect to the exterior styling process - go "digital" or "clay"? Why?

4. Would BMW derive any benefits from utilizing web-based engineering technologies in product development? Why or why not?

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ANALYSIS

1. What are the competitive challenges in the automobile Industry in 1997 and beyond? In what ways do these challenges affect BMW?

The challenges are: (a) the European car market is the buyers market with a capacity of 20 MM cars and sales only 14 MM per year; foreign car entry into Europe is expected after 1999; (b) shorter product development time (e.g., Europe 58 months, USA 55 months, Japan 51 months) allows BMW competitors (noticeably Japan) a significant competitive advantage in satisfying market niches and customer preferences faster; Japan claims to have plans for further reducing its product development time to around 30 to 40 months; (c) changes in customer preferences for model variations, more options and less cost.

In mid 1990, European luxury cars were favored due to their prestige and driving performance. As such, BMW exceeded Mercedes sales by emphasizing tradition and continuity over change. Lexus also challenged both companies with cars that look and feel like Mercedes and BMW but that cost less.

These challenges exert pressure on BMW to reevaluate its corporate strategy. Being the automaker with the longest product development time and a strong tradition of perfection engineering at the same time serving a special niche market, BMW needs to change in order to survive – hence the reengineering efforts. The parallel is the Swiss watch industry (e.g., Rolex, Omega) versus the Japanese digital watches (e.g. Timex, Seiko), where prestige and tradition compete with accuracy and low cost.

2. How would you evaluate the product development process at BMW? Why was the target objective of 50 percent reduction in development time set by BMW senior management?

The product development process at BMW has been sequential, going for perfection at each step. It was suitable for marketing products to stable niche markets for customers who value tradition, luxury and prestige and have money to spend.

The technical goals for all tasks are the same except that they should be done faster with no loss of quality.

A. BMW started its reengineering effort using computers, initiated parallel tasking, decreased design iterations and speeded up task implementation. In the ‘70s and ‘80s, BMW used to have three prototyping cycles that brought forth very successful cars. Currently, BMW allows two major prototyping cycles that have decreased the product development time by 20 percent.

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B. The re-engineering task force focuses very properly on five (5) aspects covering 90 percent of all critical areas: body, climate control, fuel supply, engines/powertrain, and acoustics.

C. Auto development requires collaboration between diverse people, including outside vendors.

Participants found difficulty to breaking away from the pressure of everyday business to devote their efforts to re-engineering. Management selected a highly visible project (ED-A project) to galvanize the firm into action. Allowing the staff to set their own priorities signifies a lack of management commitment to the re-engineering efforts.

D. Styling is a link between the past and the future for the purpose of maintaining a familiar design (e.g., dual circular headlights and the double kidney front grille). At BMW, this is an area dominated by style artists who possess constant refined empirical skills. Artist trained in old schools are not comfortable with CAS (Computer Aided Styling). The implied assumption is that there should be no change in the objective of car styling (i.e., to achieve a distinctive line, contour and light reflection characteristics).

Why 50 percent? Japanese automakers are said to have plans to further whittle down their 51-month product development time to about 30 to 40 months. BMW therefore felt necessary to target at a 50 percent reduction in product development time in order to bring them on par with the Japanese. This goal setting exercise is based on external benchmarking.

3. What should BMW do for exterior styling – go "digital" or "clay"? Why?

Clay is the favored method of styling by traditional artists at BMW. This technique has served them very well in the past. It involves multiple prototypes and allows a very adjustment of surface lines and contours to create a superior surface finish that sets BMW apart from the competition. In a way, this has been a core technology of BMW as well as a major source of corporate pride. However, it takes time and effort to style each car in this way and the preference of the marketplace has started to shift away from this distinguished product feature. Note that this value proposition is in direct contrast to SUVs which emphasize ruggedness and empowerment with a boxy and masculine image that is intended to appeal to a new generation of drivers.

Computer Aided Styling (CAS) boosts efficiency, eliminates several process steps and completes the remaining steps faster. However, CAS is not able to deliver the high quality styling of BMW; it can deliver only up to 90 percent of the BMW requirement. If stylists try to achieve the same level of perfection for the

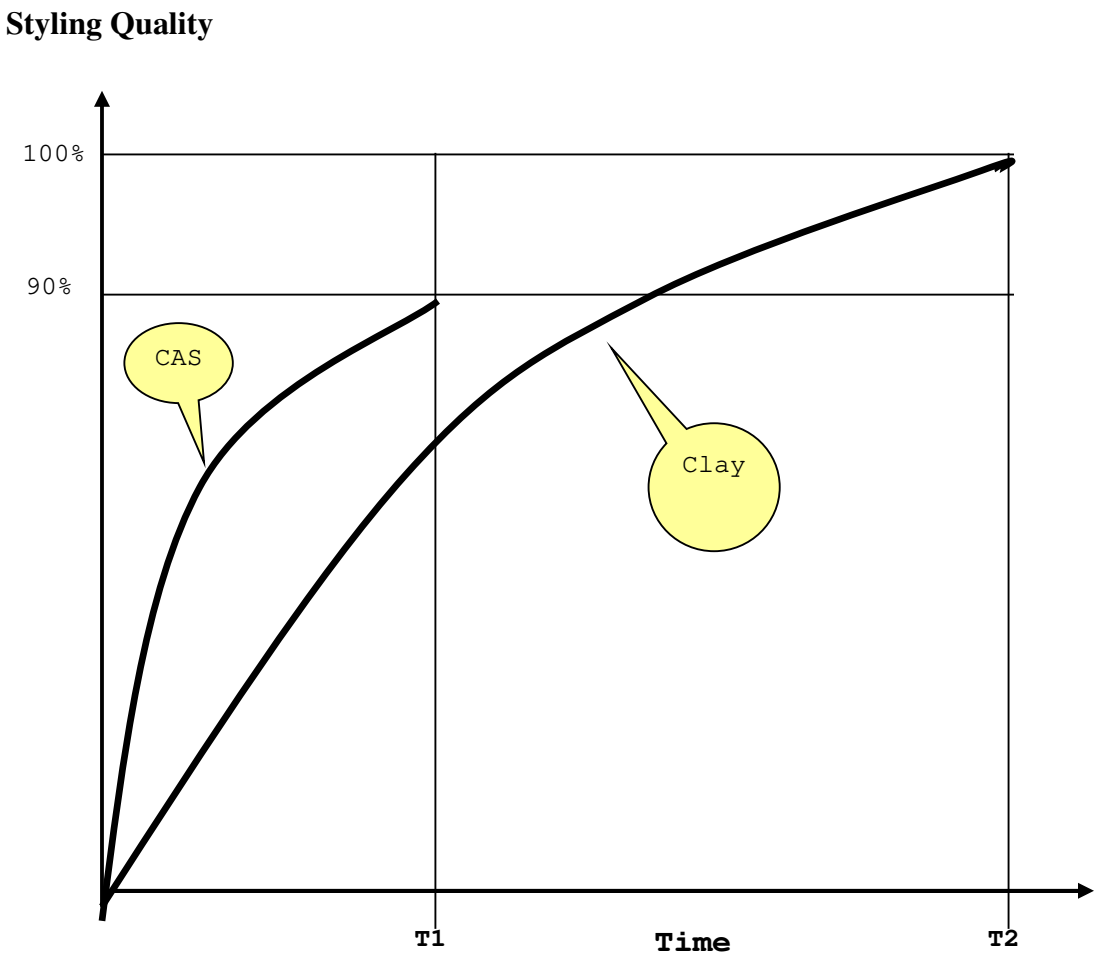
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remaining 10 percent, they would experience a diminishing return using CAS.

Market results indicate that BMW has been quite successful in overtaking Mercedes Benz in the luxury car category. However, the market success of Lexus suggests that luxury car customers are starting to prefer cheaper models without the clay-based styling. Thus, clay-based styling may no longer have the same market pull as before.

Should BMW opt for the slow clay process to achieve perfect car styling results or should BMW elect for the fast but not perfect CAS styling process? Or should BMW try something else? (see Figure C2-1). So the options are: (1) continue the clay styling tradition to retain this core technology as a corporate differentiation in the marketplace, (2) go digital all the way as the last 10 percent may not be that critical after all, and (3) others?

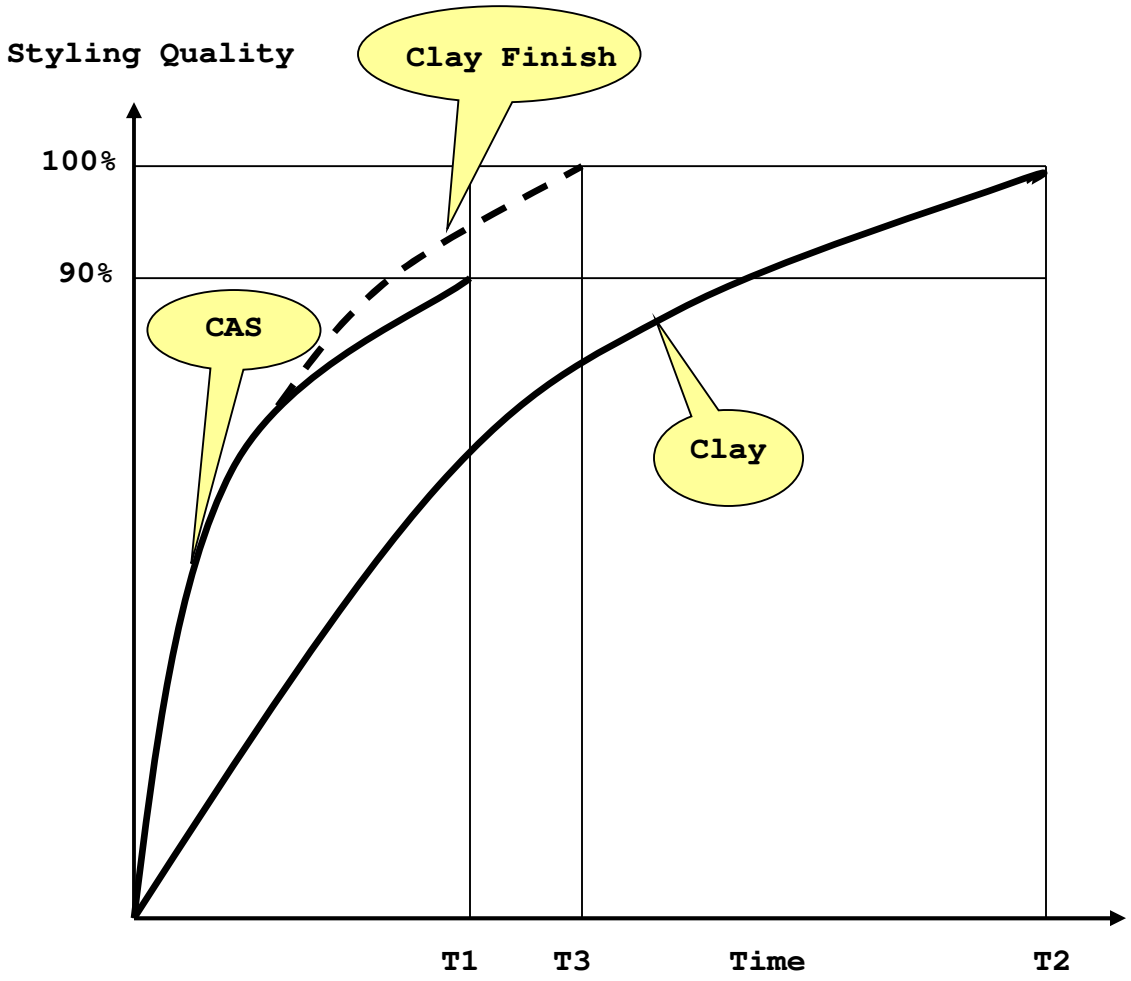
FIGURE C2-1. TIME REQUIREMENTS FOR CAS AND CLAY



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A reasonably good solution is to adopt a combination strategy, as illustrated in Figure C2-2, by applying CAS initially and finishing up with the clay method. The total development time is scaled down from T2 to T3, but still satisfies the emotional needs of stylists and preserves a unique product feature of BMW.

FIGURE C2-2. COMBINATION STRATEGY FOR CAR STYLING



4. Would BMW derive any benefits from utilizing web-based engineering technologies in product development? Why or why not?

BMW has already centralized engineering and product development in one building. It is reasonable to assume that BMW has its own server on site so that bandwidth, client equipment compatibility, transmission speed and security are not problems it faces.

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BMW appears to share quite a number of capabilities with numerous web-based engineering design tools. However, there are several others which BMW may need to add. (See Table C2-1).

TABLE C2-1. WEB-BASED TOOLS POTENTIALLY USEFUL TO BMW

In summary, the capabilities listed below, if added, could further assist BMW in achieving its ambitious goal of reducing product development time by 50 percent. To become a global player in the automobile industry, BMW needs to start planning its own "build to order" system which appears to be the wave of the future:

Project management tool will make the product development process more transparent to those involved, thus motivating all not to delay the release of product design data. Reducing the "silo" effects will foster an intensified collaboration between departments. Training and management commitment will reinforce the priority of reengineering efforts and help staff break old habits of seeking perfection beyond the point of diminishing return.

Parallel tasking is not the same as concurrent engineering. BMW may need to learn more from Ford (i.e., C3P) by eliminating prototyping as a key step for achieving the 50 percent reduction of product development time.

There was no mention of embedded systems as new technologies to enable differentiation, as the case was focused on exterior styling. Obviously, BMW must aggressively pursue new technologies as another way to compete besides just relying on styling.

As the Big Three are moving toward "Build to Order" production system, BMW cannot afford to stay within the operational model of "Build to Stock" in the "old economy." If BMW wants to serve customers worldwide, then web-based engineering technologies must be employed sooner or later to facilitate global product development, manufacturing, marketing and distribution of its products.

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Courtesy of CRC Press/Taylor & Francis Group

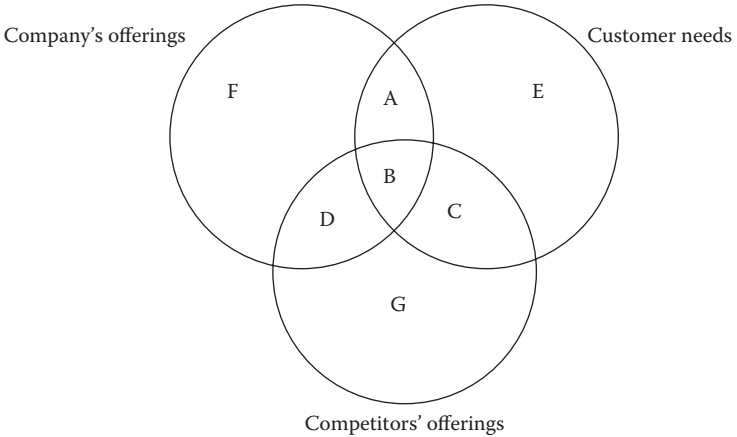


FIGURE 2.1
Strategic insights in three circles.

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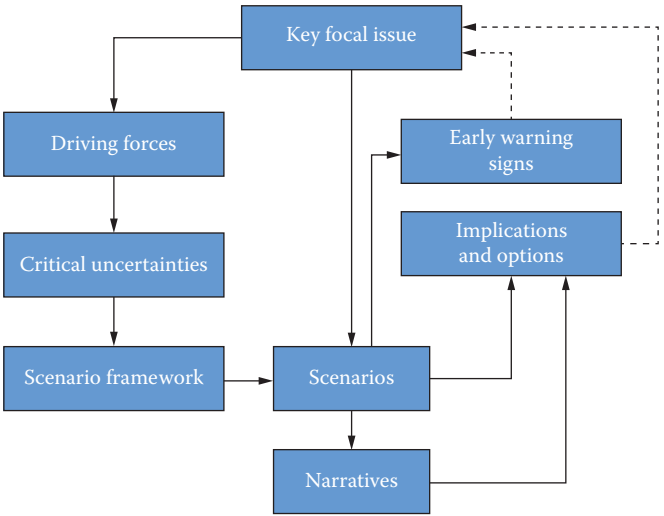


FIGURE 2.2
Scenarios planning process.

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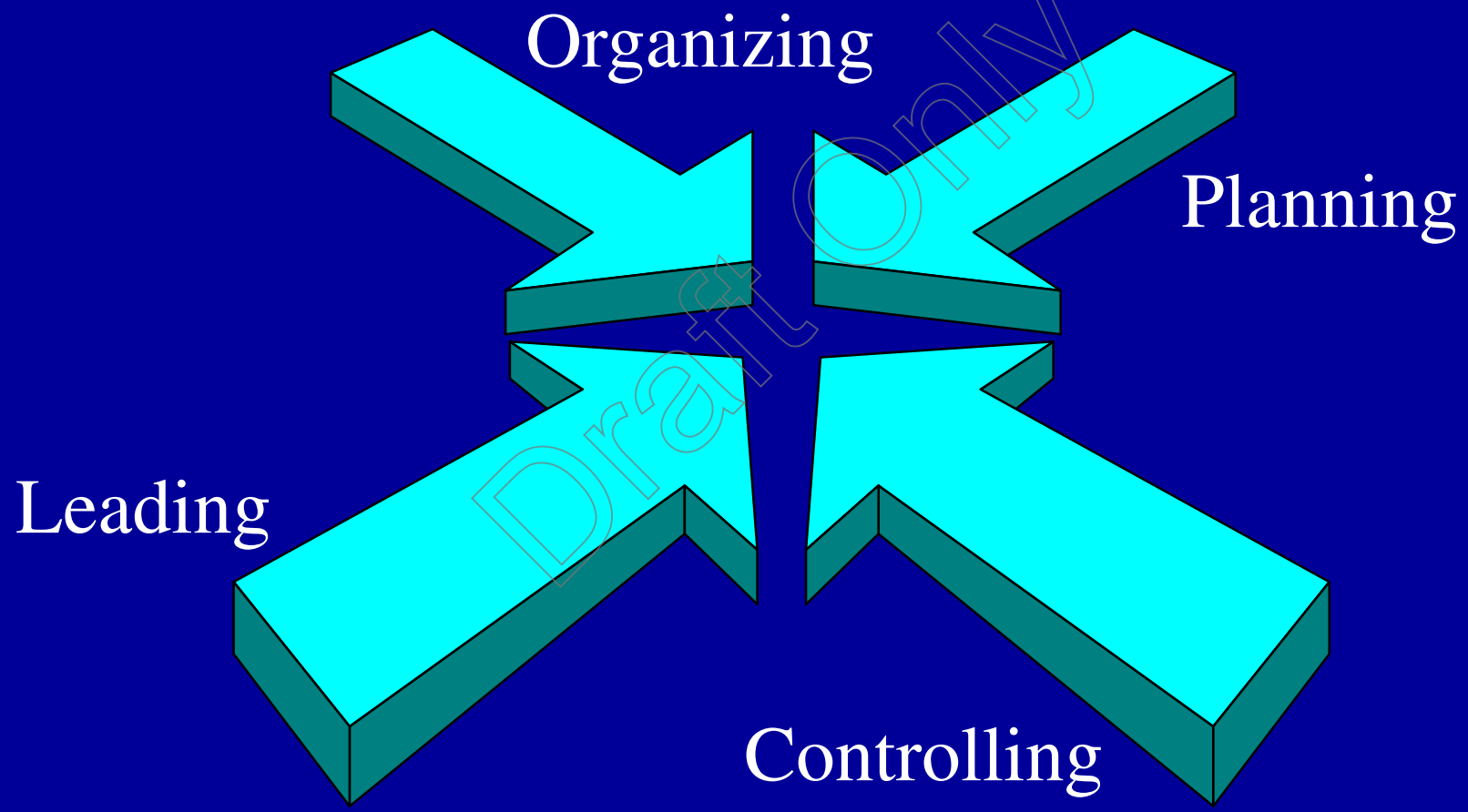
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Chapter 2 - Planning

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Engineering Management Functions



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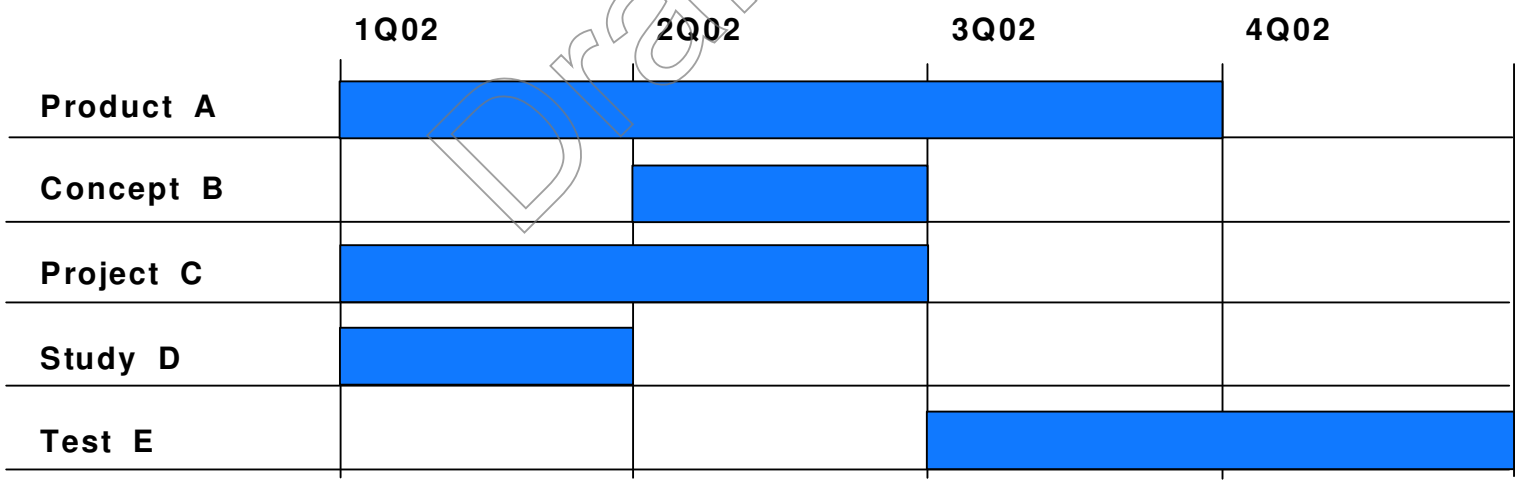
Engineering Management Functions

- **Planning** (forecasting, setting objectives, action planning, administering policies, establishing procedures)
- **Organizing** (organizing workplace, selecting structure, delegating, establishing working relationship)
- **Leading** (deciding, communicating, motivating, selecting/developing people)
- **Controlling** (setting performance standards, evaluating/documenting/correcting performance)

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Planning

- Planning is the work done to predetermine a course of action, in order to provide focus and direction for enhancing the efficiency and effectiveness of the company



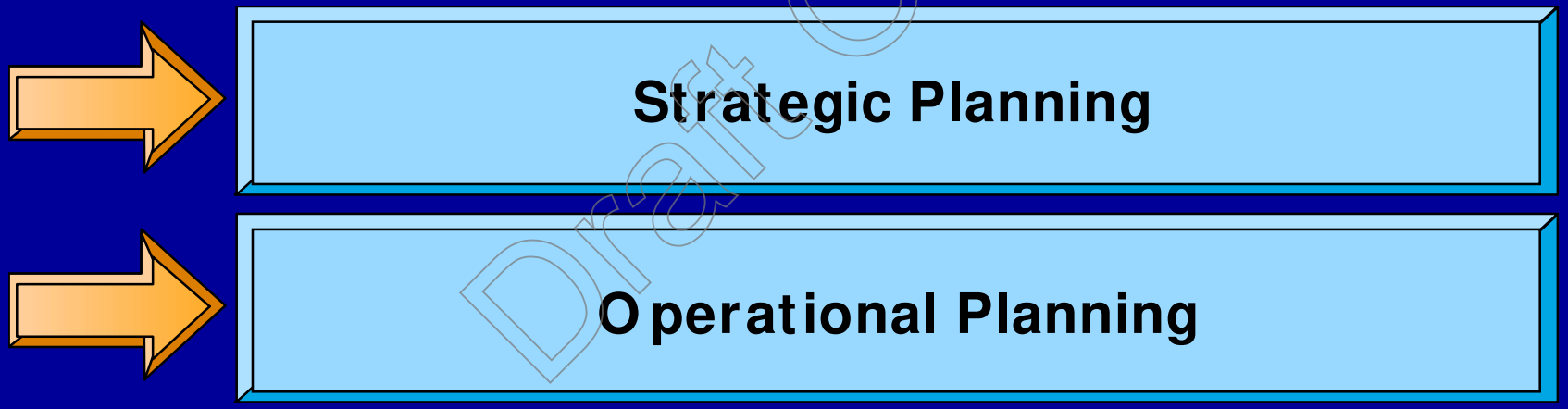
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Planning

- Planning is made necessary by rapid change of
- (a) **Technology** (Big Data, Artificial Intelligence, broadband communications options, mobile access),
- (b) **Environment** (globalization, competition, marketplace), and
- (c) **Organization** (mergers & acquisitions, networks, outsourcing and alliances)
- Planning defines who, how, where, when and using which resources to do what work

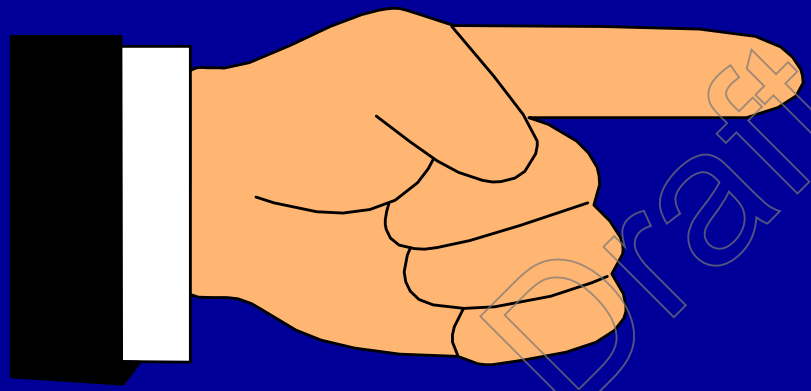
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Planning



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Strategic Planning



- Define future activities which are **worth doing** by the unit/company to assure that the company applies its recourses (skilled manpower, time, money, physical resources -equipment, facilities, business relationships) **effectively** to achieve its short-term and long-term goals

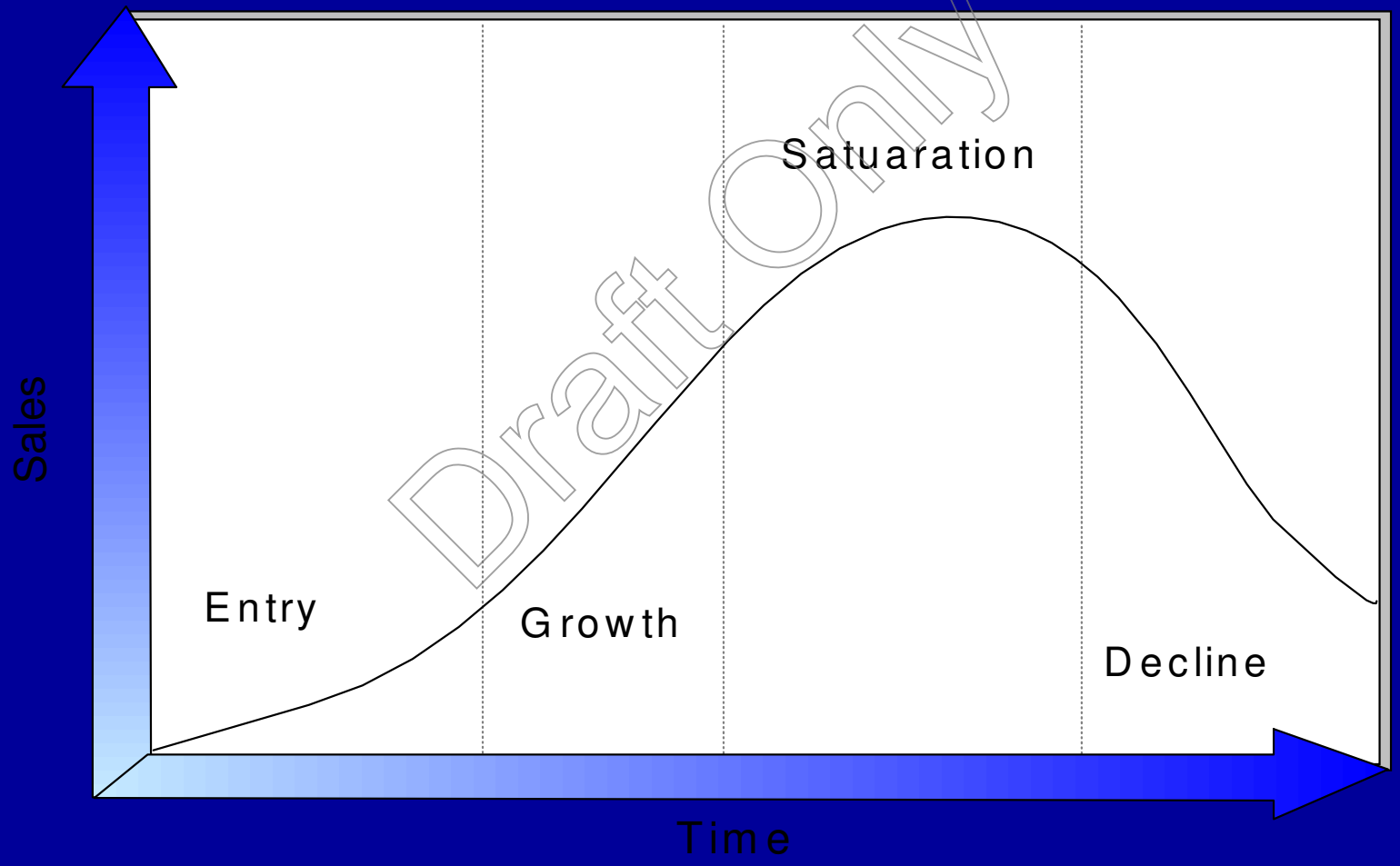
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Strategic Planning Questions

- What are the company's vision, mission and value system?
- What specific goals (profitability, market share, sales, technology leadership position, global penetration) to accomplish by when, with what investment and which technology?
- Which new/improved product streams to offer by when (considering product life cycle)?

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Product Life Cycle



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Mission and Vision

- **Mission**
- Why do we exist?
- Whom are we serving?
- What do we do to serve them?

- **Vision - Company Aspiration**
- Market capital
- Business standing
- Ranking in industrial sector
- Market share
- Others

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Sample Corporate Values

- **Innovation**
- **Honesty**
- **Quality**
- **Social responsibility**
- **Continuous improvement**
- **Stability**
- **Collaboration**
- **Accountability**
- **Trust and openness**
- **Quality of work Life**
- **Empowerment**
- **Initiative**
- **Diversity and equal opportunity**
- **Respects for others**
- **Open communications**

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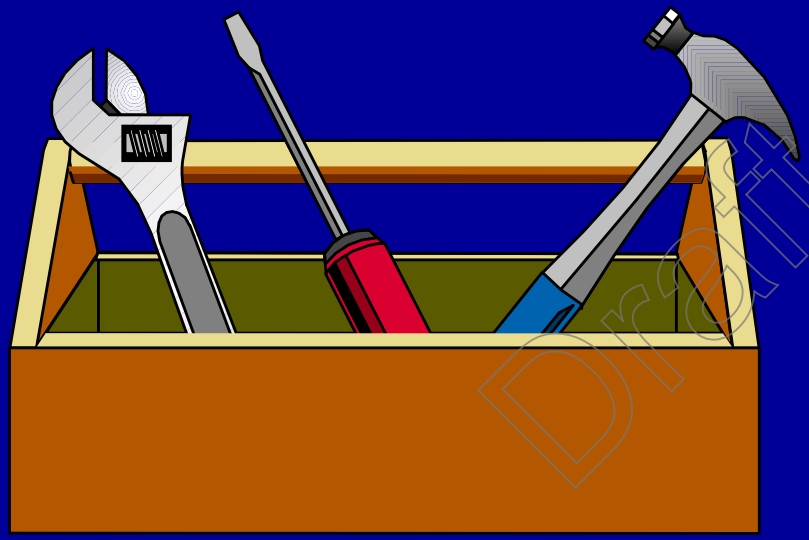
Source: James A. McComb, "Moving From Planning to Progress," Credit Union Executive Journal, Madison (July/August 2001)

Strategic Planning Questions (cont'd)

- What core technologies (design, production, distribution, service) to maintain, develop, acquire and/or apply?
- Which business networks/partnerships to create (suppliers, co-marketing, production, logistics, service)?
- With which performance metrics to monitor corporate progress?

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Tools for Strategic Planning



- Market research
- SWOT analysis
- Sensitivity analysis (what-if, scenarios, Monte Carlo)
- External benchmarking
- Technology forecasting
- Product life cycle analysis

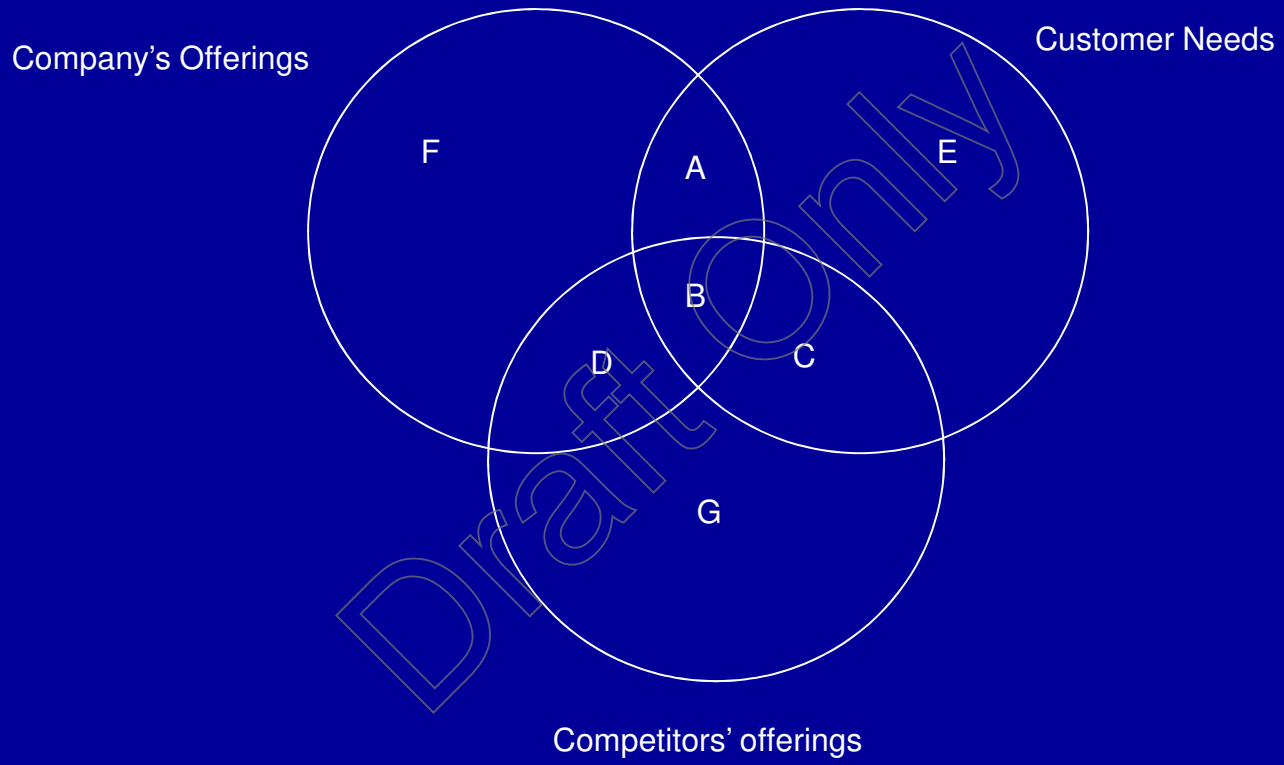
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Apply Analogy in Strategic Planning

Dimension	Major/minor	Source Case (Attributes)	Target Case (Attributes)	Is Target similar to Source?
1	Major	(a), (b)		Yes
2	Major	(c), (d)		Some-what
3	Major	(e), (f)		No
4	Major	(g), (h)		Yes
5	Minor	(i), (j)		Maybe
6	Minor	(k), (l)		No

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Strategic Insights in Three Circles



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Recourses: Urbany and Davis. 2007)

Three Circles Technique to Develop Insights

How to gain strategic insights when considering customers needs, the competition and the company's own product offering ?

A – Area of our advantages (how to enlarge it and using which technologies?)

B – Area of points of parity. Are we delivering effectively in this area?

C.- Area of competition strength. How can we do more to counteract?

E- This is an area for growth.

D,F,G are areas of no interest to customers

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Scenario Planning

It defines the major forces affecting the direction of a company's future, by

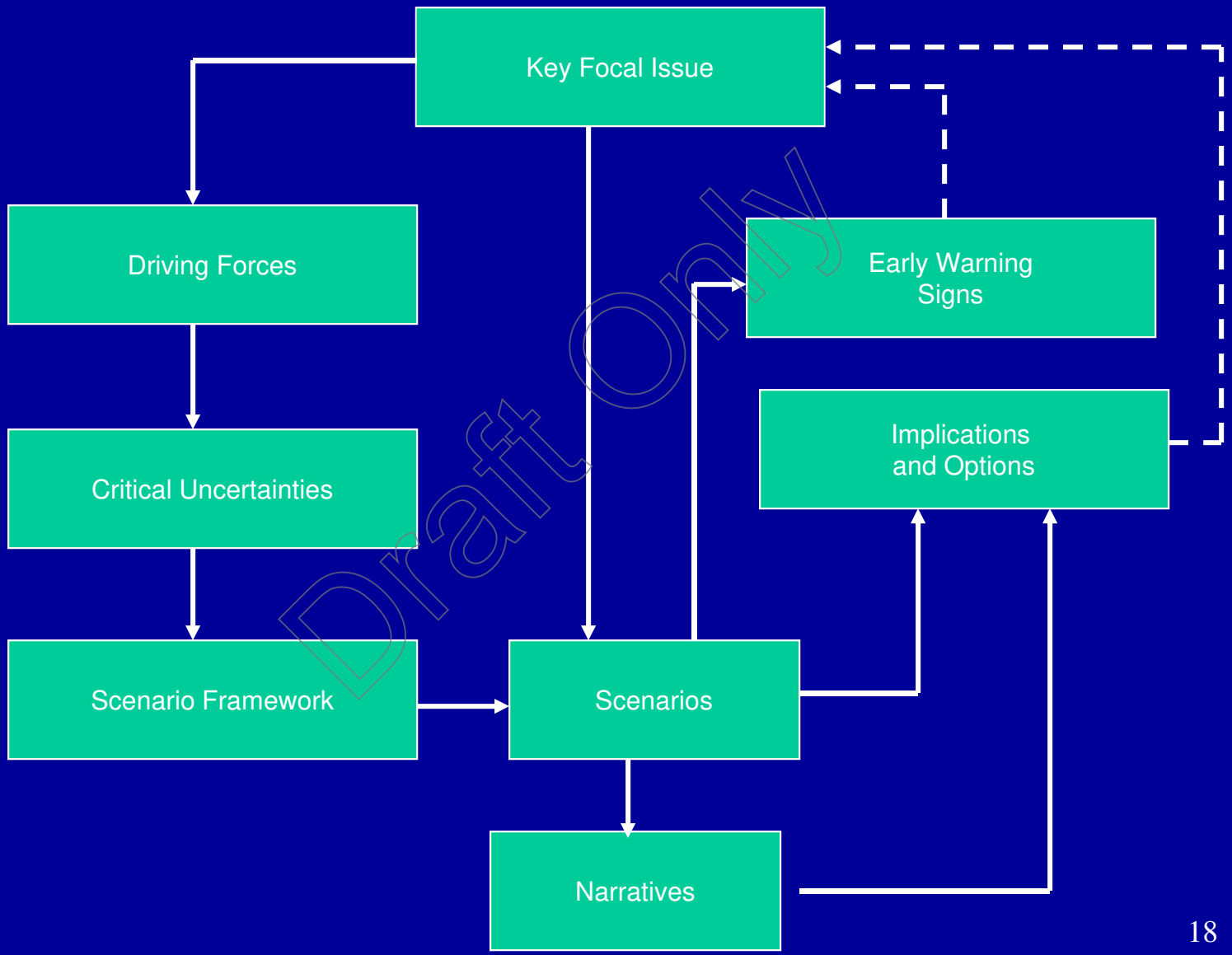
(1) Mapping out a small number of alternative futures (scenarios),

(2) Defining narratives to describing these scenarios, and

(3) Developing options for managing these futures.

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Scenario Planning Process



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Scenarios Planning Example

- Company needs to make a significant decision = Strategy uncertainty
- Driving forces = Themes and trends impacting on decision
- Define the top two driving forces = critical uncertainties & make a 2x2 Scenario framework , identify 4 futures
- discuss implication of 4 futures on key decision to gain insights

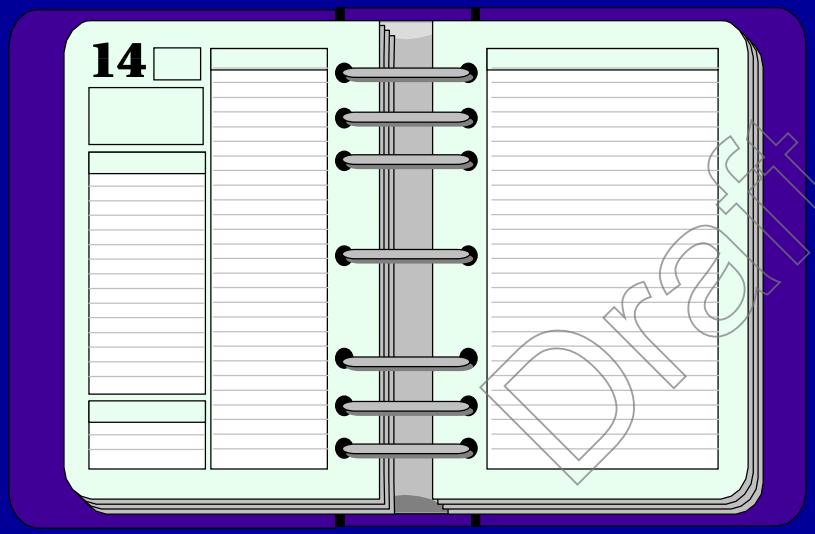
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Eight Scenarios for Three Critical Uncertainties

#	Uncertainty 1	Uncertainty 2	Uncertainty 3
1	High	Low	Low
2	High	High	Low
3	Low	Low	Low
4	Low	High	Low
5	High	Low	High
6	High	High	High
7	Low	Low	High
8	Low	High	High

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Operational Planning



- Define tasks/events to be accomplished with the least amount of resources within the shortest time, to assure that the company applies its resources **efficiently** to achieve its short-term and long-term goals

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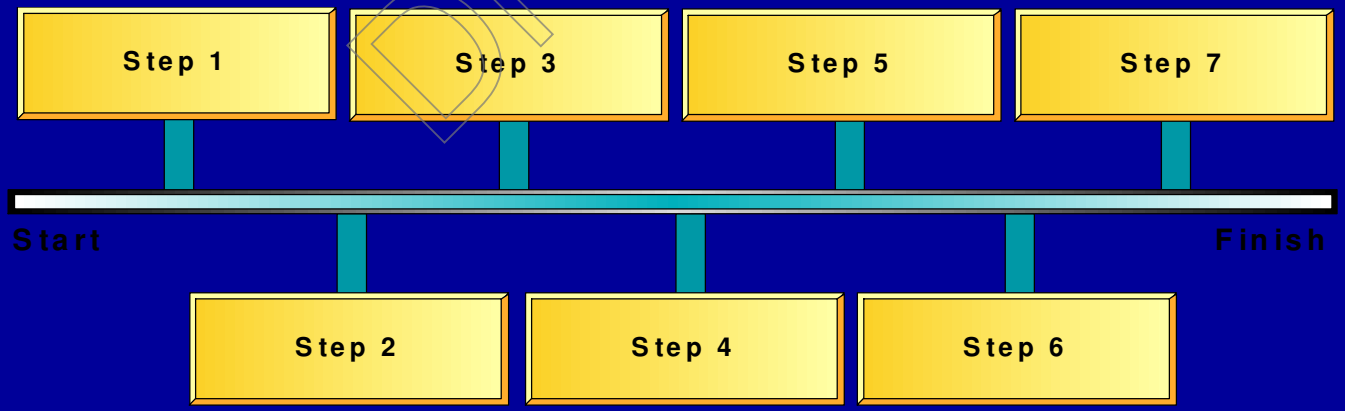
Operational Planning Questions

- What is the most efficient way of accomplishing a project/task with known objectives (doing things right) ?
- How to link up with three best suppliers in the marketplace for parts needed?
- What are the operational guidelines for performing a specific work process?

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Tools for Operational Planning

- Project management including action planning
- Design, test and analysis procedures
- Operational guidelines



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Sample Performance Metrics

- **Customer-Related** (product defect count, satisfaction score, product life cycle cost)
- **Process-Related** (time to market, unit product cost, # new products per year)
- **Financial** (gross margin, profitability, ROE)
- **Employee-Related** (turnover ratio)
- **Competition-Related** (market share, cost of innovation, growth rate)

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Question #2.6

- Quality may be defined differently by different people in a company. Explain why that is usually the case. Which quality definition is the correct one for the company to adopt?

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Activities Related to Planning

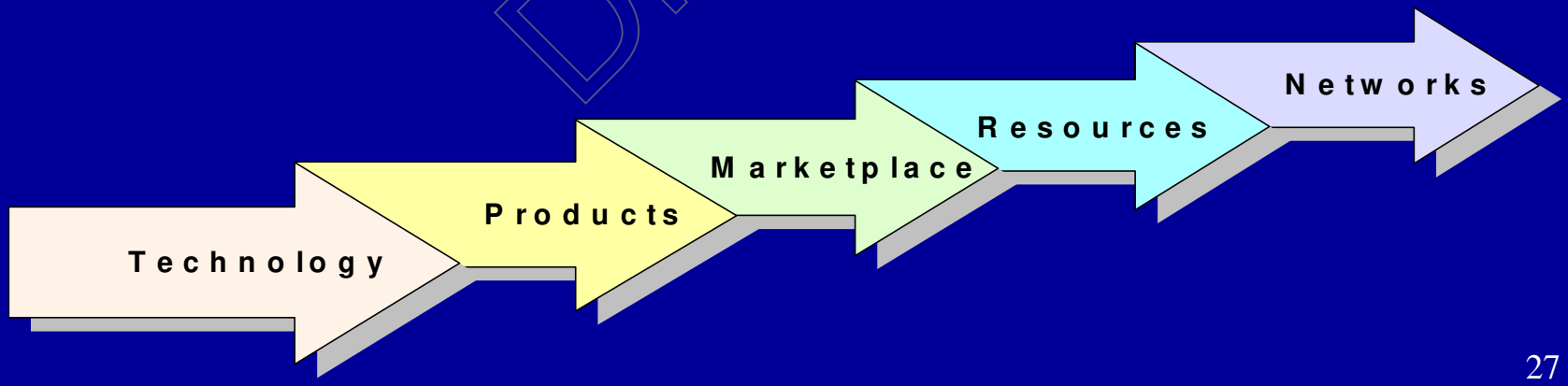


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Forecasting

- To estimate and predict future conditions and events (e.g., technology, products, marketplace - customers, competition and economy, global supply chains, manpower, capital and facilities)

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Purposes of Forecasting

- Set bounds for possibilities to help focus on specifics
- Form basis for setting objectives
- Promote inter-group coordination
- Provide basis for resources allocation (manpower, budget, facilities and business relations - alliances, joint ventures)
- Induce innovation through forecasted needs

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Steps to Forecast

- Identify critical success factors for achieving company goals
- Determine forecasting horizon (short, intermediate and long terms)
- Select forecasting techniques (e.g., trend analysis, statistics, intuition, judgement)
- Predict future states and their probability of occurrence

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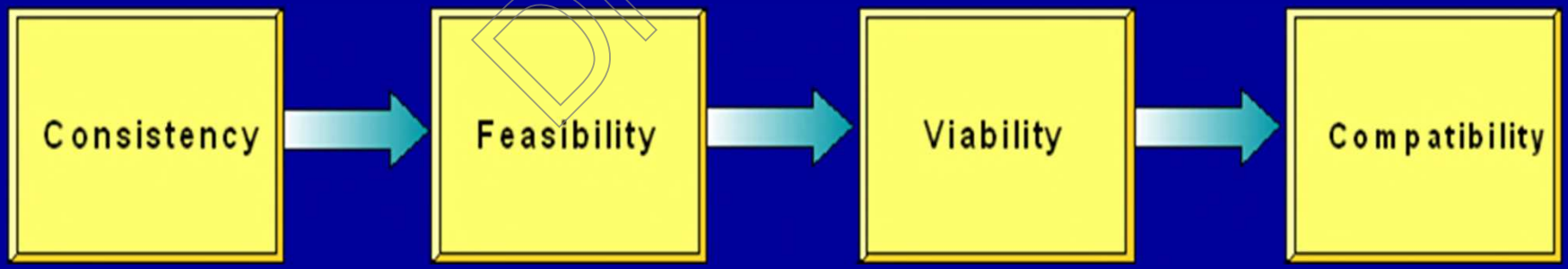
General Comments on Forecasting

- Major economic events tend to change gradually over time
- Future events tend to result from current and past occurrence, in the absence of disruptive changes (e.g., wars, natural disaster, technology break through)
- Important sources of market information: Customers, sales, production, service people

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Criteria for Future-Oriented Ideas

- Consistency with company's objectives
- Technical feasibility to implement
- Financial viability
- Marketplace compatibility



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Technology Forecast

- Impact of new technology on business performance is difficult to forecast
- Engineering managers are in the best position to do forecasting
- Teams of people with divergent experience, exposure and broad perspectives may have a better chance to accurately forecast the future technology impact



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Examples of Challenging Questions

- Will the next waves of new products be the smart appliances? What will be the impact, if many products are made smart, as the processors are getting more powerful and intelligent devices getting smaller and more mobile (e.g., RFID)
- What might be the impact of nano-technology?
- How about the "info-imaging" technologies?
- Any value of the "molecular computing" companies like Hewlett Packard and IBM are working on?

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Examples of Challenging Questions (cont'd)

- How to gauge the impact of "cloud computing" on the consumer markets, as Apple is developing watches, iPhones and other miniature devices to provide access to Internet?
- How quickly has PCs been losing market values, once alternative devices are becoming available to access internet and home appliance, purchase goods/services, and activate entertainment programs remotely?

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Technology Forecasting - Some Guidelines for Engineers

- ***Read*** broadly and ***think*** deeply
- ***Remain*** curious about new technological inventions and innovative applications
- ***Ask*** critical questions and ***exchange*** ideas with networked professionals
- ***Focus*** on potential applications of new technologies which could add value to future customers

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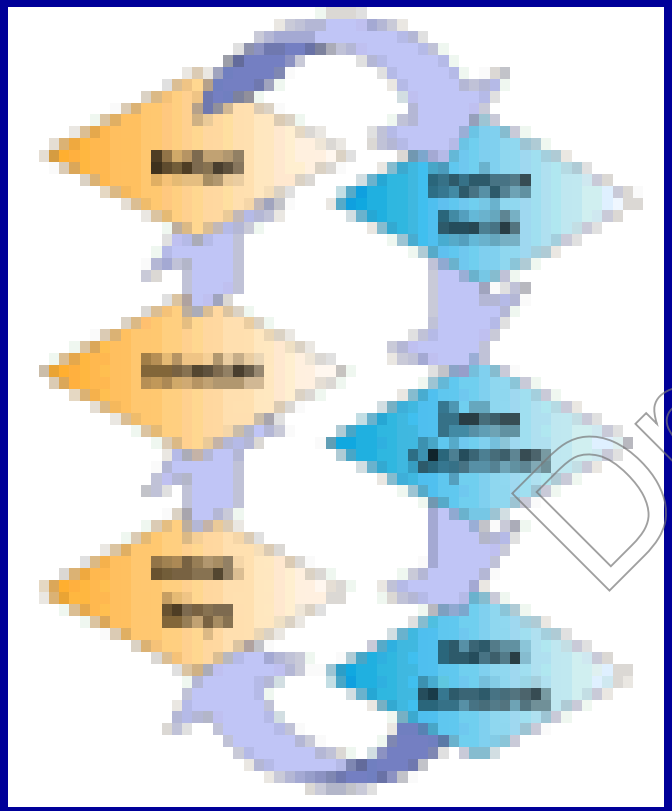
Action Planning



- Benefits: (1) **Focus** on critical areas in need of management attention, (2) **Select** specific results to be accomplished, (3) **Set** metrics to facilitate measurement and control, (4) **Clarify** accountability and permit delegation, (5) **Encourage** teamwork, (6) **Ensure** the continuation of overall performance evaluation

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Action Planning



- Planning Process
  (1) **Analyze** Critical needs,
  (2) **Set** Objectives (what results to be accomplished),
  (3) **Define** metrics to measure performance,
- (4) **Specify** actions steps (sequence and priority of tasks to perform),
- (5) **Determine** dates of task initiation and completion,
- (6) **Develop** a budget (resources to allocate)

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(A) Analyze Critical Needs

- Needs are to be defined with respect to position charter, duties, management expectations, and company goals:
  (1) development needs,
  (2) maintenance needs,
  (3) deficiency needs, and
  (4) strategic needs
- Short-term and long-term needs

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(B) Set Objectives

- Objectives are set to satisfy the critical needs: Write results statement (e.g., what desirable future state to be in and by when)
- Objectives need to be specific and measurable, in order to be useful

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(C) Define Metrics

- Metrics are what takes to measure the attainment of the objectives (be reasonable and pertinent) - Write standards statement
- Metrics need to be quantitative (using numbers, percentages, cost figures, resources parameters) - external and internal
- Metrics need to be defined with doers' participation and consent

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(D) Specify Action Steps

- List major action steps, identify work contents, define sequential relationship between steps, determine resources requirements for each, specify expected results, and assign people to each action step (getting doer's to agree)
- Evaluate risk for completing the steps planned, define contingencies to manage risks

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(E) Determine Schedule

- Determine dates of initiation and completion of each task
- Allow scheduling flexibility (slag) to account for contingency, emergency and other difficult-to-predict deviations from plan
- Focus on management of critical path tasks to avoid any overall delays

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(F) Develop Budget

- Determine the basic resources units (man-hours, man-weeks) to accomplish each steps
- Define other resources (computation, travel expenses, materials, experiments, equipment usage, pilot tests, contract services, support staff, management review, etc.)
- Revise action steps, if projected cost exceeds value expected

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Remarks on Action Planning

- Involve doers in action planning
- Apply computer-based tools (e.g., Microsoft Project, Timeline) to generate PERT or GANTT charts
- Include risks and contingency steps
- Iterate planning process until all parties (top management, doers, team leader, service providers, etc.) involved are satisfied

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Question # 2.1

- On the eve of leaving his alma mater, Joe Engineer remembers the encouraging words of the commencement speaker, "Graduation is the happy beginning of an exciting life ahead." He is of course excited about his new Master of Engineering degree, which he received with honor. But he is also a bit confused about what to do now to make his new life exciting and happy. Apparently, what he needs is a road map into the future. How can you help him?

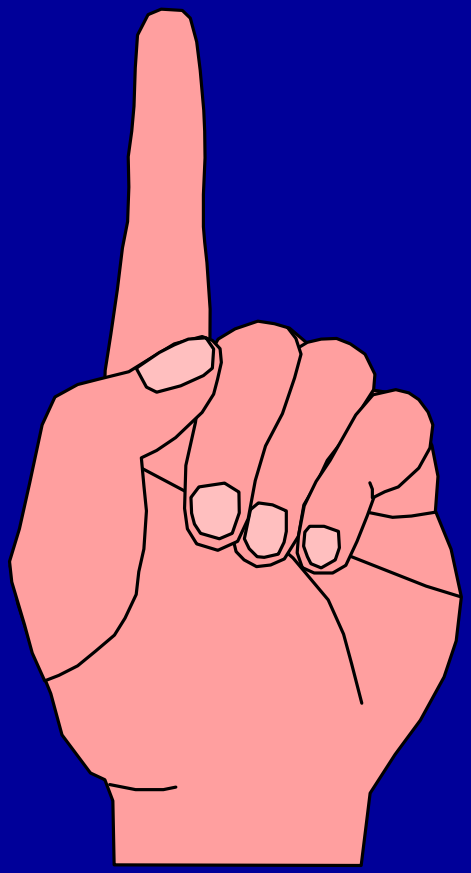
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Question # 2.2

- Joe Engineer took a course while going to graduate school at SUNY-Buffalo. There, he learned the importance of planning. He knows that luck plays a big role in one's life. But he is convinced that a proper planning will help him to have an orderly progression in his career. He thinks that it would be cool to become an CEO at the age of 60 and retiring at 65 with a net worth of $10 MM. He wants some guidance on career planning. How can you help him?

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Issuing Policies



- **Policies** are directives, promulgated to address repetitive questions and issues of general concern
- **Examples**: Hiring/firing guidelines, EEO, performance appraisal, drug policy, savings program, medical insurance, retirement benefits, educational refunds, travel expenses and trip report, technical publications, plant safety, progress reports, staff meeting, etc.

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Purposes of Policies

- ***Save*** management time and efforts, as they address the common and repetitive questions of interest to a large number of employees (policy manuals, web posting)
- ***Capture*** the distilled experience and past learning of the company
- ***Facilitate*** delegation (administered by the secretaries, or human resources group)

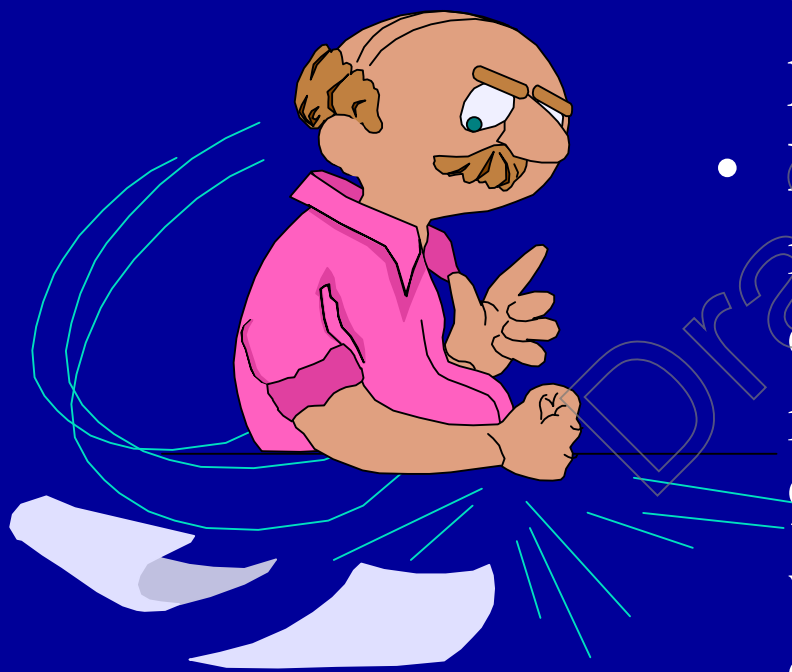
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Characteristics of Policies

- **Apply** uniformly to all employees
- **Being** relatively permanent, when in force
- **Foster** corporate objectives (assure equal treatment of all, encourage skills building via education and seminar attendance, reducing conflicts due to interpretation difference, encourage teamwork, free managers to focus on important work, etc.)

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Establishing Procedures



- **Procedures** are standardized (tried-and-true) method of performing work
- **Examples**: Product design, project management, equipment operation, facility maintenance, installation, procurement, ISO 9002 certification, manufacturing, waste disposal, customer service, customer order processing, and others

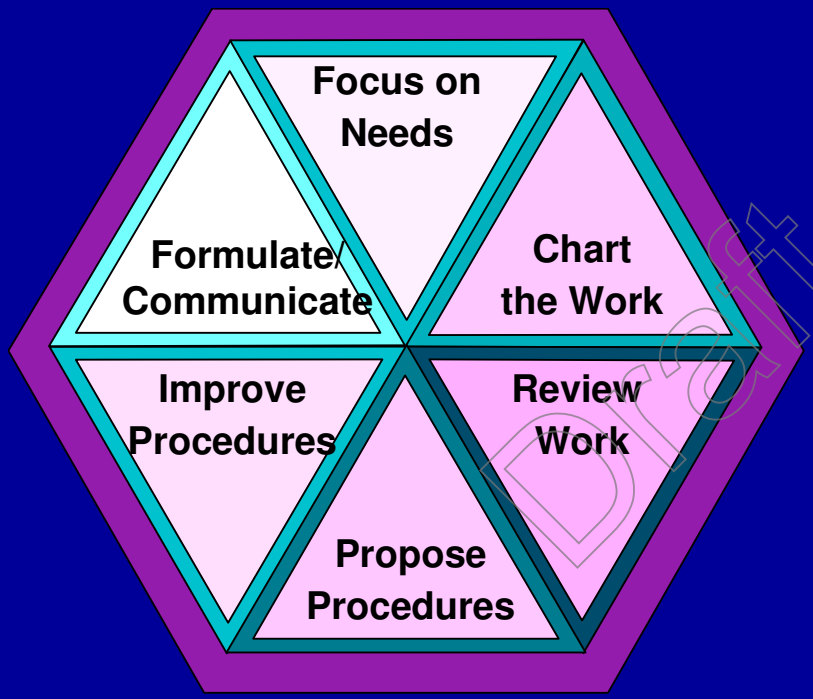
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Importance of Procedures

- **Preserve** the "best" way to perform repetitive work (efficiency-focused)
- **Provide** the basis for method improvements
- **Insure** standardized action (quality control, resource conserving, work reproducibility)
- **Simplify** training
- **Save** corporate memory (know-how, knowledge, heuristics, proven practices)

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Developing Procedures



- (1) Concentrate on critical needs
- (2) Chart the work
- (3) Review work
- (4) Propose procedure
- (5) Improve procedures
- (6) Formulate/ communicate procedures

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Developing Procedures

- (1) ***Concentrate*** on critical repetitive work of time-consuming and high demand nature
- (2) ***Char***t the work (inputs, workflow, outputs, skills, resources)
- (3) ***Study*** work characteristics (Why is it necessary? What results to get? When is best time, where is best place, and who is best person to develop it?)

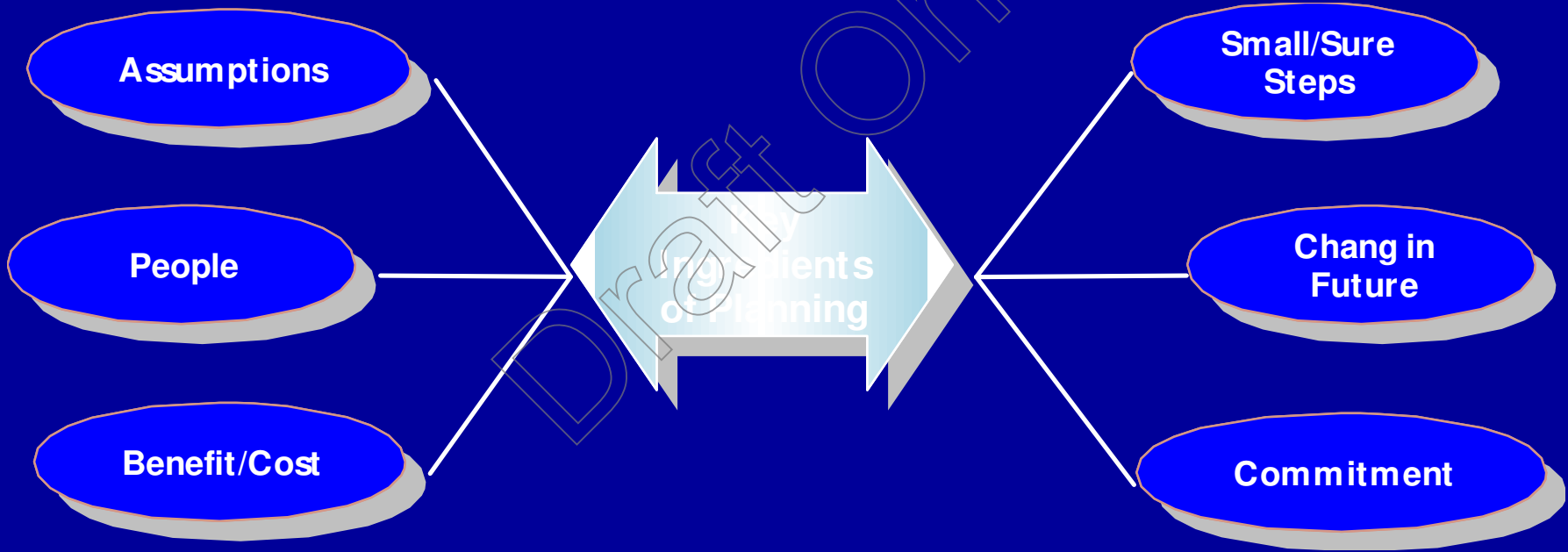
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Developing Procedures (cont'd)

- (4) ***Propose*** procedures (keeping to a minimum to avoid being restrictive, and enable its consistent administration)
- (5) ***Define*** regular improvements to procedures
- (6) ***Formulate*** procedures and communicate widely to assure understanding and acceptance by all involved

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Ingredients of Good Planning



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Key Ingredients

- (1) ***Assumptions*** - Get information, forecast future states, and study/select alternatives, check validity frequently
- (2) ***People*** - Consider involving doers and introduce changes gradually to avoid resistance.
- (3) ***Benefit versus Cost*** - Efforts to implement plan must be commensurate with value expected of the plan (effectiveness doctrine)

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Key Ingredients (cont'd)

- (4) ***Small but Sure Steps*** - Design a series of small steps to reach the expected results, allow timely control and mid-course corrections
- (5) ***Change in Future*** - Anticipate changes in future conditions and include contingency steps with fallback strategies
- (6) ***Commitment*** - Secure commitment of sufficient resources to achieve plan objectives

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Question # 2.7

- There are always risks associated with the experimentation of a new manufacturing process or with the entry into a new global market, the risks of failure. How should one decide to proceed or not to proceed with a risky venture? What is the proper level of risks to take?

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Question # 2.8

- The Marketing Director needs to submit a strategic plan for entering a new market. He knows he needs long periods of uninterrupted time. He considers two options: (1) Staying at home to develop the plan, (2) Delegating some parts of the plan to subordinates. What are the factors the Director needs to consider when he picks the best way to create this plan?

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Summary

- Planning is an important engineering management function, involving (1) forecasting, (2) action planning (3) issuing policies and (4) establishing procedures
- Forecasting and strategic planning are difficult, with performance being unpredictable
- Others planning activities are administrative/ operational in nature and should appear relatively easy to everyone

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Question # 2.3

- The company has always been focused on the high-quality high-price end of the market. Now, market intelligence indicates that some competitors are planning to enter the low-price low-quality end of the market. What should the company do?

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Question # 2.4

- Mission and value statements are indicative of the directions to which a company is headed. What are typically included in the statements of Mission and Value of some well-known companies in the U.S.? Please advise.

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Question # 2.5

- What are included in the operational guidelines some industrial companies have developed? Please advise.

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Question # 2.9

The Office Equipment Company is headed by Glen Jordon, President, who is supported by four people: Ray Fisk, VP Sales, Terry Buford, VP Manufacturing, Fred Hunter, Director of Research, and Bob Christian, Director of Corporate Planning. The company has produced typewriters, calculating machines (desktop with paper tape), accounting machines, and tabulating equipment in the last 40 years. Until two years ago, the company performed well, based on

A. Reputation for quality products and services.
B. Sales increases over the years.
C. Rate of return better than others.
D. Engineering research concentrated on improving existing machines, with new models every few years by introducing small incremental changes.

However, there had been some significant changes in the last two years. For example:

A. Typewriters sales continued to increase.
B. Sales of accounting machines and tabulating equipment become stagnant.
C. Sales of calculating machines dropped more than 50%, due to the low cost hand-held calculators.
D. Customers hold off purchases of traditional products to evaluate minicomputers.

The company is at a crossroads. Two strategic plans were presented to the Board of Directors for review, including budgets.

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1. Plan A (Ray Fisk and Terry Buford)

A. Continue with company's current products. Improve sales through a National Promotion Program:

- Increase advertising budget by 50% to expand market share by 15%, including price cut, if needed.
- Delay a plant modernization for one year.
- Cut R&D by 15%.
- Restore plant modernization and Engineering Research through sales increase in one year.

B. Supporting Arguments

- Projected sales of calculators will remain at present level.
- Company's overall sales will rise by 10 % per year for the next ten years.
- Customers will want special-purpose transistorized equipment, not complicated minicomputers.
- Full utilization of present resources (e.g. marketing organization and approach, production facilities and skills, management experience, etc.)

C. Opposing arguments

- Ignore the roots of company's problems being technology obsolescence and customer's changed needs.
- Advertisement addresses only the issue of product awareness, not technology obsolescence and performance deficiency (e.g. size, convenience, integrated operations, etc.).
- Plan's assumption is not supported by data available.
- Cycling Engineering Research by 15% is impractical.
- Plan represents only a one-year program, not a long-term strategy.

2. Plan B (Fred Hunter and Bob Christian)

A. Change company's business by entering the fields of microprocessors and minicomputers.

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- New line of minicomputers (large scale integrated circuit microprocessor) for office, financial and data processing use in small to medium size organizations.
- New line of typewriter, using integrated circuits and internal memory.
- Double Engineering research staff in two years.
- Continue engineering research on typewriters and drop work on other three.
- Delay plant modernization indefinitely.
- Make major corporate commitment to raise new capital through bond or preferred stock.

B. Supporting Arguments

- Revolutionary impact of microprocessor on company business is forecasted:

  (a) Rapid reduction of microprocessor cost.
  (b) Significant increase in the use of microprocessors.
  (c) Sales of company's currents products are projected to reduce to zero in eight years.
  (d) Sales of typewriters to drop 50% in ten years.
  (e) Company is already 5 years behind.

- Company's long term survival depends on a timely entry into the minicomputer market.

C. Opposing Arguments

- Forecast is not believable.
- Switching company into new technology will need different marketing approach, organization, sales forces, outlets, production facilities, equipment, quality control, inventory management techniques, and management experience.
- Require large capital investment.

Analyze this case and answer three questions: (1) Determine why each of the participants are taking the positions indicated before the Board of Directors? (2) As Chairman of the Board, what action would you take? (3) Is Jordon taking the right approach?

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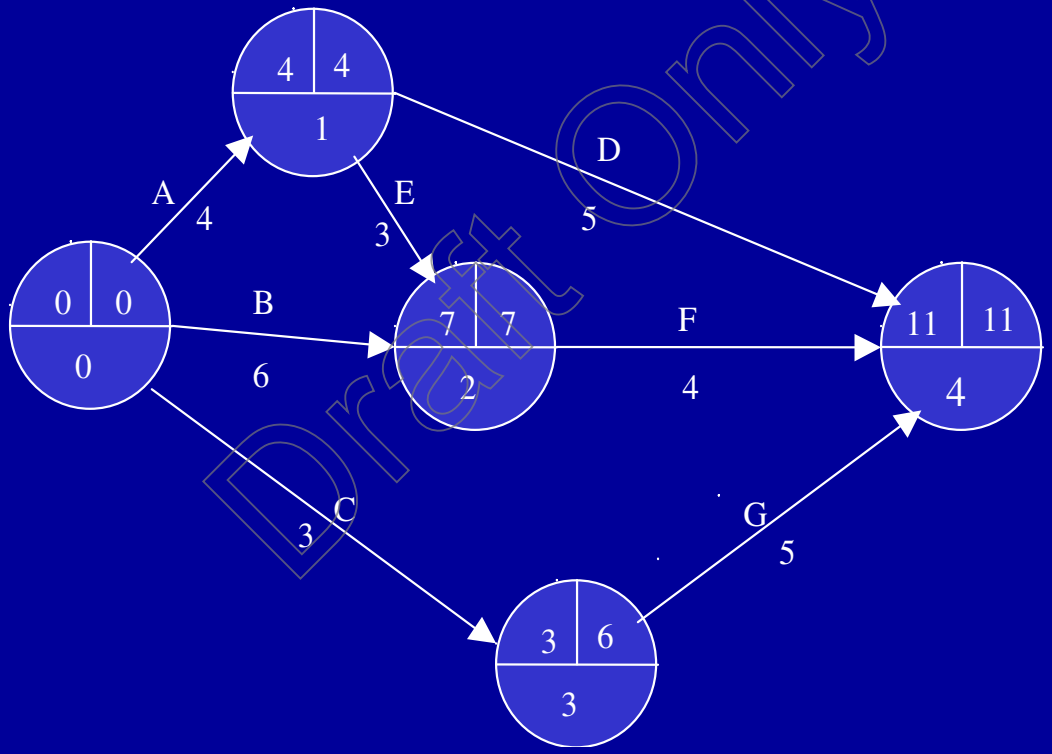
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Question # 2.10

- In planning for a project, the Critical Path Method (CPM) is being used widely in industry. Explain the basic concepts and techniques involved, illustrate it using an example, and discuss its advantages and disadvantages.

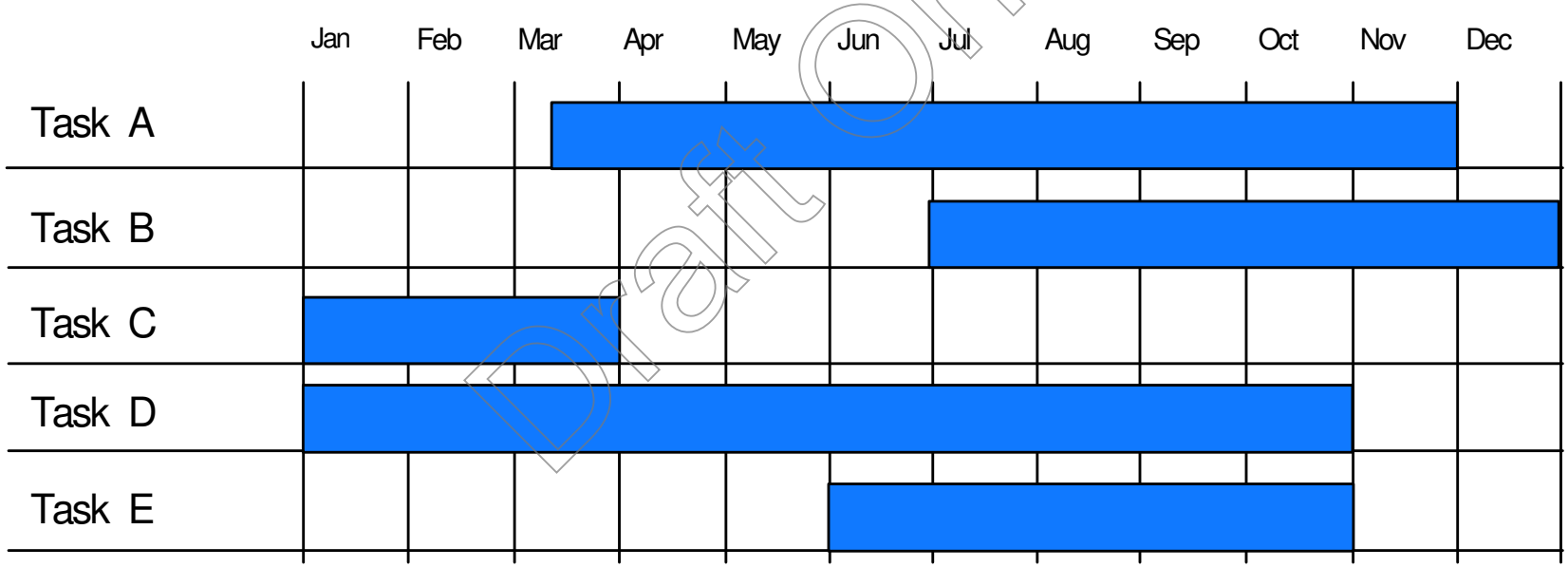
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Answer # 2.10 (CPM Chart)



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Answer # 2.10 (PERT Chart)



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