UNIT-I

TECHNOLOGICAL INNOVATION

INTRODUCTION:

The technological innovation system is a concept developed within the scientific field of innovation studies which serves to explain the nature and rate of technological change. A Technological Innovation System can be defined as 'a dynamic network of agents interacting in a specific economic/industrial area under a particular institutional infrastructure and involved in the generation, diffusion, and utilization of technology'.

The approach may be applied to at least three levels of analysis: to a technology in the sense of knowledge field, to a product or an artifact, or to a set of related products and artifacts aimed at satisfying a particular (societal) function'. With respect to the latter, the approach has especially proven itself in explaining why and how sustainable (energy) technologies have developed and diffused into a society, or have failed to do so.

The system components of a Technological Innovation System are called structures. These represent the static aspect of the system, as they are relatively stable over time. Three basic categories are distinguished:

- **Actors:** Actors involve organizations contributing to a technology, as a developer or adopter, or indirectly as a regulator, financier, etc. It is the actors of a Technological Innovation System that, through choices and actions, actually generate, diffuse and utilize technologies. The potential variety of relevant actors is enormous, ranging from private actors to public actors and from technology developers to technology adopters. The development of a Technological Innovation System will depend on the interrelations between all these actors.
- For example, entrepreneurs are unlikely to start investing in their businesses if governments are unwilling to support them financially. Visa-verse, governments have no clue where financial support is necessary if entrepreneurs do not provide them with the information and the arguments they need to legitimate policy support.
- **Institutions:** Institutional structures are at the core of the innovation system concept. It is common to consider institutions as 'the rules of the game in a society, or, more formally, (...) the humanly devised constraints that shape human interaction'. A distinction can be made between formal institutions and informal institutions, with formal institutions being the rules that are codified and enforced by some authority, and informal institutions being more tacit and organically shaped by the collective interaction of actors. Informal institutions can be normative or cognitive. The normative rules are social norms and values with moral significance, whereas cognitive rules can be regarded as collective mind frames, or social paradigms.
- Examples of formal institutions are government laws and policy decisions; firm directives or contracts also belong to this category. An example of a normative rule is the responsibility felt by a company to prevent or clean up waste. Examples of cognitive rules are search heuristics or problem-solving routines. They also involve dominant visions and expectations held by the actors.

- **Technological factors:** Technological structures consist of artifacts and the technological infrastructures in which they are integrated. They also involve the techno-economic workings of such artifacts, including costs, safety, and reliability. These features are crucial for understanding the feedback mechanisms between technological change and institutional change.
- For example, if R&D subsidy schemes supporting technology development should result in improvements with regard to the safety and reliability of applications, this would pave the way for more elaborate support schemes, including practical demonstrations. These may, in turn, benefit technological Improvements even more. It should, however, be noted here that the importance of technological features has often been neglected by scholars.

The structural factors are merely the elements that make up the system. In an actual system, these factors are all linked to each other. If they form dense configurations they are called networks. An example would be a coalition of firms jointly working on the application of a fuel cell, guided by a set of problem-solving routines and supported by a subsidy program. Likewise, industry associations, research communities, policy networks, user-supplier relations etc. are all examples of networks. An analysis of structures typically yields insight into systemic features - complementarities and conflicts - that constitute drivers and barriers for technology diffusion at a certain moment or within a given period in time.

Seven system functions

As an example, the seven system functions defined by Hekkert are explained here:

- **F1. Entrepreneurial activities:** The classic role of the entrepreneur is to translate knowledge into business opportunities, and eventually innovations. The entrepreneur does this by performing market-oriented experiments that establish change, both to the emerging technology and to the institutions that surround it. The Entrepreneurial Activities involve projects aimed to prove the usefulness of the emerging technology in a practical and/or commercial environment. Such projects typically take the form of experiments and demonstrations.
- **F2. Knowledge development:** The Knowledge Development function involves learning activities, mostly on the emerging technology, but also on markets, networks, users etc. There are various types of learning activities, the most important categories being learning-by-searching and learning-by-doing. The former concerns R&D activities in basic science, whereas the latter involves learning activities in a practical context, for example in the form of laboratory experiments or adoption trials.
- **F3. Knowledge diffusion / knowledge exchange through networks:** The characteristic organization structure of a Technological Innovation System is that of the network. The primary function of networks is to facilitate the exchange of knowledge between all the actors involved in it. Knowledge Diffusion activities involve partnerships between actors, for example technology developers, but also meetings like workshops and conferences. The important role of Knowledge Diffusion stems from Lundvall’s notion of interactive learning as the raison-d’être of any innovation system. The innovation system approach stresses that innovation happens only where actors of different backgrounds interact. A special form of interactive learning is learning-by-using, which involves learning activities based on the

experience of users of technological innovations, for example through user-producer interactions.

- **F4. Guidance of the search:** The Guidance of the Search function refers to activities that shape the needs, requirements and expectations of actors with respect to their (further) support of the emerging technology. Guidance of the Search refers to individual choices related to the technology but it may also take the form of hard institutions, for example policy targets. It also refers to promises and expectations as expressed by various actors in the community. Guidance of the Search can be positive or negative. A positive Guidance of the Search means a convergence of positive signals - expectations, promises, and policy directives - in a particular direction of technology development. If negative, there will be a digression, or, even worse, a rejection of development altogether. This convergence is important since, usually, various technological options exist within an emerging technological field, all of which require investments in order to develop further. Since resources are usually limited, it is important that specific foci are chosen. After all, without any focus there will be a dilution of resources, preventing all options from prospering. On the other hand, too much focus may result in the loss of variety. A healthy Technological Innovation System will strike a balance between creating and reducing variety.
- **F5. Market formation:** Emerging technologies cannot be expected to compete with incumbent technologies. In order to stimulate innovation, it is usually necessary to create artificial (niche) markets. The Market Formation function involves activities that contribute to the creation of a demand for the emerging technology, for example by financially supporting the use of the emerging technology, or by taxing the use of competing technologies. Market Formation is especially important in the field of sustainable energy technologies, since, in this case, there usually is a strong normative legitimating for the intervention in market dynamics.
- **F6. Resource mobilization:** Resource Mobilization refers to the allocation of financial, material and human capital. The access to such capital factors is necessary for all other developments. Typical activities involved in this system function are investments and subsidies. They can also involve the deployment of generic infrastructures such as educational systems, large R&D facilities or refueling infrastructures. In some cases, the mobilization of natural resources, such as biomass, oil or natural gas is important as well. The Resource Mobilization function represents a basic economic variable. Its importance is obvious: an emerging technology cannot be supported in any way if there are no financial or natural means, or if there are no actors present with the right skills and competences.
- **F7. Support from advocacy coalitions:** The rise of an emerging technology often leads to resistance from actors with interests in the incumbent energy system. In order for a Technological Innovation System to develop, other actors must counteract this inertia. This can be done by urging authorities to reorganize the institutional configuration of the system. The Support from Advocacy Coalitions function involves political lobbies and advice activities on behalf of interest groups. This system function may be regarded as a special form of Guidance of the Search. After all, lobbies and advices are pleas in favor of particular technologies. The essential feature which sets this category apart is that advocacy coalitions do not have the power, like for example governments, to change formal institutions directly. Instead, they employ the power of persuasion. The notion of the advocacy coalition is based on the work of Sabatier, who introduced the idea within the context of political science. The concept stresses the idea that structural change within a system is the outcome of competing

interest groups, each representing a separate system of values and ideas. The outcome is determined by political power.

Acquiring new technologies and capabilities

To improve competitiveness and retain sustainability, firms require new technologies and capabilities. In this age of rapid innovation and complexity, it is challenging for the firms to develop internally and remain competitive at the same time. Merger, acquisition and alliance are some of the ways to achieve this, but the primary driver is the desire to obtain valuable resources. Many acquisitions failed to achieve their objectives and resulted in poor performance because of improper implementation.

1. Improper documentation and changing implicit knowledge makes it difficult to share information during acquisition.
2. For acquired firm symbolic and cultural independence which is the base of technology and capabilities are more important than administrative independence.
3. Detailed knowledge exchange and integrations are difficult when the acquired firm is large and high performing.
4. Management of executives from acquired firm is critical in terms of promotions and pay incentives to utilize their talent and value their expertise.
5. Transfer of technologies and capabilities are most difficult task to manage because of complications of acquisition implementation. The risk of losing implicit knowledge is always associated with the fast pace acquisition.

Preservation of tacit knowledge, employees and literature are always delicate during and after acquisition. Strategic management of all these resources is a very important factor for a successful acquisition. Increase in acquisitions in our global business environment has pushed us to evaluate the key stake holders of acquisition very carefully before implementation. It is imperative for the acquirer to understand this relationship and apply it to its advantage. Retention is only possible when resources are exchanged and managed without affecting their independence.

THE NEED FOR A CONCEPTUAL APPROACH:

Technology management is a set of management disciplines that allows organizations to manage their technological fundamentals to create competitive advantage. Typical concepts used in technology management are:

- Technology strategy (a logic or role of technology in organization),
- Technology Forecasting (identification of possible relevant technologies for the organization, possibly through technology scouting),
- Technology Roadmap (mapping technologies to business and market needs), and
- Technology project portfolio (a set of projects under development) and technology portfolio (a set of technologies in use).

The role of the technology management function in an organization is to understand the value of certain technology for the organization. Continuous development of technology is valuable as long as there is a value for the customer and therefore the technology management function in an organization should be able to argue when to invest on technology development and when to withdraw.

Conceptual Approach to Defining Technology Development Requirements Based on End State Criteria

A conceptual approach to deriving a technology development program is based on end state criteria. This chapter discusses end states for wastes, the justification for using end states as a basis for defining a technology development program, and a conceptual approach to defining a technology development program based on end state considerations.

Definition, Purpose, and Meaning of an End State Based Approach

The establishment of fully defined program objectives and of clear program priorities for technology development investments has become increasingly important to the Office of Environmental Management (EM) for meeting schedules, cost constraints, and other requirements. A systematic planning process should provide the framework for identification of technology development needs. The use of a systematic process is imperative for efficient and effective completion of EM's mission to manage the environmental problems at its sites. The end state approach recommended by this committee is such a systematic and disciplined process.

The committee notes that the end state based approach is similar in principal to the widely used systems engineering process to define technology development needs. Top-level requirements defined as a part of the systems engineering process include end state specifications, and the flow down there from provides specific requirements for each process step. The functional flow sheets defined as a part of the end state approach are the same as the architectures that are part of the systems engineering process. Both approaches call for explicit consideration of alternatives. The primary distinction between these two approaches is that the portions of the systems engineering process related to definition of a technology development program have been elaborated in the end state based approach to fulfill the purposes of this report.

In an earlier report, the National Research Council (1996a) concluded that end state specification of the products resulting from remediation activities are an appropriate and necessary basis for planning and conducting a waste-related technology development program. In this context, an end state can be expressed as the desired composition, configuration, performance, and location of a particular waste product at the completion of remediation activities, frequently wastes emplaced in a disposal facility. If the phased-decision approach

The process of using end state specifications to derive technology development requirements is shown in Figure. The committee proposes a seven-step approach for identifying technology development needs for remediation of the waste in tanks and the tank sites:

1) characterize the initial state or condition of the wastes and sites to be remediated,

2) identify reference and alternative scenarios to accomplish the general remediation objective,

3) specify the waste forms and environmental conditions as the desired end states,

4) define the functional flow sheets required to transform the initial waste or waste site into the desired end states,

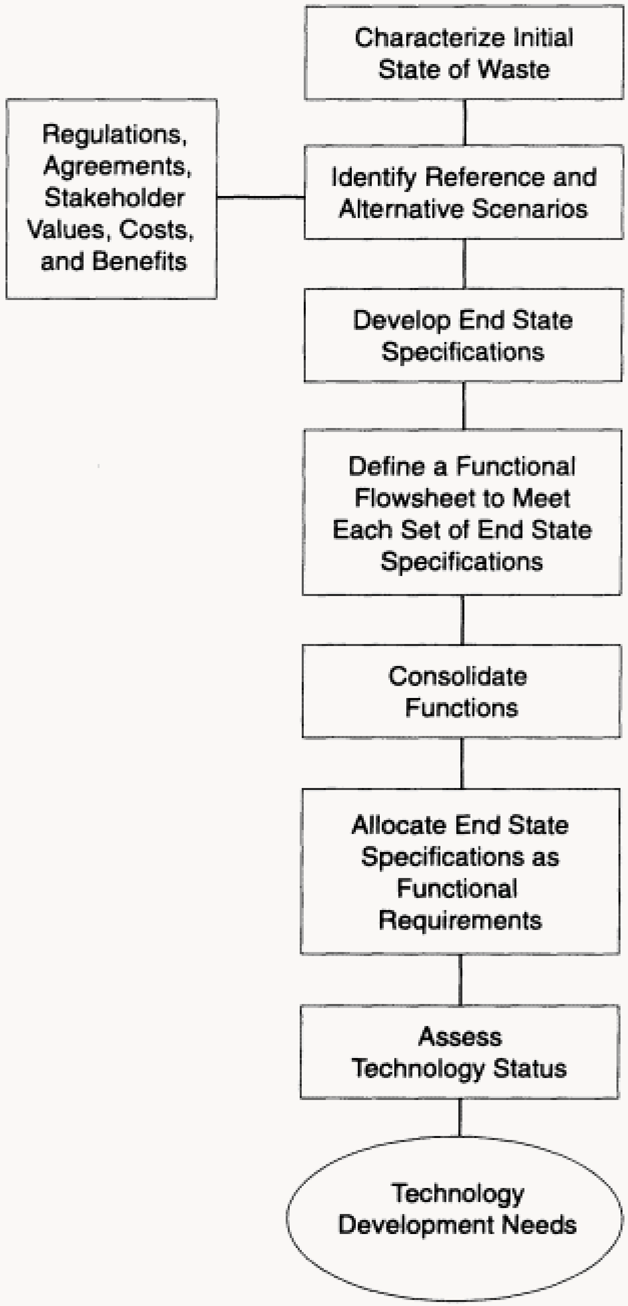
5) combine essentially identical functions in the flow sheets into a unique set of functions,

6) allocate end state specifications to each processing function as functional requirements, and

7) assess the respective development or deployment status of the technology required for each function to yield technology needs.

In the final analysis, the approach for identifying the technology development needs noted in this study was driven by end states that are believed to be reasonable in terms of regulatory, budgetary, and technical acceptability. Critical to managing the end state based approach is the level of detail associated with the definition of scenarios and functional flow sheets. Consideration of functional operations rather than specific processes is required. The framework of scenarios in which technologies are discussed in this report is defined at a relatively high level to avoid having the study consumed in the details of flow sheet process engineering and chemistry.

The development of the end state approach begins by *characterizing the initial state* of the subject waste to provide the data for subsequent processes and evaluations. The initial state represents the existing condition of the waste being managed and is often thought to be only the compositional and physical characteristics of the stored waste. In systems as complex as those at Department of Energy (DOE) sites, many other aspects, such as the contaminated environment surrounding the tanks, must be included in the definition of the initial state. These are discussed in a following section on characterization of the initial state. Based on knowledge of the initial state, a few plausible approaches are developed that will result in the transition of the waste from its initial state to an end state. These approaches, called *scenarios*, are qualitative descriptions of the transition path of waste from its initial state to an end state. Examples of scenario descriptions are 'exhume all waste to yield a site suitable for unrestricted use' or 'stabilize waste in place with long-term institutional controls.' Scenario development would focus on a *reference scenario* that is based on the best current judgment of the most desired processes for remediation. In general, scenario definition should also include a few plausible *alternative scenarios* that incorporate reasonable changes in circumstances. Then, *end state specifications* are developed for each scenario. Selection of the scenario and its associated end state(s) is based on such considerations as risk reduction, cost minimization, environmental regulations, and stakeholder values. A complete specification of an end state will include not only compositional and physical requirements that meet product



Process for Using End State Criteria to Derive Technology Development

Benefits and Limitations of the Approach

The primary benefits of an end state based approach as a basis for a technology development program are (1) the technology development needs are specifically tied to a plausible set of end states for the initial wastes by an explicit decision logic, (2) the technology development program is designed to support multiple plausible sets of end states until a final decision on the preferred end state or end states is made, and (3) the technology development program that uses this process properly has the integrity to withstand scrutiny from the research community at large, Congress, stakeholders, and various DOE review committees.

The explicit connection of the technology development program to the desired end states of the initial wastes is intended to impose discipline and efficiency on the technology development program. The need for each technology development project may be derived from a specification of the end state to be achieved and a technology assessment to determine whether additional development is required. A proposed technology development project that cannot lead to achieving a plausible end state should not be funded unless it addresses other technical needs related to implementation of new technology. If technology to achieve the end state already exists, then justification of additional technology development would require that such development lead to increased benefits, such as reduction of implementation cost or risk, that would compensate for the projected cost of the development. In the absence of an end state based approach, there is the risk that some research projects would address inconsequential needs.

Because technology development typically requires years to produce deployable results, whereas knowledge concerning remediation problems and decisions on how to best manage them are changing much more frequently, a technology development program must proceed in the face of considerable uncertainty. As technology development nears completion, its results, when combined with an analysis of relevant externally imposed constraints, will provide decision makers with reliable information to make informed decisions on technology implementation. If technology development supporting only a reference scenario is pursued, changes in externally imposed constraints (such as resource limitations or changes in allowable risks) may inhibit or prevent implementation of the reference approach due to inadequate technology. Without pursuing technology development for the alternative scenarios, the information needed to select the best course of action will not be available and, if the reference approach is even partially deficient, there will be costly delays stemming from the time required to develop additional technology.

The issue of how to allocate technology development resources among reference and alternative scenarios is a policy decision that should be explicitly addressed by DOE. Investing a significant fraction of technology development resources in functions supporting alternative scenarios and their associated end states is a useful form of technology portfolio management. Not all remediation problems require technology development or consideration of alternative scenarios. If remediation can be completed in the near term with an acceptable[2] demonstrated technology, then technology development is not required. If remediation is to be completed in the near term, but technology is inadequate, it is likely that only a reference scenario and its associated set of end states need to be addressed. However, the remediation problems in which EM is investing most of its technology development resources involve complex, long-term projects [e.g., high-level waste (HLW) tank remediation, subsurface contamination, facility decontamination and decommissioning] where changes in such external factors as budget, regulations, and stakeholder values are likely to occur. In these cases, an end state based approach that includes reference and alternative scenarios should be used.

The consideration of reference and alternative scenarios and their associated end states as described here is not intended to address the issue of whether redundant technology development should be supported to meet the end state specifications of a specific scenario. That is, the scope of alternatives does not address whether two or more different technology development projects should be pursued to meet a specific functional requirement. Such redundancy is justifiable when the need is critical or the probability for success of a single technology is judged to be low.

Another benefit of using the end state based approach to define an appropriate technology development program is its clarity (i.e., it can be readily understood). When properly documented, there is a clear path from the problem to the solution through specification of the initial problem, definition of a reference scenario and alternatives to accommodate uncertainty, identification of functional approaches to move from the initial problem to the solution, assessment of the adequacy of existing technology, and support for technology development only in those areas where technology is inadequate. The existence of this traceable path provides clear linkage of the proposed technology development projects to the ultimate desired end state of the waste, which, after appropriate independent reviews, should provide adequate justification to decision makers to support the technology development program. Achieving this linkage requires documentation of the various steps taken to implement the end state based approach. Detailed documentation should be provided to those directly involved in the process (i.e., problem owners, technology providers, reviewers). The committee notes that this documentation tends to be voluminous and frequently incomprehensible to decision makers, who need summary formats that focus on the relationship of technology development projects to bridging the gap between the initial and end states.

5 factors for successful technological innovation

Leadership support. Support for technological innovation at the executive and administrator level helps foster a campus culture where innovation is encouraged, allows for some level of risk, and strengthens the overall potential for success. A willingness of an organization to allow some amount of trial and error is needed because not all innovative efforts lead to success. Having upper-level support gives IT leaders the freedom to take risks when pursuing cutting-edge solutions for their campus and gives IT personnel the latitude to experiment. The campus benefits from these endeavors through an increased potential to find viable creative solutions.

Stakeholder involvement. Involvement of faculty, staff and students helps to map technological innovation efforts, which is crucial to the direction of technology on college campuses. A fundamental element of stakeholder involvement is communication; therefore, IT leaders are always searching for effective ways to communicate their ideas. Ultimately, the goal of the communication is to solicit the input of faculty, staff and students regarding technological initiatives and to garner their support.

Training. To sustain ongoing use and stimulate future expansion of technologies, training is paramount. However, over time training tends to become diluted by the daily activities of the campus community and is further eroded by the turnover of knowledgeable faculty and staff. The knowledge base that has gradually developed over time can be depleted. On the other hand, new training opportunities may be realized through the infusion of new personnel and the new perspectives they bring with them.

Resources and financial support. It is important for IT leaders to budget for technological innovation; otherwise, you can easily get caught drifting in a rapidly moving current with little control of your destination. IT leaders cannot take too many chances in terms of innovation because that can be costly and have an adverse effect on their budgets. However, playing it too safe can put IT leaders behind the curve and cause them to fall short of meeting technological expectations.

Support from campus community. Skill level of faculty, staff and students helps determine the success or failure of a technological innovation because it impacts the adoption and use of the technology. Users' ability and acceptance of the technology are integral to adopting the process. But if the technology is too complex or has little support from the campus community, a lack of adoption may impede the probability of success. Regardless of how beneficial a technological innovation can be to an institution, the benefits of that technology cannot be realized without the commitment of the campus community. Rapid changes in technology require higher education institutions to stay current to address the needs of an evolving audience. Increasing expectations may be attributed to the technologically savvy environment in which we live as well as to the advances in technology that are occurring on a continual basis.

To help meet the challenges of this changing environment, IT leaders must continually seek new ways to be innovative, wisely invest their scarce resources, and fully leverage new technologies to realize their maximum value.

Research and Development Strategies

The need to develop or improve products and production processes is met by the research and development (R&D) functions. outlines several questions that need to be considered in developing an R&D strategy. The most important research and development strategy issue concerns the relationship of R&D to corporate strategy. The more important innovation is to the strategy of the organization, the more implementation will require consideration of strategic issue in R&D.Moreover, if R&D is part of an aggressive new product development strategy, aseries of decisions logically follow from such a link, including funding levels, project selection decisions, and the structure for R&D. If R&D is used primarily for process improvement, the decisions are more conservative.

Failure to integrate strategies is failure to consider the cross-functional implications of strategy when the critical issues of strategy are apprised.

Cross-functional implications of strategy can be identified by considering the following:

Formulation

Careful consideration of the strengths and weaknesses of the organization includes a review of the functional areas which should alert managers to potential conflicts.

Trade-offs

A strategy which is comprehensive should spell out certain major trade-offs.

Communication

Communication of the strategy is a way of giving functional areas the same information.

Participation

Functional managers who have some part in the process of formulating and implementing strategy are in a better position to understand what is required of them.

Close lateral relations

As functional specialists have closer contact with each other, trade-offs can be better assessed.

Multifunctional experience

Many organizations require that managers spend part of their tenure in functions other that their own specialty.

Coordination

As part of the implementation process of identifying strategic issues for each of the functional areas, the cross-functional implications of a change in strategy should be addressed.

What is 'Research and Development - R&D'

Research and development (R&D) refers to the investigative activities a business conducts to improve existing products and procedures or to lead to the development of new products and procedures. Consumer companies across all sectors and industries utilize R&D to improve on product lines, and corporations experience growth through these improvements and through the development of new goods and services. In general, pharmaceuticals, semiconductor and software/technology companies tend to spend the most on R&D.

BREAKING DOWN 'Research and Development - R&D'

The term "research and development" is widely linked to the concept of corporate or governmental innovation. Known as research and technical/technological development (RTD) in Europe, activities that are classified as R&D differ from one company to the next, but standard primary models have been identified.

Basic Research and Development Organizational Setups

There are two basic R&D structures that have emerged in companies throughout the commerce spectrum. One R&D model is a department that is staffed primarily by engineers who develop new products, a task that typically involves extensive research. The other model involves a department composed of industrial scientists or researchers, all tasked with applied research in technical, scientific or industrial fields, which is aimed at the facilitation of the development of future products or the improvement of current products and/or operating procedures.R&D is different from most activities performed by a corporation in the process of operation. The research and/or development is typically not performed with the expectation or goal of immediate profit. Instead, it is focused on long-term profitability for a company. Companies that employ entire departments devoted to R&D commit substantial capital to the effort. They must estimate the risk-adjusted return on their R&D expenditures, which inevitably involve risk of capital, as no immediate payoff is experienced and the general return on investment (ROI) is somewhat uncertain. The level of capital risk increases as more is spent on R&D.

Basic vs. Applied Research

Basic research is systematic study aiming at fuller, more complete knowledge and understanding of the fundamental aspects of a concept or a phenomenon. Basic research is generally the first step in research and development, performed to give a comprehensive understanding of information without directed applications toward products, policies or operational processes. Applied research is the systematic study and gleaning of knowledge and understanding to apply to determining and developing products, policies or operational processes. While basic research is time-consuming, applied research is painstaking and more costly due to its detailed and complex nature. R&D management is the discipline of designing and leading R&D processes, managing R&D organizations, and ensuring smooth transfer of new know-how and technology to other groups or departments involved in innovation. R&D management can be defined as where the tasks of innovation management (i.e., creating and commercializing inventions) meet the tasks of technology management (i.e., external and internal creation and retention of technological know-how).[3] It covers activities such as basic research, fundamental research, technology development, advanced development, concept development, new product development, process development, prototyping, R&D portfolio management, technology transfer, etc., but generally is not considered to include technology licensing, innovation management, IP management, corporate venturing, incubation, etc. as those are sufficiently independent activities that can be carried out without the presence of a R&D function in a firm.

Definitions:

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Management models:

Few dedicated management models for R&D exist. Among the more popularized ones are Arthur D. Little's Third generation R&D management, the Development funnel, the Phase-gate model All these models are concerned with improving R&D performance and result productivity, managing R&D as a process, and providing the R&D function with an environment in which the inherent technological and market uncertainties can be managed. The Path to

Developing Successful New Products a joint research by MIT & McKinsey & Co. points out three key practices that can play critical role in R&D Management: Talk to the customer, Nurture a project culture, Keep it focused.

In business, a **competitive advantage** is the attribute that allows an organization to outperform its competitors. A competitive advantage may include access to natural resources, such as high-grade ores or a low-cost power source, highly skilled labor, geographic location, high entry barriers, and access to new technology.

The three forms of generic competitive strategy

Michael Porter, a graduate of Harvard University, wrote a book in 1985 which identified three strategies that businesses can use to tackle competition. This book was named the ninth most influential management book of the 20th century. These approaches can be applied to all businesses whether they are product-based or service-based. He called these approaches generic strategies. They include cost leadership, differentiation and focus. These strategies have been created to improve and gain competitive advantage over competitors. These strategies can also be recognized as the comparative advantage and the differential advantage.

Cost leadership strategy

Cost leadership is a business ability to produce a product or service that will be at a lower cost than other competitors. If the business is able to produce the same quality product but sell it for less this gives them a competitive advantage over other businesses. Therefore, this provides a price value to the customers. Lower costs will result in higher profits as businesses are still making a reasonable product on each good or service sold. If businesses are not making a large enough profit, Porter recommends finding a lower-cost base such as labor, materials and facilities. This gives businesses a lower manufacturing cost over those of other competitors. The company can add value to the customer via transfer of the cost benefit to them.

Differential strategy

A differential advantage is when a business' products or services are different to its competitors. In his book, Michael Porter recommended making those goods or services attractive to stand out from their competitors. The business will need strong research, development and design thinking to create innovative ideas. These improvements to the goods or service could include delivering high quality to customers. If customers see a product or service as being different from other products, consumers are willing to pay more to receive these benefits.

Focus strategy

Focus strategy ideally tries to get businesses to aim at a few target markets rather than trying to target everyone. This strategy is often used for smaller businesses, as they may not have the appropriate resources ability to target everyone. Businesses that use this method usually focus on the needs of the customer and how their products or services could improve their daily lives. In this method, some firms may even let consumers give their inputs for their product or service.

This strategy can also be called the segmentation strategy, which includes geographic, demographic, behavioral and physical segmentation. By narrowing the market down to smaller segments, businesses are able to meet the needs of the consumer. Porter believes that once businesses have decided what groups they will target, it is essential to decide if they will take the cost leadership approach or differentiation approach. Focus strategy will not make a business successful. Porter mentions that it is important to not use all 3 generic strategies because there is a high chance companies will come out achieving no strategies instead of achieving success. This can be called ‘stuck in the middle’ and the business won't be able to have a competitive advantage. When businesses can find the perfect balance between price and quality, it usually leads to a successful product or service. A product or service must offer value through price or quality to ensure the business is successful in the market. To succeed, it’s not enough to be ‘just as good as’ another business. Success comes to firms that can deliver a product or service in a manner that is different, meaningful and based on their customers' needs and desires. Deciding on the appropriate price and quality depends on the business' brand image and what they hope to achieve with relation to their competition.

Creative problem solving isn't just brainstorming, although that's what many people may associate it with. It's actually a well-defined process that can help you from problem definition to implementing solutions, according to Jeffrey Baumgartner.

A 7-step CPS framework

Although creative problem solving has been around as long as humans have been thinking creatively and solving problems, it was first formalised as a process by Alex Osborn, who invented traditional brainstorming, and Sidney Parnes. Their Creative Problem Solving Process (CPSP) has been taught at the International Center for Studies in Creativity at Buffalo College in Buffalo, New York since the 1950s.

However, there are numerous different approaches to CPS. Mine is more focused on innovation (that is the implementation of the most promising ideas). It involves seven straightforward steps.

CPS Steps

1. Clarify and identify the problem
2. Research the problem
3. Formulate creative challenges
4. Generate ideas
5. Combine and evaluate the ideas
6. Draw up an action plan

7. Do it! (implement the ideas)

Let us look at each step more closely:

1. Clarify and identify the problem

Arguably the single most important step of CPS is identifying your real problem or goal. This may seem easy, but very often, what we believe to be the problem is not the real problem or goal. For instance, you may feel you need a new job. However, if you break down your problem and analyse what you are really looking for, it may transpire that the actual issue is that your income does not cover your costs of living. In this case, the solution may be a new job, but it might also be to re-arrange your expenses or to seek a pay rise from your existing employer.

Five whys: A powerful problem-definition technique

The best way to clarify the problem and understand the underlying issues is to ask yourself – or better still, ask a friend or family member to ask you – a series of questions about your problem in order to clarify the true issues behind the problem. The first question to ask is simply: "why is this a problem?" or "why do I wish to achieve this goal?" Once you have answered that, ask yourself "why else?" four more times.

For instance, you might feel you want to overcome your shyness. So, you ask yourself why and you answer: "because I am lonely". Then ask yourself "Why else?" four times. You answer: "Because I do not know many people in this new city where I live", "Because I find it hard to meet people", "Because I am doing many activities alone" and "Because I would like to do activities with other people who share my interests". This last "why else" is clearly more of the issue than reducing shyness. Indeed, if you had focused your creative energy on solving your shyness issue, you would not have actually solved the real problem. On the other hand, if you focused your creative energy on finding people with whom to share activities, you would be happier without ever having to address the shyness issue.

More questions you can ask to help clearly define the problem

In addition, you can further clarify your problem by asking questions like: "What do I really wish to accomplish?", "What is preventing me from solving this problem/achieving the goal?", "How do I envision myself in six months/one year/five years [choose most relevant time span] as a result of solving this problem?" and "Are my friends dealing with similar problems? If so, how are they coping?"

By the time you have answered all these questions, you should have a very clear idea of what your problem or real goal is.

Set criteria for judging potential solutions

The final step is to decide what criteria you will eventually use to evaluate or judge the ideas. Are there budget limitations, timeframe or other restrictions that will affect whether or not you can go ahead with an idea? What will you want to have accomplished with the ideas? What do you wish to avoid when you implement these ideas? Think about it and make a list of three to five evaluation criteria. Then put the list aside. You will not need it for a while.

2. Research the problem

The next step in CPS is to research the problem in order to get a better understanding of it. Depending on the nature of the problem, you may need to do a great deal of research or very little. The best place to start these days is with your favourite search engine. But do not neglect good old fashioned sources of information and opinion. Libraries are fantastic for in-depth information that is easier to read than computer screens. Friends, colleagues and family can also provide thoughts on many issues. Fora on sites like LinkedIn and elsewhere are ideal for asking questions. There's nothing an expert enjoys more than imparting her knowledge. Take advantage of that. But always try to get feedback from several people to ensure you get well-rounded information.

3. Formulate one or more creative challenges

By now, you should be clear on the real issues behind your problems or goals. The next step is to turn these issues into creative challenges. A creative challenge is basically a simple question framed to encourage suggestions or ideas. In English, a challenge typically starts with "In what ways might I [or we]…?" or "How might I…?" or "How could I…?"

Creative challenges should be simple, concise and focus on a single issue. For example: "How might I improve my Chinese language skills and find a job in Shanghai?" is two completely separate challenges. Trying to generate ideas that solve both challenges will be difficult and, as a result, will stifle idea generation. So separate these into two challenges: "How might I improve my Chinese language skills?" and "How might I find a job in Shanghai?" Then attack each challenge individually. Once you have ideas for both, you may find a logical approach to solving both problems in a coordinated way. Or you might find that there is not a coordinated way and each problem must be tackled separately.

Creative challenges should not include evaluation criteria. For example: “How might I find a more challenging job that is better paying and situated close to my home?” If you put criteria in the challenge, you will limit your creative thinking. So simply ask: “How might a I find a more challenging job?” and after generating ideas, you can use the criteria to identify the ideas with the greatest potential.

4. Generate ideas

Finally, we come to the part most people associate with brainstorming and creative problem solving: idea generation. And you probably know how this works. Take only one creative challenge. Give yourself some quiet time and try to generate at least 50 ideas that may or may not solve the challenge. You can do this alone or you can invite some friends or family members to help you.

Irrespective of your idea generation approach, write your ideas on a document. You can simply write them down in linear fashion, write them down on a mind map, enter them onto a computer document (such as Microsoft Word or OpenOffice) or use a specialized software for idea generation. The method you use is not so important. What is important is that you follow these rules:

Write down every idea that comes to mind. Even if the idea is ludicrous, stupid or fails to solve the challenge, write it down. Most people are their own worst critics and by squelching their own ideas, make themselves less creative. So write everything down. NO EXCEPTIONS!

If other people are also involved, insure that no one criticizes anyone else’s ideas in any way. This is called squelching, because even the tiniest amount of criticism can discourage everyone in the group for sharing their more creative ideas. Even a sigh or the rolling of eyes can be critical. Squelching must be avoided!

If you are working alone, don’t stop until you’ve reached your target of 50 (or more) ideas. If you are working with other people, set a time limit like 15 or 20 minutes. Once you have reached this time limit, compare ideas and make a grand list that includes them all. Then ask everyone if the have some new ideas. Most likely people will be inspired by others’ ideas and add more to the list.

If you find you are not generating sufficient ideas, give yourself some inspiration. A classic trick is to open a book or dictionary and pick out a random word. Then generate ideas that somehow incorporate this word. You might also ask yourself what other people whom you know; such as your grandmother, your partner, a friend or a character on your favorite TV show, might suggest.

Brainstorming does not need to occur at your desk. Take a trip somewhere for new inspiration. Find a nice place in a beautiful park. Sit down in a coffee shop on a crowded street corner. You can even walk and generate ideas.

In addition, if you browse the web for brainstorming and idea generation, you will find lots of creative ideas on how to generate creative ideas!

One last note: If you are not in a hurry, wait until the next day and then try to generate another 25 ideas; ideally do this in the morning. Research has shown that our minds work on creative challenges while we sleep. Your initial idea generation session has been good exercise and has certainly generated some great ideas. But it will probably also inspire your unconscious mind to generate some ideas while you sleep. Don't lose them!

5. Combine and evaluate ideas

After you have written down all of your ideas, take a break. It might just be an hour. It might be a day or more. Then go through the ideas. Related ideas can be combined together to form big ideas (or idea clusters).

Then, using the criteria you devised earlier, choose all of the ideas that broadly meet those criteria. This is important. If you focus only on the "best" ideas or your favorite ideas, the chances are you will choose the less creative ones! Nevertheless, feel free to include your favorite ideas in the initial list of ideas.

Now get out that list of criteria you made earlier and go through each idea more carefully. Consider how well it meets each criterion and give it a rating of 0 to 5 points, with five indicating a perfect match. If an idea falls short of a criterion, think about why this is so. Is there a way that it can be improved in order to increase its score? If so, make a note. Once you are finished, all of the ideas will have an evaluation score. Those ideas with the highest score best meet your criteria. They may not be your best ideas or your favorite ideas, but they are most likely to best solve your problem or enable you to achieve your goal.

Depending on the nature of the challenge and the winning ideas, you may be ready to jump right in and implement your ideas. In other cases, ideas may need to be developed further. With complex ideas, a simple evaluation may not be enough. You may need to do a SWOT (strengths, weaknesses, opportunities and threats) analysis or discuss the idea with others who will be affected by it. If the idea is business related, you may need to do a business case, market research, build a prototype or a combination of all of these.

Also, keep in mind that you do not need to limit yourself to one winning idea. Often you can implement several ideas in order to solve your challenge.

6. Draw up an action plan

At this point, you have some great ideas. However, a lot of people have trouble motivating them to take the next step. Creative ideas may mean big changes or taking risks. Some of us love change and risk. Others are scared by it. Draw up an action plan with the simple steps you need to take in order to implement your ideas. Ideas that involve a lot work to implement can be particularly intimidating. Breaking their implementation down into a series of readily accomplished tasks makes these ideas easier to cope with and implement.

7. Do it!

This is the simplest step of all. Take your action plan and implement your idea. And if the situation veers away from your action plan steps, don't worry. Rewrite your action plan!

CPS and innovation

Any effective innovation initiative or process will use CPS at the front end. Our innovation process does so. TRIZ also uses elements of CPS. Any effective and sustainable idea management system or ideation activity will be based on CPS.
Systems and methods that do not use CPS or use it badly, on the other hand, tend not to be sustainable and fail early on. Suggestion schemes in which employees or the public are invited to submit any idea whatsoever are effectively asking users of the system to determine a problem and then offer a solution. This will result not only in many ideas, but many different problems, most of which will not be relevant to your strategic needs. Worse, having to evaluate every idea in the context of its implied problem – which may not be clear – is a nightmare from a resource point of view.

UNIT-II

FINANCIAL EVALUATION OFRESEARCH AND DEVELOPMENT

Cost-effectiveness analysis (**CEA**) is a form of economic analysis that compares the relative costs and outcomes (effects) of different courses of action. Cost-effectiveness analysis is distinct from cost–benefit analysis, which assigns a monetary value to the measure of effect. Cost-effectiveness analysis is often used in the field of health services, where it may be inappropriate to monetize health effect. Typically the CEA is expressed in terms of a ratio where the denominator is a gain in health from a measure (years of life, premature births averted, and sight-years gained) and the numerator is the cost associated with the health gain. The most commonly used outcome measure is quality-adjusted life years (QALY). Cost-utility analysis is similar to cost-effectiveness analysis. Cost-effectiveness analyses are often visualized on a plane consisting of four-quadrants, the cost represented on the *x*–axis and the effectiveness on the *y*– axis. Cost-effectiveness analysis focuses on maximizing the average level of an outcome, distributional cost-effectiveness analysis extends the core methods of CEA to incorporate concerns for the distribution of outcomes as well as their average level and make trade-offs between equity and efficiency, these more sophisticated methods are of particular interest when analyzing interventions to tackle health inequality.

Cost–benefit analysis (**CBA**), sometimes called **benefit costs analysis** (**BCA**), is a systematic approach to estimating the strengths and weaknesses of alternatives (for example in transactions, activities, functional business requirements or projects investments); it is used to determine options that provide the best approach to achieve benefits while preserving savings. The CBA is also defined as a systematic process for calculating and comparing benefits and costs of a decision, policy (with particular regard to government policy) or (in general) project.

Broadly, CBA has two main purposes:

1. To determine if an investment/decision is sound (justification/feasibility) – verifying whether its benefits outweigh the costs, and by how much;
2. To provide a basis for comparing projects – which involves comparing the total expected cost of each option against its total expected benefits.

CBA is related to (but distinct from) cost-effectiveness analysis. In CBA, benefits and costs are expressed in monetary terms, and are adjusted for the time value of money, so that all flows of benefits and flows of project costs over time (which tend to occur at different points in time) are expressed on a common basis in terms of their net present value.

Closely related, but slightly different, formal techniques include cost-effectiveness analysis, cost–utility analysis, risk–benefit analysis, economic impact analysis, fiscal impact analysis, and social return on investment (SROI) analysis.

A **financial forecast** is an estimate of future financial outcomes for a company or country (for futures and currency markets). Using historical internal accounting and sales data, in addition to external market and economic indicators, a financial forecast is an economist's best guess of what will happen to a company in financial terms over a given time period which is usually one year. See financial modeling.

Arguably, the most difficult aspect of preparing a financial forecast is predicting revenue. Future costs can be estimated by using historical accounting data; variable costs are also a function of sales. Analysts often use information such as the 52-week high of stock prices to augment their fundamental analysis of stock prices.

Unlike a financial plan or a budget a financial forecast doesn't have to be used as a planning document. Outside analysts can use a financial forecast to estimate a company's success in the coming year.

What is 'Risk Analysis'

Risk analysis is the process of assessing the likelihood of an adverse event occurring within the corporate, government, or environmental sector. Risk analysis is the study of the underlying uncertainty of a given course of action and refers to the uncertainty of forecasted cash flow streams, variance of portfolio/stock returns, the probability of a project's success or failure, and possible future economic states. Risk analysts often work in tandem with forecasting professionals to minimize future negative unforeseen effects.

BREAKING DOWN 'Risk Analysis'

A risk analyst starts by identifying what could go wrong. The negative events that could occur are then weighed against a probability metric to measure the likelihood of the event occurring. Finally, risk analysis attempts to estimate the extent of the impact that will be made if the event happens.

Quantitative Risk Analysis

Risk analysis can be quantitative or qualitative. Under quantitative risk analysis, a risk model is built using simulation or deterministic statistics to assign numerical values to risk. Inputs which are mostly assumptions and random variables are fed into a risk model. For any given range of input, the model generates a range of output or outcome. The model is analyzed using graphs, scenario analysis, and/or sensitivity analysis by risk managers to make decisions to mitigate and deal with the risks.

A Monte Carlo simulation can be used to generate a range of possible outcomes of a decision made or action taken. The simulation is a quantitative technique that calculates results for the random input variables repeatedly, using a different set of input values each time. The resulting outcome from each input is recorded, and the final result of the model is a probability distribution of all possible outcomes. The outcomes can be summarized on a distribution graph showing some measures of central tendency such as the mean and median, and assessing variability of the data through standard deviation and variance.

The outcomes can also be assessed using risk management tools such as scenario analysis and sensitivity tables. A scenario analysis shows the best, middle, and worst outcome of any event. Separating the different outcomes from best to worst provides a reasonable spread of insight for a risk manager. For example, an American Company that operates on a global scale might want to know how its bottom line would fare if the exchange rate of select countries strengthens. A sensitivity table shows how outcomes vary when one or more random variables or assumptions are changed. A portfolio manager might use a sensitivity table to assess how changes to the different values of each security in a portfolio will impact the variance of the portfolio. Other types of risk management tools include decision trees and break-even analysis.

Qualitative Risk Analysis

Qualitative risk analysis is an analytical method that does not identify and evaluate risks with numerical and quantitative ratings. Qualitative analysis involves a written definition of the uncertainties, an evaluation of the extent of impact if the risk ensues, and countermeasure plans in the case of a negative event occurring. Examples of qualitative risk tools include SWOT Analysis, Cause and Effect diagrams, Decision Matrix, Game Theory, etc. A firm that wants to measure the impact of a security breach on its servers may use a qualitative risk technique to help prepare it for any lost income that may occur from a data breach.

Almost all sorts of large businesses require a minimum sort of risk analysis. For example, commercial banks need to properly hedge foreign exchange exposure of oversees loans while large department stores must factor in the possibility of reduced revenues due to a global recession. It is important to know that risk analysis allows professionals to identify and mitigate risks, but not avoid them completely.

BREAKING DOWN 'Quantitative Analysis'

In general terms, quantitative analysis can best be understood as simply a way of measuring or evaluating things through the examination of mathematical values of variables. The primary advantage of quantitative analysis is that it involves studying precise, definitive values that can easily be compared with each other, such as a company's year-over-year revenues or earnings. In the financial world, analysts who rely strictly on quantitative analysis are frequently referred to as "quant’s" or "quant jockeys."

I. Understand your role

In reality, project managers rarely get to make actual project selection decisions. These decisions are most often made by the executive leadership, or perhaps the project management office. But this does not mean the PM is left out of the process.

A good project manager should lend their experience and expertise to the selection process, thus offering an educated and unbiased opinion about the pros and cons of various projects. After all, you may be the only person with any real project management experience to weigh in on the decision. As such, you can offer unique insights into the potential benefits and risks of each project (risk and resource requirements especially). Moreover, you can serve as a useful sounding board for ideas from the executive leadership. They may believe a particular project can be done within a specified budget range, for example, but your past experience may suggest otherwise. This is the time to speak up.

You are also in a unique position to help suggest the type of project to be undertaken. Perhaps there are problems or inefficiencies to be resolved within the business, and a solution is needed. Using your experience and understanding of the organizational needs, you may be in an excellent position to suggest the best project approach for a given situation.

II. Understand your organization

As someone with input on project selection matters, you must be especially aware of your organizational environment. What are your key business drivers? What are your strengths and vulnerabilities as an organization? Do you have resource limitations, and if so, where are you lacking?

When performing this analysis, be mindful of past experiences and refer to archived information as much as possible. Whether a prior project went very well or very poorly, there are organizational and environmental factors which likely contributed to the outcome. Consider whether those factors have changed, and be prepared to discuss these matters openly and frankly. After all, if an organization is fundamentally limited in terms of what it can achieve - whether for lack of skilled resources, funding, or otherwise - it is very important to acknowledge this early on. Failure to weigh in candidly could result in a project being doomed to fail before it even kicksoff.

III. Understand the key benefit measurement methods

There are complex financial and analytical tools that upper management may use to choose amongst various projects, which are collectively referred to as "constrained optimization methods." They include techniques like integer programming, linear programming and dynamic programming. These complex analyses go beyond the scope of this article, and likely well beyond the scope of your role as a project manager in helping select a project.

Instead, your focus should be on the more simplified techniques which are collectively referred to as "benefit measurement methods." These techniques do not require advanced finance degrees to understand and utilize, and are therefore often favored when choosing amongst various project options.

A. Benefit Cost Analysis

Let's start by reviewing one of the simpler techniques, which is Benefit Cost Analysis. Here we want to determine the overall financial benefit of the project (the total amount of money it will generate) and compare that figure to what we must spend to complete the project.

Thus, if a project costs $1 million dollars to perform, but will return $1.5 million in proceeds, the benefit cost ratio is 3:2, meaning it will return $3 for every $2 invested. This ratio can then be reduced by dividing the benefit value by the cost value (here, 3/2). In this case, the benefit cost ratio can also be expressed as 1.5, meaning we realize $1.50 in returns for every $1 invested. This provides a good indicator of the project's economic viability, but it often does not include the discounted value of the returns (i.e. what the future income is worth in today's dollars, after adjusting for interest and inflation). To provide the most meaningful figures, therefore, the future income should be appropriately discounted before it is compared to the amounts we must spend up front in order to do the project.

C. Discounted Cash Flow Analysis

That brings us to our next technique, which is called Discounted Cash Flow Analysis. This tool allows us to determine the present value (in today's dollars) of a future return. To do this calculation, we need to know 3 things: 1) the time it takes to recover the money; 2) the applicable discount rate (usually the prevailing interest rates, which may also factor in inflation costs); and 3) the amount of money we will recover in the future.

Once we know these values, we use the following formula to determine the present value of that future income: PV = FV / (1 + i)n. The "FV" equals the amount of future recovery, while the "i" equals the discount rate and the "n" equals the number of compounding periods (usually years) it takes to recover the future amount. Let's assume that the future value is $1,000, the discount rate is 6% and the number of years to recover that $1,000 is three.

$PV = FV / (1 + i)^n$
$PV = 1000 / (1 + .06)^3$
$PV = 1000 / (1.06)^3$
$PV = 1000 / 1.191016$

PV = $839.62

Make sure you note the correct order of operations here: First, we take 1 plus the discount interest rate. Since the rate is 6%, we express this as .06, and get a sum of 1.06. We then raise this 1.06 to the power equal to the number of periods it takes to recover the future value. Since it is a 3-year recovery period, we would multiply 1.06 by itself three times: (1.06 x 1.06 x 1.06).

Remember not to multiply the 1.06 by 3 - that will not yield the correct figure. We need an exponential value, so we must multiply the 1.06 by itself three times. Our resulting value is 1.191016 (for maximum precision, do not round this number). We then divide the future value of $1,000 by 1.191016, to get a present value of $839.62 (rounded to the nearest cent). We can now say that the $1,000 we will recover in three years is worth only $839.62 in today's dollars, having factored in the time it takes to recover that $1,000, along with the discount rate.

D. Net Present Value (NPV)

Net Present Value is an extension of the Discounted Cash Flow Analysis, which allows us to derive more detailed information. Specifically, Net Present Value allows us to see the net gain or loss that we will incur in each period, which is discounted to today's values. Thus, we project our future gains and expenditures for each year going forward, and discount both to today's values based on the interest rate and time in which those costs/revenues are realized. Our result may look something like this:

Year 1: ($1,000)

Year 2: ($500)

Year 3: $250

Year 4: $500

Year 5: $1,000

Total Net Present Value: $250

In this example, our discounted net returns (revenues minus expenses) were negative for the first 2 years, but ultimately rose to positive $1,000 in year 5. We simply add these five values up to determine the Net Present Value for the project as a whole, which comes out to $250. Thus, after factoring in our net gains/losses for each year, which were discounted to today's dollars, we can say that this project will return enough net revenue to keep up with the cost of capital over time, and still return an additional $250 (assuming our projections are accurate).

Naturally we are looking for the highest Net Present Value we can achieve, but even where the NPV is low, we can say that the project is financially viable. The key is for NPV to not be negative. If it is a negative value that means the discounted revenues will not exceed the discounted expenses over time, which means the project will lose money.

E. Opportunity Cost

In certain scenarios we must choose one project and leave the other possible project behind. In this scenario, we might use Opportunity Cost analysis to help us make our decision. For example, assume Project A has a potential net return of $50,000 and Project B has a potential net return of $100,000. But we cannot do them both. The opportunity cost is the amount of profit we will forego by choosing one project over another. Assuming we opportunity cost selected Project

B, that means we could not pursue the benefits that Project A offered. Thus, our opportunity cost would be $50,000 - the net amount that Project A would have returned.

Naturally, we want to keep our opportunity costs as low as possible. There will always be opportunity costs when choosing amongst more than one profitable opportunity, but the idea is to minimize that cost as much as possible. This technique is unlikely to be utilized on its own as a project selection tool, but would more likely be used in conjunction with other techniques to help arrive at a decision.

F. Scoring Models

Moving away from the strict financial analyses, another helpful way to evaluate potential projects is to rate them on various weighted criteria, and come up with an overall score. For example, let's choose 5 criteria that are important to us (we will use profitability, technical difficulty, resource strain, risk and stakeholder support for this example).

We then want to weigh these various criteria so that they collectively add up to 100%. So let's say profitability is the most important, so we give it a 40% weight. Next up is technical difficulty, at 20%, followed by resource strain, at 15%, with risk also being weighted at 15% and stakeholder support coming in at 10%.

Next we need to determine how each project scores on these various rankings. We want to identify some consistent values to use here, to ensure the raw scores assigned for each attribute add up to 100 across all projects. For example, if we have 5 possible projects, we might use predetermined scores of, say, 5, 10, 20, 25 and 40, to ensure they collectively will add up to 100 (this aligns with our weighting figures, which also add up to 100).

We then analyze each possible project by multiplying its score for each criterion by the percentage weight that criterion was assigned in order to get a weighted score for that particular project attribute. Let's assume Project A seems highly profitable, so we give it a score of 40 in the profitability column. That 40 then gets multiplied by .4, since we weight the profitability attribute at 40% of the total concern. The combined score for profitability would then be 16.

We then repeat this process for each criterion, and add up the 5 weighted scores to get a total score for Project A. These steps are then repeated for all other project options, to identify the potential project which gets the highest overall score.

IV. Conclusion

While project selection decisions are often not left to the project manager, one must still be prepared to advise and consult with others in the organization to help arrive at these decisions. Gathering information and facilitating discussions will be an important part of the PM's role here. The more information, documentation, and analysis performed prior to this discussion, the more weight the PM's opinion will hold. Thus, one must have at least a high-level understanding of the most common project selection methods in order to meaningfully participate in this important process.

Resource allocation

In economics, resource allocation is the assignment of available resources to various uses. In the context of an entire economy, resources can be allocated by various means, such as markets or central planning.

In project management, resource allocation or resource management is the scheduling of activities and the resources required by those activities while taking into consideration both the resource availability and the project time.

Economics

In economics, the area of public finance deals with three broad areas: macroeconomic stabilization, the distribution of income and wealth, and the allocation of resources. Much of the study of the allocation of resources is devoted to finding the conditions under which particular mechanisms of resource allocation lead to Pareto efficient outcomes, in which no party's situation can be improved without hurting that of a Strategic planning

In strategic planning, resource allocation is a plan for using available resources, for example human resources, especially in the near term, to achieve goals for the future. It is the process of allocating scarce resources among the various projects or business units.

There are a number of approaches to solving resource allocation problems e.g. resources can be allocated using a manual approach,[2] an algorithmic approach (see below), or a combination of both.

Resource Leveling optimizes histogram of resources on a project.

There may be contingency mechanisms such as a priority ranking of items excluded from the plan, showing which items to fund if more resources should become available and a priority ranking of some items included in the plan, showing which items should be sacrificed if total funding must be reduced.

When to Use Each Valuation Technique

1. Comparable Company Analysis. ...
2. Discounted Cash Flow Analysis (DCF) ...
3. Precedent Transaction Analysis. ...
4. Leverage Buyout Analysis (LBO) ...
5. Comparable Company Analysis. ...
6. Discounted Cash Flow (DCF) Analysis. ...
7. Precedent Transaction/Premium Paid Analysis. ...
8. Leverage Buyout (LBO) Analysis.

COMPARABLE COMPANY ANALYSIS

The Comparable Company valuation technique is generally the easiest to perform. It requires that the comparable companies have publicly traded securities, so that the value of the comparable companies can be estimated properly. We will detail the calculation process for Comparable Company analysis later in this guide.

The analysis is best used when a minority (small, or non-controlling) stake in a company is being acquired or a new issuance of equity is being considered (this also does not cause a change in control). In these cases there is no **control premium**, i.e., there is no value accrued by a change in control, wherein a new entity ends up owning *all* (or at least *the majority*) of the voting interests in the business, which allows the owner to control the company cleanly. With no change of control occurring, Comparable Company analysis is usually the most relied-upon technique.

DISCOUNTED CASH FLOW ANALYSIS (DCF)

A DCF valuation attempts to get at the value of a company in the most direct manner possible: a company's worth is equal to *the current value of the cash it will generate in the future,* and DCF is a framework for attempting to calculate exactly that. In this respect, DCF is the most theoretically correct of all of the valuation methods because it is the most precise.

However, this level of preciseness can be tricky. What DCFs gain in precision (giving an exact estimate based on theory and computation), they often lose in accuracy (giving a true indicator of the exact value of the company). DCFs are exceedingly difficult to get right in practice, because they involve predicting future cash flows (and the value of them, as determined by the discount rate), and all such predictions require assumptions. The farther into the future we predict, the more difficult these projections become. Any number of assumptions made in a DCF valuation can swing the value of the company—sometimes quite significantly. Therefore, DCF valuations are typically most useful and reliable in a company with highly stable and predictable cash flows, such as an established Utility company.Because DCFs are so difficult to "get perfect," they are typically used to supplement Comparable Companies Analysis and Precedent Transaction Analysis (discussed next).

PRECEDENT TRANSACTION ANALYSIS

The Precedent Transaction valuation technique is also generally fairly easy to perform. It does require that the specifics of a prior acquisition/divestiture deal are known (price per share, number of shares acquired or spun off, amount of debt assumed, etc.), but this is usually the case if the target (acquired company) had publicly traded instruments prior to the transaction. In some industries, however, relatively few truly comparable M&A transactions have occurred (or the acquisitions were too small to have publicized deal details), so the Precedent Transaction analysis maybe be difficult to conduct. If the buyer acquires a majority stake in a company (or similarly, when a controlling stake in a business is divested), a Precedent Transaction analysis is almost always the theoretically correct Comparable Company analysis to perform. Why do we use Precedent Transactions analysis in this scenario? Because when a majority stake is purchased, the buyer *assumes control of the acquired entity*. By having control over the business, the buyer has more flexibility and more options about how to create value for the business, with less interference from other stakeholders. Therefore, when control is transferred, a control premium is typically paid.

Precedent Transactions are designed to attempt to ascertain the difference between the value of the comparable companies acquired in the past *before* the transaction vs. *after*the transaction. (In other words, the analyst determines the difference between the market value of the company before the transaction is announced vs. the amount paid for the company in a control-transferring purchase.) This difference represents the premium paid to acquire the controlling interest in the business. Thus when a change of control is occurring, Precedent Transaction analysis should typically be one of the valuation methods used.

We will detail the calculation process for Precedent Transaction analysis later in this guide.

LEVERAGE BUYOUT ANALYSIS (LBO)

Another possible way to value a company is via LBO analysis. LBOs are typically used by "financial sponsors" (private equity firms) who are looking to acquire companies inexpensively in the hopes that they can be sold at a profit in several years. In order to maximize returns from these investments, LBO firms generally try to use as much borrowed capital (debt financing) as possible to fund the acquisition of the company, thereby minimizing the amount of equity capital That the sponsor itself must invest (equity financing). Assuming that the investment makes a profit, this debt leverage maximizes the return achieved for the sponsors' investors.

There are three possible approaches to take in running an LBO analysis for a target company:

1. Assume a minimum required return for the financial sponsor plus an appropriate debt/equity ratio, and from this impute a company value.
2. Assume a minimum required return for the financial sponsor plus an appropriate company value, and from this impute the required debt/equity ratio.
3. Assume an appropriate debt/equity ratio and company value, and from this compute the investments expected return.

Usually the first analysis is performed by investment bankers. If the value of the company is unknown (as is usually the case), then the goal of the LBO exercise is to determine that value by assuming an expected return for a private equity investor (typically 20-30%) and a feasible capital structure, and from that, determining how much the company could be sold for (and thereby still allow the financial sponsor to achieve that required return). If the expected sale price/value of the company is known (for example, if a bid on the company has been proposed), then the primary goal of performing an LBO analysis is to determine the best possible returns scenario given that value. (Bankers will often use LBO analysis to determine whether a higher valuation from private equity investors is possible, again using the first analysis.)

LBO analysis can be quite complex to perform, especially as the model gets more and more detailed. For example, different assumptions about the capital structure can be made, with increasing layers of refinement, to the point where each individual component of the capital structure is being modeled over time with a host of tranche-specific assumptions and features. That said, a simple, standard LBO model with generic, high-level assumptions can be put together fairly easily. Unfortunately, LBO valuations can be highly subject to market conditions. In a poor market environment (periods of low capital markets activity, high interest rates, and/or high credit spreads for High Yield bond issuances), this type of transaction is difficult to use. Hence LBO investing is highly cyclical depending upon market forces.

DCF TECHNIQUES:

Step 1—Forecast Expected Cash Flow: the first order of business is to forecast the expected cash flow for the company based on assumptions regarding the company's revenue growth rate, net operating profit margin, income tax rate, fixed investment requirement, and incremental working capital requirement. We describe these variables and how to estimate them in other screens.

Step 2—Estimate the Discount Rate: the next order of business is to estimate the company's weighted average cost of capital (WACC), which is the discount rate that's used in the valuation process. We describe how to do these using easily observable inputs in other screens.

Step 3—Calculate the Value of the Corporation: the company's WACC is then used to discount the expected cash flows during the Excess Return Period to get the corporation's *Cash Flow from Operations*. We also use the WACC to calculate the company's *Residual Value.* To that we add the value of *Short-Term Assets* on hand to get the *Corporate Value*.

Step 4—Calculate Intrinsic Stock Value: we then subtract the values of the company's liabilities—debt, preferred stock, and other short-term liabilities to get *Value to Common Equity,* divide that amount by the amount of stock outstanding to get the *per share intrinsic stock value.*

<u>UNIT-III</u>

<u>RESEARCH AND DEVELOPMENT</u>

<u>Program me planning and control:</u>

Planning (also called forethought) is the process of thinking about and organizing the activities required to achieve a desired goal. It involves the creation and maintenance of a plan, such as psychological aspects that require conceptual skills. There are even a couple of tests to measure someone's capability of planning well. As such, planning is a fundamental property of intelligent behavior.

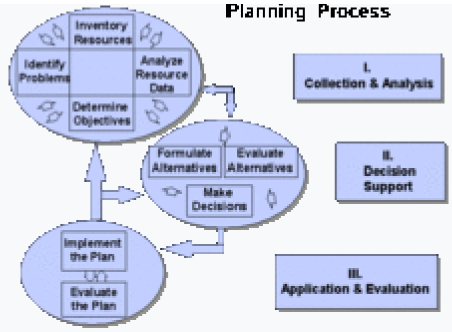
Also, planning has a specific process and is necessary for multiple occupations (particularly in fields such as management, business, etc.). In each field there are different types of plans that help companies achieve efficiency and effectiveness. An important, albeit often ignored aspect of planning, is the relationship it holds to forecasting. Forecasting can be described as predicting what the future will look like, whereas planning predicts what the future should look like for multiple scenarios. Planning combines forecasting with preparation of scenarios and how to react to them. Planning is one of the most important project management and time management techniques. Planning is preparing a sequence of action steps to achieve some specific goal. If a person does it effectively, they can reduce much the necessary time and effort of achieving the goal. A plan is like a map. When following a plan, a person can see how much they have progressed towards their project goal and how far they are from their destination.

Planning in public policy

Public policy planning includes environmental, land use, regional, urban and spatial planning. In many countries, the operation of a town and country planning system is often referred to as "planning" and the professionals which operate the system are known as "planners".

It is a conscious as well as sub-conscious activity. It is "an anticipatory decision making process" that helps in coping with complexities. It is deciding future course of action from amongst alternatives. It is a process that involves making and evaluating each set of interrelated decisions. It is selection of missions, objectives and "translation of knowledge into action." A planned performance brings better results compared to an unplanned one. A manager's job is planning, monitoring and controlling. Planning and goal setting are important traits of an organization. It is done at all levels of the organization. Planning includes the plan, the thought process, action, and implementation. Planning gives more power over the future. Planning is deciding in advance what to do, how to do it, when to do it, and who should do it. This bridges the gap from where the organization is to where it wants to be. The planning function involves establishing goals and arranging them in logical order. A well planned organization achieves faster goals than the ones that don't plan before implementation.

Planning process



Example of planning process framework.

Patrick Montana and Bruce Charnel outline a three-step result-oriented process for planning:

1. Choosing a destination
2. Evaluating alternative routes, and
3. Deciding the specific course of your plan.

In organizations, planning is a management process, concerned with defining goals for company's future direction and determining on the missions and resources to achieve those targets. To meet the goals, managers may develop plans such as a business plan or a marketing plan. Planning always has a purpose. The purpose may be achievement of certain goals or targets.

Main characteristics of planning in organizations are:

Planning increases the efficiency of an organization. It reduces the risks involved in modern business activities. It utilizes with maximum efficiency the available time and resources. The concept of planning is to identify what the organization wants to do by using the four questions which are "where are we today in terms of our business or strategy planning? Where are we going? Where do we want to go? How are we going to get there?

Program management or **programmer's management** is the process of managing several related projects, often with the intention of improving an organization's performance. In practice and in its aims it is often closely related to systems engineering, industrial engineering, change management, and business transformation.

The program manager has oversight of the purpose and status of the projects in a program and can use this oversight to support project-level activity to ensure the program goals are met by providing a decision-making capacity that cannot be achieved at project level or by providing the project manager with a program perspective when required, or as a sounding board for ideas and approaches to solving project issues that have program impacts. In a program there is a need to identify and manage cross-project dependencies and often the project management office (PMO) may not have sufficient insight of the risk, issues, requirements, design or solution to be able to usefully manage these.

The program manager may be well placed to provide this insight by actively seeking out such information from the project managers although in large and/or complex projects, a specific role may be required. However this insight arises, the program manager needs this in order to be comfortable that the overall program goals are achievable.

DEFINITION of 'Portfolio Plan'

An investment strategy applied to a personal or corporate portfolio that determines its general purpose and constraints. Once a portfolio plan has been determined, investments adhering to the plan are bought and sold accordingly.

BREAKING DOWN 'Portfolio Plan'

Individual investors have ranging risk tolerances, liquidity needs and investment time horizons. A proper portfolio plan must take these factors into consideration along with any other unique requirements. A portfolio is a grouping of financial assets such as stocks, bonds and cash equivalents, as well as their funds counterparts, including mutual, exchange-traded and closed funds. Portfolios are held directly by investors and/or managed by financial professionals. Prudence suggests that investors should construct an investment portfolio in accordance with risk tolerance and investing objectives. BREAKING DOWN 'Portfolio 'An investment portfolio can be thought of as a pie that is divided into pieces of varying sizes, representing a variety of asset classes and/or types of investments to accomplish an appropriate risk-return portfolio allocation. Many different types of securities can be used to build a diversified portfolio, but stocks, bonds and cash are generally considered a portfolio's core building blocks. Other potential asset classes include, but aren't limited to, real estate, gold and currency.

BREAKING DOWN 'Capital Growth Strategy'

Portfolios with the goal of capital growth consist mainly of equities. The exact proportion of equities to the total portfolio will vary according to the individual investor's investment horizon, financial constraints, investment goals and tolerance. In general, a capital growth portfolio will contain approximately 65-70% equities, 20-25% fixed-income securities and the remainder in cash or money market securities. While seeking high returns, this mixture still somewhat protects the investor against a severe loss in portfolio value if the higher-risk equity portion of the portfolio takes a plunge. Note that an aggressive portfolio strategy also aims to maximize capital growth, but of the total portfolio value, these strategies are of considerably higher risk; sometimes consisting entirely of equities!

Project planning is part of project management, which relates to the use of schedules such as Gantt charts to plan and subsequently report progress within the project environment.

Initially, the project scope is defined and the appropriate methods for completing the project are determined. Following this step, the durations for the various tasks necessary to complete the work are listed and grouped into a work breakdown structure. Project planning is often used to organize different areas of a project, including project plans, loads and the management of teams and individuals. The logical dependencies between tasks are defined using an activity network diagram that enables identification of the critical path.

Project planning is inherently uncertain as it must be done before the project is actually started. Therefore the duration of the tasks is often estimated through a weighted average of optimistic, normal, and pessimistic cases. The critical chain method adds "buffers" in the planning to anticipate potential delays in project execution. Float or slack time in the schedule can be calculated using project management software. Then the necessary resources can be estimated and costs for each activity can be allocated to each resource, giving the total project cost. At this stage, the project schedule may be optimized to achieve the appropriate balance between resource usage and project duration to comply with the project objectives. Once established and agreed, the project schedule becomes what is known as the baseline schedule. Progress will be measured against the baseline schedule throughout the life of the project. Analyzing progress compared to the baseline schedule is known as earned value management.

- The inputs of the project planning phase 2 include the project charter and the concept proposal.
- The outputs of the project planning phase include the project requirements, the project schedule, and the project management plan.
- Project planning can be done manually, but project management software is often used.

Project termination:

Project termination is sometimes also called project close-out or final shutdown. During this phase the people involved are acknowledged for their achieved goals and the work is considered complete.

Project termination (or *close-out*) is the last stage of managing the project, and occurs after the implementation phase has ended. Acceptance testing has been carried out, and the project deliverables have been handed over to the client. The project team has been disbanded and unused resources have been disposed of as appropriate. All outstanding bills have been passed for payment, and the final invoices for work carried out have been issued. The main purpose of the close-out stage is to evaluate how well you performed, and to learn lessons for the future. A final project status report is prepared that should contain a summary of changes to the project scope (if any), and show how actual completion dates for project milestones and costs accrued compare with the final version of the project schedule and budget.

All significant variances from the project baseline should be explained here.

A review is then undertaken with the client and other project stakeholders, during which the project outcomes are evaluated against the project's stated aims and objectives. The results of the review are recorded in a *close-out report*. The questions the stakeholders should be asked will vary depending on the nature of the project, but will normally include questions such as:

- Was the project completed on time (or were delays acceptable limits?)
- Were budgetary requirements adhered to?
- Were project management procedures used effectively?
- Was communication effective?
- How did the project team perform?
- Was the overall outcome acceptable?
- What changes could be made for future projects?

Projects fail for many reasons, some of which are outside the control of the project manager. External factors that can affect the outcome include a changing commercial environment, lack of support from senior management (including the provision of adequate resources), or lack of co-operation from the project client. Internal factors include inadequate expertise within the project team, a lack of planning and management, poorly defined project objectives, and a failure to communicate effectively. However, despite the fact that a project may not have fulfilled the expectations of its stakeholders, future projects can benefit from the lessons learned from a post-project appraisal process. It is important to learn lessons from successful aspects of the project as well as from mistakes. In that way, not only can the same mistakes be avoided in future, but good practice can be implemented in future projects.

10 Resource Allocation Tips for Managers

Resource allocation is just a fancy term for a plan that you develop for using the available resources at your disposal in a project. This is mostly a short-term plan set in place to achieve goals in the future. Resources are varied. Everything from the people you’re working with and the equipment they’re using to complete their tasks to the materials and other supplies you need to even the site where you’re working on the project all fall under the umbrella of resources.

1. Know Your Scope

Before you can allocate your resources or manage them, you have to determine the scope of the project you’re working on. Is it a big or small project, long or short? Once you have those questions answered, then you can make the right decision on what resources you’ll need and how many of them are necessary to complete the project. The clearer the project scope is, the better you’ll be able to figure out how to allocate your resources. Therefore, take the time to get the full picture of the project prior to doing any resource allocation.

2. Identify Resources

You know the scope of the project, it’s objective and the tasks necessary to get the work done on time and within the budget approved, now you have to get your resources together. But that doesn’t mean you have an unlimited pool from which to pull from. So, you have to see who’s currently available, what equipment you’re going to need or purchase and where are you going to perform the tasks for this project, and is that space available. Before you can allocate resources, you have to have them. So, make a list using the criteria above and then make sure it fits within the budget allotted for the project.

3. Don’t Procrastinate

You’re a project manager. You live and die by your planning. Resource allocation is no different. Waiting until something has gone awry means you have to scramble to get it back on track, if that’s even possible. It’s inevitable that resources will need reallocation. What plan have you ever created that was set in stone? Therefore, in the planning process you should take some time to research where and when you might have blocked team member or task dependencies. By setting up a resource plan and noting these red-flag warnings, and more importantly figuring out how you’ll respond to them, beforehand, you’re prepared to handle them when they arise. And they’ll always arise.

4. Think Holistically

It’s a problem when you’re so focused on process that you neglect to lift your head up from the project plan to note what is actually happening. This isn’t merely checking your estimates against actual progress in the project, though that is important, too.What you must always be aware of is the state of your resources. For example, what is the schedule for your team, are any taking vacation time, are they sick, etc.? Also, what is the duration of the lease for site or equipment? Don’t let any of these details get past you because of tunnel vision. Look at the whole project, not just the various pieces, as captivating as it can be to lose oneself in project metrics.

5. Track Time

You always want to keep a close eye on time, how your team is working and if they're being efficient. It's your job to make sure that a task that can be completed in a day doesn't take a week. There are ways to improve time tracking. To do this you must keep track of your team's workload. That requires the right tools to give you real-time data collected on one page where you can both see and schedule ahead when needed. With a dashboard tool, you can see whether your resources are properly allocated and, if not, easily reschedule them. That way you can balance the workload and run a more efficient project.

6. Use Tools

Speaking of tools, project management software is a great asset to managing your resources more productively. With an online tool, you get project data instantly updated. You can see where your resources are allocated across a calendar that is color-coded to note whether they're on- or off-task, on vacation or sick. Rescheduling to help a team member who is over tasked is a simple click of the keyboard. You can also set up notifications, so when a task is running behind you know about it before it becomes a problem. And you can automate email notifications to keep team members on schedule without micromanaging them

7. Don't Over-allocate:

Many managers over-allocate, whether because of poor planning or an inability to say no, which doesn't help. Instead of bringing in the project on time and within budget, over-allocation threatens team burnout. Be honest. Do you suffer from this bad habit? If so, stay vigilant and avoid it. If you don't, there's a good chance you'll tarnish team morale and the quality of their project work. It's unfair to expect so much from your resources that they break..

8. Be Realistic

While it's good practice to be prepared for issues that might arise in your project, you don't want to hog resources by adding too many people or days to your schedule. When you do this, you're skewing the project estimate and messing with the effectiveness of long-term planning. It's going to take from your bottom line. Remember when we mentioned comparing your estimated to actual utilization? This is where that process helps keep you properly allocated. Using a tool, like we noted above, is also key to getting an accurate sense of how the project is going.

9. Have a Routine

As a manager, you plan and then you execute and monitor. It's all very structured. But sometimes things like resource allocation fall through the cracks, which is only going to come back and haunt you. Therefore, you want to set up regular check-ins, say a specific day and time every week, to go through your resources, check your PM tools and make sure no one over-tasked for the week's work ahead. Another thing you can do is speak with your team members, get a sense of what's going on with them on the front lines of the project, and ask if they have any issues. By setting up a routine check-in and keeping updated by your PM software, you get a clear sense of your resources.

10. Know Your Resources

You can't manage what you don't know. You should know the experience and skills and personality very resource that you've tasked or allocated to support the project. If you're looking for a project management tool that can help you implement those tips and manage your resources properly, then look no further. ProjectManager.com has all the features mentioned above to help you manage your resources, and its cloud-based software, which means the information you're working with is in real-time. See how it can help you by taking this free 30-day trial today!

New product development:

In business and engineering, **new product development** (**NPD**) covers the complete process of bringing a new product to market. A central aspect of NPD is product design, along with various business considerations. New product development is described broadly as the transformation of a market opportunity into a product available for sale. The product can be tangible (something physical which one can touch) or intangible (like a service, experience, or belief), though sometimes services and other processes are distinguished from "products." NPD requires an understanding of customer needs and wants, the competitive environment, and the nature of the market. Cost, time and quality are the main variables that drive customer needs.

Aiming at these three variables, companies develop continuous practices and strategies to better satisfy customer requirements and to increase their own market share by a regular development of new products. There are many uncertainties and challenges which companies must face throughout the process. The use of best practices and the elimination of barriers to communication are the main concerns for the management of the NPD.

Marketing considerations

There have been a number of approaches proposed for analyzing and responding to the marketing challenges of new product development. Two of these are *the eight stages* process of Peter Koen of the Stevens Institute of Technology, and a process known as *the fuzzy front end.*

Fuzzy Front End

The Fuzzy Front End (FFE) is the messy "getting started" period of new product engineering development processes. It is in the front end where the organization formulates a concept of the product to be developed and decides whether or not to invest resources in the further development of an idea. It is the phase between first consideration of an opportunity and when it is judged ready to enter the structured development process (Kim and Wilemon, 2007;Koen et al., 2001). It includes all activities from the search for new opportunities through the formation of a germ of an idea to the development of a precise concept. The Fuzzy Front End phase ends when an organization approves and begins formal development of the concept.

Although the Fuzzy Front End may not be an expensive part of product development, it can consume 50% of development time (see Chapter 3 of the Smith and Reinertsen reference below), and it is where major commitments are typically made involving time, money, and the product's nature, thus setting the course for the entire project and final end product. Consequently, this phase should be considered as an essential part of development rather than something that happens "before development," and its cycle time should be included in the total development cycle time.

Koen et al. distinguish five different front-end elements (not necessarily in a particular order):[16]

1. Opportunity Identification
2. Opportunity Analysis
3. Idea Genesis
4. Idea Selection
5. Idea and Technology Development

- The first element is the opportunity identification. In this element, large or incremental business and technological chances are identified in a more or less structured way. Using the guidelines established here, resources will eventually be allocated to new projects.... which then lead to a structured NPPD (New Product & Process Development) strategy.
- The second element is the opportunity analysis. It is done to translate the identified opportunities into implications for the business and technology specific context of the company. Here extensive efforts may be made to align ideas to target customer groups and do market studies and/or technical trials and research.
- The third element is the idea genesis, which is described as evolutionary and iterative process progressing from birth to maturation of the opportunity into a tangible idea. The process of the idea genesis can be made internally or come from outside inputs, e.g. a supplier offering a new material/technology or from a customer with an unusual request.
- The fourth element is the idea selection. Its purpose is to choose whether to pursue an idea by analyzing its potential business value.
- The fifth element is the idea and technology development. During this part of the front-end, the business case is developed based on estimates of the total available market, customer needs, investment requirements, and competition analysis and project uncertainty. Some organizations consider this to be the first stage of the NPPD process (i.e., Stage 0).

Other approaches

Other authors have divided predevelopment product development activities differently:

1. Preliminary
2. Technical assessment
3. Source-of-supply assessment: suppliers and partners or alliances
4. Market research: market size and segmentation analysis, VoC (voice of the customer) research
5. Product idea testing
6. Customer value assessment
7. Product definition

8. Business and financial analysis

These activities yield essential information to make a Go/No-Go to Development decision.

One of the earliest studies using the case study method defined the front-end to include the interrelated activities of:

- Product strategy formulation and communication
- Opportunity identification and assessment
- Idea generation
- Product definition
- Project planning
- Executive reviews

Economical analysis, benchmarking of competitive products and modeling and prototyping are also important activities during the front-end activities. The outcomes of FFE are the:

- Mission statement
- Customer needs
- Details of the selected idea
- Product definition and specifications
- Economic analysis of the product
- The development schedule
- Project staffing and the budget
- A business plan aligned with corporate strategy

A conceptual model of Front-End Process was proposed which includes early phases of the innovation process. This model is structured in three phases and three gates:

- Phase 1: Environmental screening or opportunity identification stage in which external changes will be analyzed and translated into potential business opportunities.
- Phase 2: Preliminary definition of an idea or concept.
- Phase 3: Detailed product, project or service definition, and Business planning.

The gates are:

- Opportunity screening
- Idea evaluation
- Go/No-Go for development

The final gate leads to a dedicated new product development project. Many professionals and academics consider that the general features of Fuzzy Front End (fuzziness, ambiguity, and uncertainty) make it difficult to see the FFE as a structured process, but rather as a set of interdependent activities However, Hosing et al., 2005 argue that front-end not need to be fuzzy, but can be handled in a structured manner. In fact Carbone showed that when using the front end success factors in an integrated process, product success is increased. Peter Koenargues that in the FFE for incremental, platform and radical projects, three separate strategies and processes are typically involved. The traditional Stage Gate (TM) process was designed for incremental product development, namely for a single product. The FFE for developing a new platform must start out with a strategic vision of where the company wants to develop products and this will lead to a family of products. Projects for breakthrough products start out with a similar strategic vision, but are associated with technologies which require new discoveries.

Incremental, platform and breakthrough products include:

- *Incremental products* are considered to be cost reductions, improvements to existing product lines, additions to existing platforms and repositioning of existing products introduced in markets.
- *Breakthrough products* are new to the company or new to the world and offer a 5-10 times or greater improvement in performance combined with a 30-50% or greater reduction in costs.
- *Platform products* establish a basic architecture for a next generation product or process and are substantially larger in scope and resources than incremental projects.

Marketing research is "the process or set of processes that links the producers, customers, and end users to the marketer through information used to identify and define marketing opportunities and problems; generate, refine, and evaluate marketing actions; monitor marketing performance; and improve understanding of marketing as a process. Marketing research specifies the information required to address these issues, designs the method for collecting information, manages and implements the data collection process, analyzes the results, and communicates the findings and their implications."

It is the systematic gathering, recording, and analysis of qualitative and quantitative data about issues relating to marketing products and services. The goal of marketing research is to identify and assess how changing elements of the marketing mix impacts customer behavior. The term is commonly interchanged with market research; however, expert practitioners may wish to draw a distinction, in that *market* research is concerned specifically with markets, while *marketing* research is concerned specifically about marketing processes.

Marketing research is often partitioned into two sets of categorical pairs, either by target market:

- Consumer marketing research, and
- Business-to-business (B2B) marketing research.

Or, alternatively, by methodological approach:

- Qualitative marketing research, and
- Quantitative marketing research.

Consumer marketing research is a form of applied sociology that concentrates on understanding the preferences, attitudes, and behaviors of consumers in a market-based economy, and it aims to understand the effects and comparative success of marketing campaigns[*citation needed*]. The field of consumer marketing research as a statistical science was pioneered by Arthur Nielsen with the founding of the ACNielsen Company in 1923.

Thus, marketing research may also be described as the systematic and objective identification, collection, analysis, and dissemination of information for the purpose of assisting management in decision making related to the identification and solution of problems and opportunities in marketing.

ROLE OF MARKETING RESEARCH

The purpose of marketing research (MR) is to provide management with relevant, accurate, reliable, valid, and up to date market information. Competitive marketing environment and the ever-increasing costs attributed to poor decision making require that marketing research provide sound information. Sound decisions are not based on gut feeling, intuition, or even pure judgment. Managers make numerous strategic and tactical decisions in the process of identifying and satisfying customer needs. They make decisions about potential opportunities, target market selection, market segmentation, planning and implementing marketing programs, marketing performance, and control. These decisions are complicated by interactions between the controllable marketing variables of product, pricing, promotion, and distribution.

Further complications are added by uncontrollable environmental factors such as general economic conditions, technology, public policies and laws, political environment, competition, and social and cultural changes. Another factor in this mix is the complexity of consumers. Marketing research helps the marketing manager link the marketing variables with the environment and the consumers. It helps remove some of the uncertainty by providing relevant information about the marketing variables, environment, and consumers. In the absence of relevant information, consumers' response to marketing programs cannot be predicted reliably or accurately. Ongoing marketing research programs provide information on controllable and non-controllable factors and consumers; this information enhances the effectiveness of decisions made by marketing managers.

Traditionally, marketing researchers were responsible for providing the relevant information and marketing decisions were made by the managers. However, the roles are changing and marketing researchers are becoming more involved in decision making, whereas marketing managers are becoming more involved with research. The role of marketing research in managerial decision making is explained further using the framework of the DECIDE model.

Methodologically, marketing research uses the following types of research designs:

Based on questioning

- Qualitative marketing research - generally used for exploratory purposes — small number of respondents — not generalizable to the whole population — statistical significance and confidence not calculated — examples include focus groups, in-depth interviews, and projective techniques
- Quantitative marketing research - generally used to draw conclusions — tests a specific hypothesis - uses random sampling techniques so as to infer from the sample to the population — involves a large number of respondents — examples include surveys and questionnaires. Techniques include choice modeling, maximum difference preference scaling, and covariance analysis.

Based on observations

- Ethnographic studies — by nature qualitative, the researcher observes social phenomena in their natural setting — observations can occur cross-section ally (observations made at one time) or longitudinally (observations occur over several time-periods) - examples include product-use analysis and computer cookie traces. See also Ethnography and Observational techniques.
- Experimental techniques - by nature quantitative, the researcher creates a quasi-artificial environment to try to control spurious factors, then manipulates at least one of the variables examples include purchase laboratories and test markets

Researchers often use more than one research design. They may start with secondary research to get background information, and then conduct a focus group (qualitative research design) to explore the issues. Finally they might do a full nationwide survey (quantitative research design) in order to devise specific recommendations for the client.

Commercialization or **commercialisation** isthe process ofintroducinga new product or production method into commerce—making it available on the market. The term often connotes especially entry into the mass market (as opposed to entry into earlier niche markets), but it also includes a move from the laboratory into (even limited) commerce. Many technologies begin in a research and development laboratory or in an inventor's workshop and may not be practical for commercial use in their infancy (as prototypes). The "development" segment of the "research and development" spectrum requires time and money as systems are engineered with a view to making the product or method a paying commercial proposition. The product launch of a new product is the final stage of new product development - at this point advertising, promotion, and other marketing efforts encourage commercial adoption of the product or method. Beyond commercialization (in which technologies enter the business world) can lie consumerization (in which they become consumer goods, as for example when computers went from the laboratory to the enterprise and then to the home, pocket, or body).

Technology transfer, also called **transfer of technology** (**TOT**), is the process of transferring (disseminating) technology from the places and ingroups of its origination to wider distribution among more people and places. It occurs along various axes: among universities, from universities to businesses, from large businesses to smaller ones, from governments to businesses, across borders, both formally and informally, and both openly and surreptitiously. Often it occurs by concerted effort to share skills, knowledge, technologies, methods of manufacturing, samples of manufacturing, and facilities among governments or universities and other institutions to ensure that scientific and technological developments are accessible to a wider range of users who can then further develop and exploit the technology into new products, processes, applications, materials, or services. It is closely related to (and may arguably be considered a subset of) knowledge transfer. Horizontal transfer is the movement of technologies from one area to another. At present transfer of technology (TOT) is primarily horizontal. Vertical transfer occurs when technologies are moved from applied research centers to research and development departments.

Technology transfer is promoted at conferences organized by such groups as the Ewing Marion Kauffman Foundation and the Association of University Technology Managers, and at "challenge" competitions by organizations such as the Center for Advancing Innovation in

Maryland. Local venture capital organizations such as the Mid-Atlantic Venture Association (MAVA) also sponsor conferences at which investors assess the potential for commercialization of technology.

Technology brokers are people who discovered how to bridge the emergent worlds and apply scientific concepts or processes to new situations or circumstances. A related term, used almost synonymously, is "technology valorization". While conceptually the practice has been utilized for many years (in ancient times, Archimedes was notable for applying science to practical problems), the present-day volume of research, combined with high-profile failures at Xerox PARC and elsewhere, has led to a focus on the process itself.

Whereas technology transfer can involve the dissemination of highly complex technology from capital-intensive origins to low-capital recipients (and can involve aspects of dependency and fragility of systems), it also can involve appropriate technology, not necessarily high-tech or expensive, that is better disseminated, yielding robustness and independence of systems.

INDUSTRIAL DESIGN

Industrial design is a process of design applied to products that are to be manufactured through techniques of mass production. Its key characteristic is that design is separated from manufacture: the creative act of determining and defining a product's form and features takes place in advance of the physical act of making a product, which consists purely of repeated, often automated, replication. This distinguishes industrial design from craft-based design, where the form of the product is determined by the product's creator at the time of its creation.

All manufactured products are the result of a design process, but the nature of this process can take many forms: it can be conducted by an individual or a large team; it can emphasize intuitive creativity or calculated scientific decision-making, and often emphasizes both at the same time; and it can be influenced by factors as varied as materials, production processes, business strategy and prevailing social, commercial or aesthetic attitudes. The role of an industrial designer is to create and execute design solutions for problems of form, function, usability, physical ergonomics, marketing, brand development, sustainability, and sales.

Precursors

For several millennia before the onset of industrialization, design, technical expertise, and manufacturing were often done by individuals craftsmen, who determined the form of a product at the point of its creation, according to their own manual skill, the requirements of their clients, experience accumulated through their own experimentation, and knowledge passed on to them through training or apprenticeship.

The division of labor that underlies the practice of industrial design did have precedents in the pre-industrial era. The growth of trade in the medieval period led to the emergence of large workshops in cities such as Florence, Venice, Nuremberg and Bruges, where groups of more specialized craftsmen made objects with common forms through the repetitive duplication of models which defined by their shared training and technique. Competitive pressures in the early 16th century led to the emergence in Italy and Germany of pattern books: collections of engravings illustrating decorative forms and motifs which could be applied to a wide range of products, and whose creation took place in advance of their application. The use of drawing to specify how something was to be constructed later was first developed by architects and shipwrights during the Italian Renaissance.

In the 17th century, the growth of artistic patronage in centralized monarchical states such as France led to large government-operated manufacturing operations epitomized by the Gobelins Manufactory, opened in Paris in 1667 by Louis XIV. Here teams of hundreds of craftsmen, including specialist artists, decorators and engravers, produced sumptuously decorated products ranging from tapestries and furniture to metalwork and coaches, all under the creative supervision of the King's leading artist Charles Le Burn. This pattern of large-scale royal patronage was repeated in the court porcelain factories of the early 18th century, such as the Meissen porcelain workshops established in 1709 by the Grand Duke of Saxony, where patterns from a range of sources, including court goldsmiths, sculptors and engravers, were used as models for the vessels and figurines for which it became famous. As long as reproduction remained craft-based, however, the form and artistic quality of the product remained in the hands of the individual craftsman, and tended to decline as the scale of production increased.

Birth of industrial design

The emergence of industrial design is specifically linked to the growth of industrialization and mechanization that began with the industrial revolution in Great Britain in the mid 18th century. The rise of industrial manufacture changed the way objects were made, urbanization changed patterns of consumption, the growth of empires broadened tastes and diversified markets, and the emergence of a wider middle class created demand for fashionable styles from a much larger and more heterogeneous population.

The first use of the term "industrial design" is often attributed to the industrial designer Joseph Claude Sine in 1919 (although he himself denied this in interviews), but the discipline predates 1919 by at least a decade. Christopher Dresser is considered among the first independent industrial designers.[14] Industrial design's origins lie in the industrialization of consumer products. For instance the Deutscher Werkbund, founded in 1907 and a precursor to the Bauhaus, was a state-sponsored effort to integrate traditional crafts and industrial mass-production techniques, to put Germany on a competitive footing with England and the United States.

The earliest use of the term may have been in *The Art Union*, A monthly Journal of the Fine Arts, 1839.

Dyce’s report to the Board of Trade on foreign schools of Design for Manufactures. Mr Dyces official visit to France, Prussia and Bavaria for the purpose of examining the state of schools of design in those countries will be fresh in the recollection of our readers. His report on this subject was ordered to be printed some few months since, on the motion of Mr Hume.

The school of St Peter, at Lyons was founded about 1750 for the instruction of draftsmen employed in preparing patterns for the silk manufacture. It has been much more successful than the Paris school and having been disorganized by the revolution, was restored by Napoleon and differently constituted, being then erected into an Academy of Fine Art: to which the study of design for silk manufacture was merely attached as a subordinate branch. It appears that all the students who entered the school commence as if they were intended for artists in the higher sense of the word and are not expected to decide as to whether they will devote themselves to the Fine Arts or to Industrial Design, until they have completed their exercises in drawing and painting of the figure from the antique and from the living model. It is for this reason, and from the fact that artists for industrial purposes are both well paid and highly considered (as being well instructed men) that so many individuals in France engage themselves in *both* pursuits.

Definition of industrial design

Industrial design studies function and form—and the connection between product, user, and environment. Generally, industrial design professionals work in small scale design, rather than overall design of complex systems such as buildings or ships. Industrial designers don't usually design motors, electrical circuits, or gearing that make machines move, but they may affect technical aspects through usability design and form relationships. Usually, they work with other professionals such as engineers who design the mechanical aspects of the product assuring functionality and manufacturability, and with marketers to identify and fulfill customer needs and expectations.

Industrial design (ID) is the professional service of creating and developing concepts and specifications that optimize the function, value and appearance of products and systems for the mutual benefit of both user and manufacturer.

Industrial Designers Society of America,

Design, itself, is often difficult to describe to non-designers and engineers, because the meaning accepted by the design community is not made of words. Instead, the definition is created as a result of acquiring a critical framework for the analysis and creation of artifacts. One of the many accepted (but intentionally unspecific) definitions of design originates from Carnegie Mellon's School of Design, "Design is the process of taking something from its existing state and moving it to a preferred state." (Simon, Herbert A. "The sciences of the artificial." Cambridge, MA (1969, 1981, 1996)). This applies to new artifacts, whose existing state is undefined and previously created artifacts, whose state stands to be improved.

Industrial design can overlap significantly with engineering design, and in different countries the boundaries of the two concepts can vary, but in general engineering focuses principally on functionality or utility of products, whereas industrial design focuses principally on *aesthetic and user-interface* aspects of products. In many jurisdictions this distinction is effectively defined by credentials and/or licensure required to engage in the practice of engineering. "Industrial design" as such does not overlap much with the engineering sub-discipline of industrial engineering, except for the latter's sub-specialty of ergonomics.

At the 29th General Assembly in Kwangju, South Korea, 2015, the Professional Practice Committee unveiled a renewed definition of industrial design as follows: "Industrial Design is a strategic problem-solving process that drives innovation, builds business success and leads to a better quality of life through innovative products, systems, services and experiences." An extended version of this definition is as follows: "Industrial Design is a strategic problem-solving process that drives innovation, builds business success and leads to a better quality of life through innovative products, systems, services and experiences. Industrial Design bridges the gap between what is and what's possible. It is a trans-disciplinary profession that harnesses creativity to resolve problems and co-create solutions with the intent of making a product, system, service, experience or a business, better. At its heart, Industrial Design provides a more optimistic way of looking at the future by reframing problems as opportunities. It links innovation, technology, research, business and customers to provide new value and competitive advantage across economic, social and environmental spheres. Industrial Designers place the human in the centre of the process. They acquire a deep understanding of user needs through empathy and apply a pragmatic, user centric problem solving process to design products, systems, services and experiences. They are strategic stakeholders in the innovation process and are uniquely positioned to bridge varied professional disciplines and business interests. They value the economic, social and environmental impact of their work and their contribution towards co-creating a better quality of life. "

Design process

A Fender Stratocaster with sunburst finish, one of the most widely recognized electric guitars in the world.

Model 1300 Volkswagen Beetle

Although the process of design may be considered 'creative,' many analytical processes also take place. In fact, many industrial designers often use various design methodologies in their creative process. Some of the processes that are commonly used are user research, sketching, comparative product research, model making, prototyping and testing. These processes are best defined by the industrial designers and/or other team members. Industrial designers often utilize 3D software, computer-aided industrial design and CAD programs to move from concept to production. They may also build a prototype first and then use industrial CT scanning to test for interior defects and generate a CAD model. From this the manufacturing process may be modified to improve the product.

Product characteristics specified by industrial designers may include the overall form of the object, the location of details with respect to one another, colors, texture, form, and aspects concerning the use of the product. Additionally they may specify aspects concerning the production process, choice of materials and the way the product is presented to the consumer at the point of sale. The inclusion of industrial designers in a product development process may lead to added value by improving usability, lowering production costs and developing more appealing products.

Industrial design may also focus on technical concepts, products, and processes. In addition to aesthetics, usability, and ergonomics, it can also encompass engineering, usefulness, market placement, and other concerns—such as psychology, desire, and the emotional attachment of the user. These values and accompanying aspects that form the basis of industrial design can vary—between different schools of thought, and among practicing designers.

Industrial design rights

Industrial design rights are intellectual property rights that make exclusive the visual design of objects that are not purely utilitarian. A design patent would also be considered under this category. An industrial design consists of the creation of a shape, configuration or composition of pattern or color, or combination of pattern and color in three-dimensional form containing aesthetic value. An industrial design can be a two- or three-dimensional pattern used to produce a product, industrial commodity or handicraft. Under the Hague Agreement Concerning the International Deposit of Industrial Designs, a WIPO-administered treaty, a procedure for an international registration exists. An applicant can file for a single international deposit with WIPO or with the national office in a country party to the treaty. The design will then be protected in as many member countries of the treaty as desired.

Product design as a verb is to create a new product to be sold by a business to its customers. A very broad concept, it is essentially the efficient and effective generation and development of ideas through a process that leads to new products. Thus, it is a major aspect of new product development.

Due to the absence of a consensually accepted definition that reflects the breadth of the topic sufficiently; two discrete, yet interdependent, definitions are needed: one that explicitly defines product design in reference to the artifact, the other that defines the product design process in relation to this artifact.

Product design as a noun: the set of properties of an artifact, consisting of the discrete properties of the form (i.e., the aesthetics of the tangible good and/or service) and the function (i.e., its capabilities) together with the holistic properties of the integrated form and function.

Product design process: the set of strategic and tactical activities, from idea generation to commercialization, used to create a product design. In a systematic approach, product designers conceptualize and evaluate ideas, turning them into tangible inventions and products. The product designer's role is to combine art, science, and technology to create new products that people can use. Their evolving role has been facilitated by digital tools that now allow designers to communicate, visualize, analyze and actually produce tangible ideas in a way that would have taken greater manpower in the past.

Product design is sometimes confused with (and certainly overlaps with) industrial design, and has recently become a broad term inclusive of service, software, and physical product design.

Industrial design is concerned with bringing artistic form and usability, usually associated with craft design and ergonomics, together in order to mass-produce goods.[4] Other aspects of product design include engineering design, particularly when matters of functionality or utility (e.g. problem-solving) are at issue, though such boundaries are not always clear.

Product design process

There are various product design processes, and many focus on different aspects. One example formulation/model of the process is described by Don Koberg and Jim Bagnellin, in "The Seven Universal Stages of Creative Problem-Solving." The process is usually completed by a group of people with different skills and training - e.g. industrial designers, field experts (prospective users), engineers (for engineering design aspects), depending upon the nature and type of product involved. The process often involves figuring out what is required, brainstorming possible ideas, creating mock prototypes, and then generating the product. However, that is not the end. Product designers would still need to execute the idea, making it into an actual product and evaluating its success (seeing if any improvements are necessary).

The product design process has experienced huge leaps in evolution over the last few years with the rise and adoption of 3D printing. New consumer-friendly 3D printers can produce dimensional objects and print upwards with a plastic like substance opposed to traditional printers that spread ink across a page.

The product design process, as expressed by Koberg and Bagnell, typically involves three main aspects:

- Analysis
- Concept
- Synthesis

Depending on the kind of product being designed, the latter two sections are most often revisited (e.g. depending on how often the design needs revision, to improve it or to better fit the criteria). This is a continuous loop, where feedback is the main component. Koberg and Bagnell offer more specifics on the process: In their model, "analysis" consists of two stages, "concept" is only one stage, and "synthesis" encompasses the other four. (These terms notably vary in usage in different design frameworks. Here, they are used in the way they're used by Koberg and Bagnell.)

Analysis

- **Accept Situation:** Here, the designers decide on committing to the project and finding a solution to the problem. They pool their resources into figuring out how to solve the task most efficiently.
- **Analyze:** In this stage, everyone in the team begins research. They gather general and specific materials which will help to figure out how their problem might be solved. This can range from statistics, questionnaires, and articles, among many other sources.[6]

Concept

- **Define:** This is where the key issue of the matter is defined. The conditions of the problem become objectives, and restraints on the situation become the parameters within which the new design must be constructed.

Synthesis

- **Ideate:** The designers here brainstorm different ideas, solutions for their design problem. The ideal brainstorming session does not involve any bias or judgment, but instead builds on original ideas.[6]
- **Select:** By now, the designers have narrowed down their ideas to a select few, which can be guaranteed successes and from there they can outline their plan to make the product.
- **Implement:** This is where the prototypes are built, the plan outlined in the previous step is realized and the product starts to become an actual object.
- **Evaluate:** In the last stage, the product is tested, and from there, improvements are made. Although this is the last stage, it does not mean that the process is over. The finished prototype may not work as well as hoped so new ideas need to be brainstormed.

Demand-pull innovation and invention-push innovation

Most product designs fall under one of two categories: demand-pull innovation or invention-push innovation.

Demand-pull happens when there is an opportunity in the market to be explored by the design of a product. This product design attempts to solve a design problem. The design solution may be the development of a new product or developing a product that's already on the market, such as developing an existing invention for another purpose.

Invention-push innovation happens when there is an advancement in intelligence. This can occur through research or it can occur when the product designer comes up with a new product design idea.

Product design expression

So-called "color chips" or color samples, used in the plastic industry to help designers visually identify available colors of plastic.

Design expression comes from the combined effect of all elements in a product. Color tone, shape and size should direct a person's thoughts towards buying the product. Therefore, it is in the product designer's best interest to consider the audiences who are most likely to be the product's end consumers. Keeping in mind how consumers will perceive the product during the design process will direct towards the product’s success in the market. However, even within a specific audience, it is challenging to cater to each possible personality within that group.

The solution to that is to create a product that, in its designed appearance and function, expresses a personality or tells a story. Products that carry such attributes are more likely to give off a stronger expression that will attract more consumers. On that note it is important to keep in mind that design expression does not only concern the appearance of a product, but also its function. For example, as humans our appearance as well as our actions is subject to people's judgment when they are making a first impression of us. People usually do not appreciate a rude person even if they are good looking. Similarly, a product can have an attractive appearance but if its function does not follow through it will most likely drop in regards to consumer interest. In this sense, designers are like communicators, they use the language of different elements in the product to express something.

Product design considerations

Product design is not an easy task. The stakeholders involved all demand something different from the product designer and from the design process.

- The manufacturer is concerned with production cost; in the end, the manufacturer wants an economically produced product.
- The purchaser looks at price, appearance, and prestige value.
- The end user is concerned with usability and functionality of the final product.
- The maintenance and repair department focuses on how well the final product can be maintained: is the product easily reassembled, disassembled, diagnosed, and serviced?

Stakeholders' needs vary from one another and it is the product designer's job to incorporate those needs into their design.

Trends in product design

Product designers need to consider all of the details: the ways people use and abuse objects, faulty products, errors made in the design process, and the desirable ways in which people wish they could use objects. Many new designs will fail and many won't even make it to market. Some designs eventually become obsolete. The design process itself can be quite frustrating usually taking 5 or 6 tries to get the product design right. A product that fails in the marketplace the first time may be re-introduced to the market 2 more times. If it continues to fail, the product is then considered to be dead because the market believes it to be a failure. Most new products fail, even if it's a great idea. All types of product design are clearly linked to the economic health of manufacturing sectors. Innovation provides much of the competitive impetus for the development of new products, with new technology often requiring a new design interpretation. It only takes one manufacturer to create a new product paradigm to force the rest of the industry to catch up - fueling further innovation. Products designed to benefit people of all ages and abilities—without penalty to any group—accommodate our swelling aging population by extending independence and supporting the changing physical and sensory needs we all encounter as we grow older.

Design for manufacturability (also sometimes known as design for manufacturing or DFM) is the general engineering practice of designing products in such a way that they are easy to manufacture. The concept exists in almost all engineering disciplines, but the implementation differs widely depending on the manufacturing technology. DFM describes the process of designing or engineering a product in order to facilitate the manufacturing process in order to reduce its manufacturing costs. DFM will allow potential problems to be fixed in the design phase which is the least expensive place to address them. Other factors may affect the manufacturability such as the type of raw material, the form of the raw material, dimensional tolerances, and secondary processing such as finishing.

Depending on various types of manufacturing processes there are set guidelines for DFM practices. These DFM guidelines help to precisely define various tolerances, rules and common manufacturing checks related to DFM.

While DFM is applicable to the design process, a similar concept called DFSS (Design for Six Sigma) is also practiced in many organizations.

Background

Traditionally, in the prenanometer era, DFM consisted of a set of different methodologies trying to enforce some soft (recommended) design rules regarding the shapes and polygons of the physical layout of an integrated circuit. These DFM methodologies worked primarily at the full chip level. Additionally, worst-case simulations at different levels of abstraction were applied to minimize the impact of process variations on performance and other types of parametric yield loss. All these different types of worst-case simulations were essentially based on a base set of worst-case (or corner) SPICE device parameter files that were intended to represent the variability of transistor performance over the full range of variation in a fabrication process.

Taxonomy of yield loss mechanisms

The most important yield loss models (YLMs) for VLSI ICs can be classified into several categories based on their nature.

- **Functional yield loss** is still the dominant factor and is caused by mechanisms such as misprocessing (e.g., equipment-related problems), systematic effects such as printability or planarization problems, and purely random defects.
- High-performance products may exhibit parametric design marginalities caused by either process fluctuations or environmental factors (such as supply voltage or temperature).
- The test-related yield losses, which are caused by incorrect testing, can also play a significant role.

Techniques

After understanding the causes of yield loss, the next step is to make the design as resistant as possible. Techniques used for this include:

- Substituting higher yield cells where permitted by timing, power, and rout ability.

- Changing the spacing and width of the interconnect wires, where possible
- Optimizing the amount of redundancy in internal memories.
- Substituting fault tolerant (redundant) visa in a design where possible

All of these require a detailed understanding of yield loss mechanisms, since these changes trade off against one another. For example, introducing redundant visa will reduce the chance of via problems, but increase the chance of unwanted shorts. Whether this is good idea, therefore, depends on the details of the yield loss models and the characteristics of the particular design.

Design for Inspection

The concept of Design for Inspection (DFI) should complement and work in collaboration with Design for Manufacturability (DFM) and Design for Assembly (DFA) to reduce product manufacturing cost and increase manufacturing practicality.

A raw material, also known as a feedstock or most correctly unprocessed material, is a basic material that is used to produce goods, finished products, energy, or intermediate materials which are feedstock for future finished products. As feedstock, the term connotes these materials are bottleneck assets and are highly important with regard to producing other products. An example of this is crude oil, which is a raw material and a feedstock used in the production of industrial chemicals, fuels, plastics, and pharmaceutical goods; lumber is a raw material used to produce a variety of products including furniture.

The term "raw material" denotes materials in minimally processed or unprocessed in states; e.g., raw latex, crude oil, cotton, coal, raw biomass, iron ore, air, logs, or water i.e. "...any product of agriculture, forestry, fishing and any other mineral that is in its natural form or which has undergone the transformation required to prepare it for internationally marketing in substantial volumes."

Places with plentiful raw materials and little economic development often show a phenomenon, known as "Dutch disease" or the "resource curse", that occurs when the economy of a country is mainly based upon its exports due to its method of governance. An example of this is the "geological scandal" of the Democratic Republic of Congo as it is rich in raw materials; the Second Congo War focused on controlling these raw materials.

Raw materials are also used by non-humans, such as birds using found objects and twigs to create nests.

UNIT-IV

TECHNOLOGICAL FORECASTING FOR DECISION MAKING

Important aspects

Primarily, a technological forecast deals with the characteristics of technology, such as levels of technical performance, like speed of a military aircraft, the power in watts of a particular future engine, the accuracy or precision of a measuring instrument, the number of transistors in a chip in the year 2015, etc. The forecast does not have to state how these characteristics will be achieved.

Secondly, technological forecasting usually deals with only useful machines, procedures or techniques. This is to exclude from the domain of technological forecasting those commodities, services or techniques intended for luxury or amusement.

Rational and explicit methods

The whole purpose of the recitation of alternatives is to show that there really is no alternative to forecasting. If a decision maker has several alternatives open to him or her, s/he will choose among them on the basis of which provides him/her with the most desirable outcome. Thus his/her decision is inevitably based on a forecast. His/her only choice is whether the forecast is obtained by rational and explicit methods, or by intuitive means.

The virtues of the use of rational methods are as follows:

1. They can be taught and learned,
2. They can be described and explained,
3. They provide a procedure follow able by anyone who has absorbed the necessary training, and in some cases,
4. These methods are even guaranteed to produce the same forecast regardless of who uses them.

The virtue of the use of explicit methods is that they can be reviewed by others, and can be checked for consistency. Furthermore, the forecast can be reviewed at any subsequent time. Technology forecasting is not imagination.

Methods of technology forecasting

Commonly adopted methods of technology forecasting include the Delphi method, forecast by analogy, growth curves and extrapolation. Normative methods of technology forecasting — like the relevance trees, morphological models, and mission flow diagrams — are also commonly used.

Combining forecasts

Studies of past forecasts have shown that one of the most frequent reasons why a forecast goes wrong is that the forecaster ignores related fields.

A given technical approach may fail to achieve the level of capability forecast for it, because it is superseded by another technical approach which the forecaster ignored.

Another problem is that of inconsistency between forecasts. Because of these problems, it is often necessary to combine forecasts of different technologies. Therefore rather than to try to select the one method which is most appropriate, it may be better to try to combine the forecasts obtained by different methods.

If this is done, the strengths of one method may help compensate for the weaknesses of another.

Reasons for combining forecasts

The primary reason for combining forecasts of the same technology is to attempt to offset the weaknesses of one forecasting method with the strengths of another. In addition, the use of more than one forecasting method often gives the forecaster more insight into the processes at work which are responsible for the growth of the technology being forecast.

Trend curve and growth curves

A frequently used combination is that of growth curves and a trend curve for some technology. Here we see a succession of growth curves, each describing the level of functional capability achieved by a specific technical approach.

An overall trend curve is also shown, fitted to those items of historical data which represent the currently superior approach.

The use of growth curves and a trend curve in combination allows the forecaster to draw some conclusions about the future growth of a technology which might not be possible, were either method used alone.

With growth curves alone, the forecaster could not say anything about the time at which a given technical approach is likely to be supplanted by a successor approach.

With the trend curve alone, the forecaster could not say anything about the ability of a specific technical approach to meet the projected trend, or about the need to look for a successor approach. Thus the need for combining forecasts.

Identification of consistent deviations

Another frequently used combination of forecasts is that of the trend curve and one or more analogies.

We customarily consider the scatter of data points about a trend curve to be due to random influences which we can neither control nor even measure. However, consistent deviations may represent something other than just random influences.

Where such consistent deviations are identified, we may have an opportunity to apply an analogy. Typical events which bring about deviations from a trend are wars and depressions. Thus the purpose of combining analogies with a trend forecast is to predict deviations from the trend deviations which are associated with or caused by external events or influences.

As with other uses of analogy, it is important to determine the extent to which the analogy between the event used as the basis for the forecast, and the historical model event, satisfies the criteria for a valid analogy.

Forecasts of different technologies

Combining forecasts of different technologies may be even more important than combining the forecasts of the same technology.

One reason for this is the fact that technologies may interact or be interrelated in some fashion. Another reason for this is that of consistency in an overall picture or scenario. One of the simplest examples of interacting trends is the projection to absurdity, i.e. simply projecting the given data indefinitely without getting any specific result. For instance, if one simply projects recent rates of growth of world population, one arrives at some fantastic conclusions about the density of population in a particular place by various dates in the next millennium.

Some other trends which can confidently be expected to not continue indefinitely are:

1. Annual production of scientific papers.
2. Number of automobiles per capita.
3. Kilowatt hours of electricity generated annually.

Another instance of interacting trends was in the case of the number of scientists in the U.S. growing faster than the overall population. Since the 1940s through the 1960s, science as an activity in the United States grew exponentially. The number of dollars spent on R&D was growing faster than the GNP (in the 1960s).

If projected indefinitely, these two curves would give the result that eventually every person in the U.S. would be working as a scientist and the entire GNP would be devoted to R&D alone, which are however absurd conclusions. Thus it is clear that the scientific discipline of technology forecasting is not mere trend extrapolation but also involves combining forecasts.

Uses in manufacturing

Almost all modern manufacturing firms utilize the services of a technological forecaster. Nevertheless, there are a number of alternatives to the rational and explicit forecasting of technology, such as 'no forecast', 'anything can happen' (i.e. relying on pure chance), 'window-blind forecasting', 'genius forecasts' and boasting of a 'glorious past' (i.e. adopting the same old techniques).

Thus technological forecasting is not mere astrology or palmistry, but a scientific and well defined procedure adopted by a technological forecaster or a consultancy for the forecasting of a particular technology. Even though technological forecasting is a scientific discipline, some experts are of the view that "the only certainty of a particular forecast is that it is wrong to some degree."

Forecasting:

Forecasting is the process of making predictions of the future based on past and present data and most commonly by analysis of trends. A commonplace example might be estimation of some variable of interest at some specified future date. Prediction is a similar, but more general term. Both might refer to formal statistical methods employing time series, cross-sectional or longitudinal data, or alternatively to less formal judgmental methods. Usage can differ between areas of application: for example, in hydrology the terms "forecast" and "forecasting" are sometimes reserved for estimates of values at certain specific future times, while the term "prediction" is used for more general estimates, such as the number of times floods will occur over a long period.

Risk and uncertainty are central to forecasting and prediction; it is generally considered good practice to indicate the degree of uncertainty attaching to forecasts. In any case, the data must be up to date in order for the forecast to be as accurate as possible.

Trade Promotion Forecasting

Trade Promotion spending is one of the consumer goods industry's largest expenses with costs for major manufacturers ranging from 10 percent to 20 percent of gross sales. Understandably, 67 percent of respondents to a recent survey said they were concerned about the return on investment (ROI) gained from such spending. Quantifying ROI depends heavily on the ability to accurately identify the "baseline" demand (the demand that would exist without the impact of the trade promotion) and the uplift.

In fact, forecast accuracy plays a critical role in the success of consumer goods companies. Aberdeen Group research found that best-in-class forecasting companies (with an average forecast accuracy of 72 percent) have an average promotion gross margin uplift of 28 percent, while laggard forecasting companies (with an average forecasting accuracy of only 42 percent) have a gross margin uplift of less than 7 percent.

A bottom-up sales forecast at the SKU-account/POS level requires taking into account product attributes, historical sales levels and store specifics. The large number of different variables which describe the product, the store and the promotion attributes, both quantitative and qualitative, could potentially have many different values. Selecting the most important variables and incorporating them into a prediction model is a challenging task.

Despite these challenges, two-thirds of companies in the consumer supply chain consider forecast accuracy a high business priority. 74 percent said it would be helpful to develop a bottom-up forecast based on stock-keeping unit (SkU) by key customer.

Traditional trade promotion forecasting methods

Many companies forecast the impact of trade promotions primarily through a human expert approach. Human experts are unable to take into account all the variables involved and also cannot provide an analytic prediction of campaign behavior and trends. A recent survey by Aberdeen Group showed that 78 percent of companies used Excel spreadsheets as their primary trade promotion forecasting technology tool. The limitations of spreadsheets for trade promotion planning and forecasting include lack of visibility, ineffectiveness and difficulty in tracking deductions.

Specialized trade promotion forecasting applications have been developed and are becoming more common. 35 percent of companies now use legacy systems, 30 percent use Sales and Operations Planning (S&OP) applications, 26 percent use integrated Enterprise Resource Planning (ERP) modules and 17percent use home grown trade promotion solutions. These applications support the planning process, while still primarily relying on human knowledge and intuition for forecasting. One problem with this approach is that humans tend to make optimistic assumptions when forecasting and planning. The result is that forecasts most commonly err on the optimistic side and that human forecasters also tend to underestimate the amount of uncertainty in their forecasts.

A further issue is that legacy trade promotion systems contribute to internal fragmentation of trade marketing data. Many companies using these tools are currently producing assumption-based forecasts with limited accuracy.

Analytic approaches to trade promotion forecasting

TPF is complicated by the fact that campaigns are described by both quantitative (such as price and discount) and qualitative (such as display space and support by sales representatives) variables. New approaches are being developed to address this and other challenges. Most of these approaches attempt to incorporate large amounts of heterogeneous data in the forecasting process. One researcher validated the ability of multivariate regression models to forecast the impact on sales of a product of many variables including price, discount, visual merchandizing, etc.

The term Big Data describes the increasing volume and velocity of heterogeneous data that is coming into the enterprise. The data can be used to improve trade promotion forecast accuracy because it usually contains real connections and causation that can help to better understand what customers are buying, where they are buying it, why they are buying and how they are buying. Often, the challenge is to combine this data across all of the silos within the organization for a single view.

Traditional methods are insufficient to assimilate and process such a large volume of data. Therefore more sophisticated modeling and algorithms have been developed to address the problem. Some companies have begun using machine learning methods to utilize the massive volumes of unstructured and structured data they already hold to better understand these connections and causality.

Machine learning can make it possible to recognize the shared characteristics of promotional events and identify their effect on normal sales. Learning machines use simpler versions of nonlinear functions to model complex nonlinear phenomena. Learning machines process sets of input and output data and develop a model of their relationship. Based on this model, learning machines forecast outputs associated with new sets of input data.

Intelligible Machine Learning (IML) is an implementation of Switching Neural Networks that has been applied to TPF. Starting from a collection of promotional characteristics, IML is able to identify and present in intelligible form existing correlations between relevant attributes and uplift. This approach is designed to automatically select the most suitable uplift model in order to

describe the future impact of a planned promotion. In addition, new promotions are automatically classified using the previously trained model, thus providing a simple way of studying different what-if scenarios.

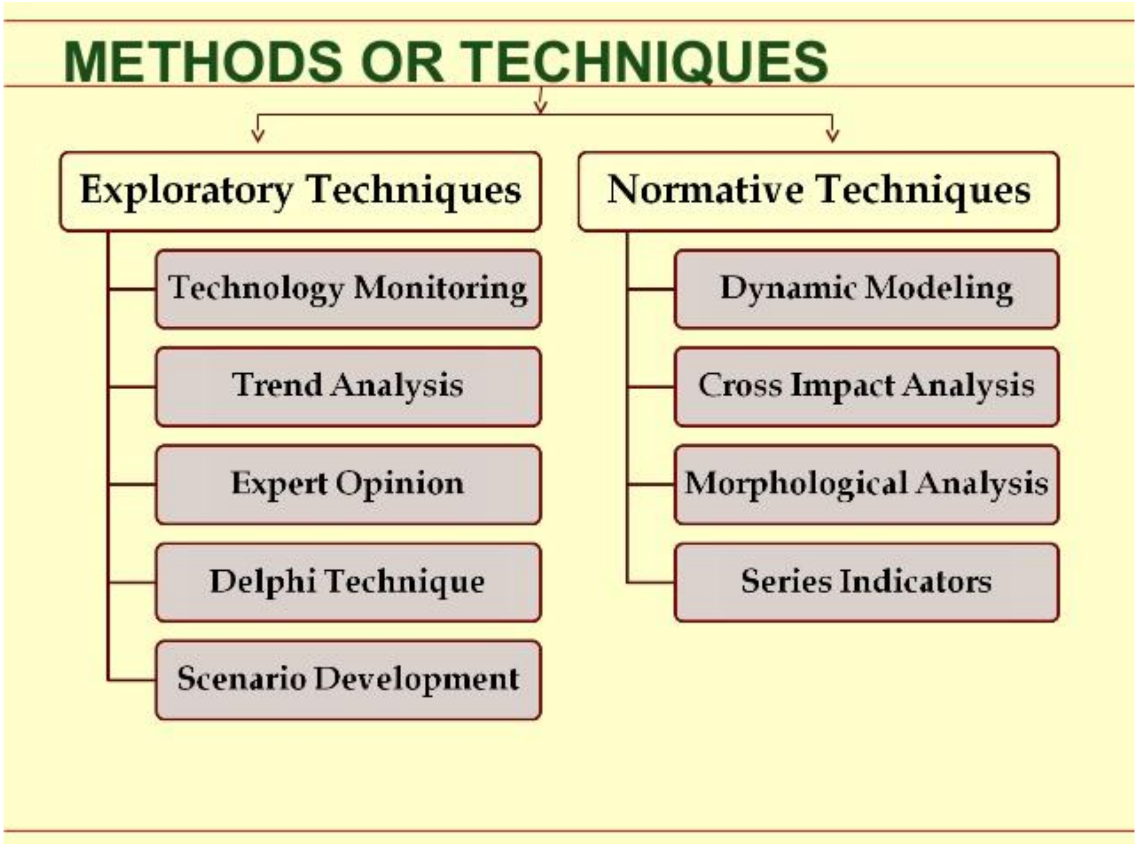
A **master production schedule** (**MPS**) is a plan for individual commodities to be produced in each time period such as production, staffing, inventory, etc. It is usually linked to manufacturing where the plan indicates when and how much of each product will be demanded. This plan quantifies significant processes, parts, and other resources in order to optimize production, to identify bottlenecks, and to anticipate needs and completed goods. Since an MPS drives much factory activity, its accuracy and viability dramatically affect profitability. Typical MPSs are created by software with user tweaking.

Due to software limitations, but especially the intense work required by the "master production schedulers", schedules do not include every aspect of production, but only key elements that have proven their control affectivity, such as forecast demand, production costs, inventory costs, lead time, working hours, capacity, inventory levels, available storage, and parts supply. The choice of what to model varies among companies and factories. The MPS is a statement of what the company expects to produce and purchase (i.e. quantity to be produced, staffing levels, dates, available to promise, and projected balance).

The MPS translates the customer demand (sales orders, PIR's), into a build plan using planned orders in a true component scheduling environment. Using MPS helps avoid shortages, costly expediting, last minute scheduling, and inefficient allocation of resources. Working with MPS allows businesses to consolidate planned parts, produce master schedules and forecasts for any level of the Bill of Material (BOM) for any type of part.

Demand forecasting is the art and science of forecasting customer demand to drive holistic execution of such demand by corporate supply chain and business management. Demand forecasting involves techniques including both informal methods, such as educated guesses, and quantitative methods, such as the use of historical sales data and statistical techniques or current data from test markets. Demand forecasting may be used in production planning, inventory management, and at times in assessing future capacity requirements, or in making decisions on whether to enter a new market

Demand forecasting is predicting future demand for the product. In other words, it refers to the prediction of a future demand for a product or a service on the basis of the past events and prevailing trends in the present.



Reference class forecasting or **comparison class forecasting** is a method of predicting the future by looking at similar past situations and their outcomes.

Reference class forecasting predicts the outcome of a planned action based on actual outcomes in a reference class of similar actions to that being forecast. The theories behind reference class forecasting were developed by Daniel Kahneman and Amos Tversky. The theoretical work helped Kahneman win the Nobel Prize in Economics.

Categories of forecasting methods

- Qualitative vs. quantitative methods. ...
- Average approach. ...
- Naïve approach. ...
- Drift method. ...
- Seasonal naïve approach. ...
- Time series methods. ...
- Causal / econometric forecasting methods. ...
- Judgmental methods.

Qualitative

You should use qualitative techniques when relevant and reliable numerical data is not available. This may be because you are trying something new or because the existing situation has changed radically. Qualitative techniques rely on quality advice from informed people familiar with your situation. These could be experts in the field or your own employees who are familiar with the markets or business situation. Brainstorming and exploring scenarios are qualitative techniques that result in options and choices. A team-based approach to qualitative decision-making can build consensus and arrive at a valid forecast and resulting course of action.

Time Series

When you have data, a quantitative technique based on time series can give reliable forecasts. Time series forecasting uses historical data to develop a matching series over a given time. If sales of a product decreased over the summer but peaked at Christmas every year for the past 5 years, then you can forecast the same behavior for next year. If total sales increased steadily by 5 percent per year over the last 10 years, you can forecast that they will increase 5 percent per year over the next 3 years. Time series forecasting gives specific answers but needs consistent data trends.

Causation

Causation also examines past data but looks for a cause and effect relationship. Such a technique predicts an increase in Christmas sales based on the increased demand due to the holiday season and possibly because of sales featuring low prices. If the technique can filter out the effect of low prices, it can forecast how much of a sales increase you can expect from lowering your prices at other times of the year. Causation is a powerful technique if you can identify the cause and effect relationship.

Modeling

Simulating your business situation mathematically is an effective quantitative technique. It relies on a mathematical model based on past data. If you can establish a mathematical relationship between past data sets, you can use the mathematical formula for forecasting future behavior. Past data may show that decreasing the price by 5 percent results in an 8 percent sales increase. Placing such data in a mathematical model can allow you to predict the sales increase resulting from a 12 percent price drop.

Meaning of Forecasting:

In preparing plans for the future, the management authority has to make some predictions about what is likely to happen in the future.

It shows that the managers know something of future happenings even before things actually happen.

On the basis of the definition, the following features of forecasting can be identified:

1. Forecasting relates to future events.
2. Forecasting is needed for planning process because it devises the future course of action.
3. It defines the probability of happening of future events. Therefore, the happening of future events can be precise only to a certain extent.
4. Forecasting is made by analyzing the past and present factors which are relevant for the functioning of an organization.
5. The analysis of various factors may require the use of statistical and mathematical tools and techniques.

Role of Forecasting:

Since planning involves the future, no usable plan can be made unless the manager is able to take all possible future events into account. This explains why forecasting is a critical element in the planning process. In fact, every decision in the organization is based on some sort of forecasting.

It helps the managers in the following ways:

1. Basis of Planning:

Forecasting is the key to planning. It generates the planning process. Planning decides the future course of action which is expected to take place in certain circumstances and conditions. Unless the managers know these conditions, they cannot go for effective planning.

Forecasting provides the knowledge of planning premises within which the managers can analyse their strengths and weaknesses and can take appropriate actions in advance before actually they are put out of market. Forecasting provides the knowledge about the nature of future conditions.

2. Promotion of Organization:

The objectives of an organization are achieved through the performance of certain activities. What activities should be performed depends on the expected outcome of these activities. Since expected outcome depends on future events and the way of performing various activities, forecasting of future events is of direct relevance in achieving an objective.

3. Facilitating Co-ordination and Control:

Forecasting indirectly provides the way for effective co-ordination and control. Forecasting requires information about various factors. Information is collected from various internal and external sources. Almost all units of the organization are involved in this process.

It provides interactive opportunities for better unity and co-ordination in the planning process. Similarly, forecasting can provide relevant information for exercising control. The managers can know their weaknesses in the forecasting process and they can take suitable action to overcome these.

4. Success in Organization:

All business enterprises are characterized by risk and have to work within the ups and downs of the industry. The risk depends on the future happenings and forecasting provides help to overcome the problem of uncertainties.

Though forecasting cannot check the future happenings, it provides clues about those and indicates when the alternative actions should be taken. Managers can save their business and face the unfortunate happenings if they know in advance what is going to happen.

Steps in Forecasting:

The process of forecasting generally involves the following steps:

1. Developing the Basis:

The future estimates of various business operations will have to be based on the results obtainable through systematic investigation of the economy, products and industry.

2. Estimation of Future Operations:

On the basis of the data collected through systematic investigation into the economy and industry situation, the manager has to prepare quantitative estimates of the future scale of business operations. Here the managers will have to take into account the planning premises.

3. Regulation of Forecasts:

It has already been indicated that the managers cannot take it easy after they have formulated a business forecast. They have to constantly compare the actual operations with the forecasts prepared in order to find out the reasons for any deviations from forecasts. This helps in making more realistic forecasts for future.

4. Review of the Forecasting Process:

Having determined the deviations of the actual performances from the positions forecast by the managers, it will be necessary to examine the procedures adopted for the purpose so that improvements can be made in the method of forecasting.

Techniques of Forecasting:

There are various methods of forecasting. However, no method can be suggested as universally applicable. In fact, most of the forecasts are done by combining various methods.

A brief discussion of the major forecasting methods is given below:

1. Historical Analogy Method:

Under this method, forecast in regard to a particular situation is based on some analogous conditions elsewhere in the past. The economic situation of a country can be predicted by making comparison with the advanced countries at a particular stage through which the country is presently passing.

Similarly, it has been observed that if anything is invented in some part of the world, this is adopted in other countries after a gap of a certain time. Thus, based on analogy, a general forecast can be made about the nature of events in the economic system of the country. It is often suggested that social analogies have helped in indicating the trends of changes in the norms of business behavior in terms of life.

Likewise, changes in the norms of business behavior in terms of attitude of the workers against inequality, find similarities in various countries at various stages of the history of industrial growth. Thus, this method gives a broad indication about the future events of general nature.

2. Survey Method:

Surveys can be conducted to gather information on the intentions of the concerned people. For example, information may be collected through surveys about the probable expenditure of consumers on various items. Both quantitative and qualitative information may be collected by this method.

On the basis of such surveys, demand for various products can be projected. Survey method is suitable for forecasting demand—both of existing and new products. To limit the cost and time, the survey may be restricted to a sample from the prospective consumers.

3. Opinion Poll:

Opinion poll is conducted to assess the opinion of the experienced persons and experts in the particular field whose views carry a lot of weight. For example, opinion polls are very popular to predict the outcome of elections in many countries including India. Similarly, an opinion poll of the sales representatives, wholesalers or marketing experts may be helpful in formulating demand projections.

If opinion polls give widely divergent views, the experts may be called for discussion and explanation of why they are holding a particular view. They may be asked to comment on the views of the others, to revise their views in the context of the opposite views, and consensus may emerge. Then, it becomes the estimate of future events.

4. Business Barometers:
A barometer is used to measure the atmospheric pressure. In the same way, index numbers are used to measure the state of an economy between two or more periods. These index numbers are the device to study the trends, seasonal fluctuations, cyclical movements, and irregular fluctuations.
These index numbers, when used in combination with one another, provide indications as to the direction in which the economy is proceeding. Thus, with the business activity index numbers, it becomes easy to forecast the future course of action.
However, it should be kept in mind that business barometers have their own limitations and they are not sure road to success. All types of business do not follow the general trend but different index numbers have to be prepared for different activities, etc.
5. Time Series Analysis:
Time series analysis involves decomposition of historical series into its various components, viz. trend, seasonal variances, cyclical variations, and random variances. When the various components of a time series are separated, the variation of a particular situation, the subject under study, can be known over the period of time and projection can be made about the future.
A trend can be known over the period of time which may be true for the future also. However, time series analysis should be used as a basis for forecasting when data are available for a long period of time and tendencies disclosed by the trend and seasonal factors are fairly clear and stable.
6. Regression Analysis:
Regression analysis is meant to disclose the relative movements of two or more inter-related series. It is used to estimate the changes in one variable as a result of specified changes in other variable or variables. In economic and business situations, a number of factors affect a business activity simultaneously.
Regression analysis helps in isolating the effects of such factors to a great extent. For example, if we know that there is a positive relationship between advertising expenditure and volume of sales or between sales and profit, it is possible to have estimate of the sales on the basis of advertising, or of the profit on the basis of projected sales, provided other things remain the same.
7. Input-Output Analysis:
According to this method, a forecast of output is based on given input if relationship between input and output is known. Similarly, input requirement can be forecast on the basis of final output with a given input-output relationship. The basis of this technique is that the various sectors of economy are interrelated and such inter-relationships are well-established.
For example, coal requirement of the country can be predicted on the basis of its usage rate in various sectors like industry, transport, household, etc. and how the various sectors behave in future. This technique yields sector-wise forecasts and is extensively used in forecasting business events as the data required for its application are easily obtained.

Technological forecasting

Technological Forecasting (TF) is concerned with the investigation of new trends, radically new technologies, and new forces which could arise from the interplay of factors such as new public concerns, national policies and scientific discoveries. Many of these forces are beyond the control, influence and knowledge of individual companies.

Technology Foresight is a combination of creative thinking, expert views and alternative scenarios to make a contribution to strategic planning.

The future is almost by definition unknown, but in both forecasting and foresight activities the judgments or opinions of experts are used. Experts can be used singly, or in numbers. Different techniques can be applied to provide either a consensus view, a range of opinions, or maverick views. The kinds of exercises that can be carried out vary enormously in their complexity and structure and in the ease with which they can be managed.

The simple expedient of subscribing to a technical journal, or belonging to a network or collaborative R&D project, or finding out what research is being done by a relevant research organization, can all be the first stage towards setting up a more structured approach.

Planning the exercise and getting started

When planning to start either forecasting or fore sighting it is useful to consider:

- The reasons for doing it.
- What resources will be needed and what resources can be made available.
- How long will it take?.
- How to learn the techniques and improve the overall process?

Establish the need

In order to assess if a more systematic approach will be useful the following factors can be considered:

- The criticality of technologies used by the company.
- The maturity and rate of change of critical technologies.
- The nature of the R&D strategy, (eg whether offensive or defensive).
- The complexity and flexibility of markets and the overall business environment.

The magnitude and direction of technological progress in general is driven by financial investment and by market forces and needs; these must also be watched and monitored as part of any forecasting activity.

Co-coordinating resources

Decisions must be made about who should manage the forecasting process. It is not a task for a junior member of staff. It may need a multidisciplinary team or a single individual with adequate authority to co-ordinate across several departments. In all cases the exercise should first seek to use the knowledge and expertise of individuals within the company. Their specific knowledge of company activities and processes will be useful; much additional information can also be gleaned from their contacts and networks and from their appreciation of the general business environment.

Establish and improve the process: forecasting

The process has two primary activities: information gathering and analysis. The value of the overall process to each company depends on how the two main activities are carried out, how the techniques are customized, and the extent to which the process is followed through to recommendations and actions. They are often applied in iterative or parallel processes. It is not necessary to complete the whole process to appreciate the potential benefits so the process reinforces itself and encourages further iterations.

Activity 1: collection of relevant information

The major issues to be addressed are:

- What information and what kind of data are relevant?
- What sources of information are to be used?
- How accurate is it?
- What systems need to be set up to provide information and data on technological developments and trends?

Practical decisions arising from consideration of these issues include:

- Which journals to monitor, and how.
- Which conferences and trade fairs to attend.
- How to share information.
- Who should participate in which networks.
- How can an individual's relevant expertise best be used?
- What internal data to collect and external data to acquire.
- How to track performance parameters of competitors' products?

Activity 2: analysis of the data by individuals and by various methods and techniques

The major issues to be addressed are:

- Whose expertise should be used?
- Which methodologies or techniques are appropriate?
- Against what criteria or objectives are the analyses to be judged?
- What data should be used or is relevant?
- Who are the relevant people to apply the techniques to the data?

Decisions following from considerations of these issues could result in a greater understanding of the potential contribution and judgment of different experts, within and without the company; more tightly formulated objectives; and a greater understanding of the value of forecasting in general.

Establish and improve the process: foresight

Foresight activity seeks the subjective or intuitive opinions of a number of people with varying degrees of expertise. Opinions need to be collected without bias or misinterpretation. Using different techniques, some more structured than others, experts are asked to project their present knowledge towards how events and trends might develop in the future. They also need to consider what alternatives might be possible within the projected time frame. When setting up a foresight programmed it is important to consider:

- What kind of expertise is relevant and how can it be obtained.
- What boundaries to the creativity of the process have to be imposed?
- How can the exercise be aligned to the needs of the organization that is commissioning the study.

Specific techniques

Forecasting techniques

The formal forecasting techniques are standard components that are described in many textbooks on forecasting techniques (see specific techniques). Specific techniques for forecasting fall into two main categories, exploratory and normative. Information about each technique is available in various references.

- **Exploratory** techniques are primarily concerned with the analysis of historical data. Selected attributes such as functional performance, technical parameters, economic performance etc. are plotted against time. Since it is usually assumed that progress is evolutionary and that technological progress is not random, it is possible to generate characteristic curves or patterns from the data and from these patterns forecasts can be made with varying degrees of certainty. However, changes do occur and the influence and impact of new or surprise factors must not be disregarded. Examples of relevant exploratory techniques are:
    - S-curves
    - Cycles
    - Trend extrapolation
    - Technology substitution

All of which rely on a large amount of statistical data, which may or may not be available freely.

- **Normative** techniques start by proposing a desired or possible state, such as the satisfaction of a market need or the achievement of a technological development, and work backwards from this to determine the steps necessary to reach the required outcome. The number of foreseeable paths of development from the present position to the objective could range from ‘none’, implying a completely new technology, to ‘several’. Each feasible path to the objective is analyzed for its relevance and difficulty. Examples of relevant normative techniques are:
    - Relevance trees
    - Morphological analysis
    - Technology watch and technology monitoring
    - Delphi analysis
    - Trend impact analysis
    - Technology substitution.

Information needed for these techniques is likely to be more firm-specific than that needed for exploratory techniques. Technology-watch in particular needs a proactive role to help the organization identify and establish links with the most useful sources of information and opinion; typically these will be at the forefront of innovative activity.

Foresight techniques

The methods and systems used in foresight programmers are drawn from the forecasting field, particularly technology forecasting (see above).

Intuitive thinking is used more in technology foresight than in technology forecasting and is used in a comprehensive and structured form. All intuitive thinking methods are relevant to foresight activities, but only a few of the exploratory and normative methods used in forecasting are applicable to foresight. Which exploratory or normative method to use, under different circumstances, will depend on the requirements of each specific study.

The use of ‘vision’ is a form of intuitive thinking. When companies formulate a business strategy the vision of key individuals can play an important part. The value of this kind of input is increasingly acknowledged.

It is unlikely that any single method on its own will meet the needs of a foresight programmed.

UNIT-V

TRANSFER OF TECHNOLOGY

Modes of technology transfer:

Technology is information that is put to use in order to accomplish some task. Transfer is the movement of technology via some communication channel from one individual or organization to another. Technology is the useful application of knowledge and expertise into an operation.

Technology transfer usually involves some source of technology, group which posses specialized technical skills, which transfers the technology to a target group of receptors who do not possess those specialized technical skills, and who therefore cannot create the tool themselves (Carayannis et al., 1997). In the United States especially, the technology transfer experience has pointed to multiple transfer strategies, two of which are the most significant: the licensing of intellectual property rights and extending property rights and technical expertise to developing firms.

The major categories of technology transfer and commercialization involve the transfer of:

1. technology codified and embodied in tangible artifacts
2. processes for implementing technology
3. knowledge and skills that provide the basis for technology and process development.

WHY TRANSFER TECHNOLOGY?

Most technology transfer takes place because the organization in which a technology is developed is different from the organization that brings the technology to market. The process of introducing a technology into the marketplace is called technology commercialization. In many cases, technology commercialization is carried out by a single firm. The firm's employees invent the technology, develop it into a commercial product or process, and sell it to customers. In a growing number of cases, however, the organization that creates a technology does not bring it to the market. There are several potential reasons for this:

- If the inventing organization is a private company, it may not have the resources needed to bring the technology to market, such as a distribution network, sales organization, or simply the money and equipment for manufacturing the product (these resources are called complementary assets). Even if the company has those resources, the technology may not be viewed as a strategic product for that firm, especially if the technology was created as a byproduct of a research project with a different objective.
- If the inventing organization is a government laboratory, that laboratory is forbidden in general by law or policy (in the United States) from competing with the private sector by selling products or processes. Therefore, the technology can only be brought to market by a private firm.
- If the inventing organization is a university, the university usually does not have the resources or expertise to produce and market the products from that technology. Also, if the technology was developed with funding from the federal government, U.S. law

strongly encourages the university to transfer the technology to a private firm for commercialization.

From a public policy perspective, technology transfer is important because technology can be utilized as a resource for shared prosperity at home and abroad. As a resource, technology

(1) consists of a body of knowledge and know-how,

(2) acts as a stimulant for healthy competitive international trade,

(3) is linked with other nations' commercial needs, and

(4) needs an effective plan for management and entrepreneurship from lab to market.

From a business perspective, companies engage in technology transfer for a number of reasons:

- Companies look to transfer technologies from other organizations because it may be cheaper, faster, and easier to develop products or processes based on a technology someone else has invented rather than to start from scratch. Transferring technology may also be necessary to avoid a patent infringement lawsuit, to make that technology available as an option for future technology development, or to acquire a technology that is necessary for successfully commercializing a technology the company already possesses.
- Companies look to transfer technologies to other organizations as a potential source of revenue, to create a new industry standard, or to partner with a firm that has the resources or complementary assets needed to commercialize the technology.

For government laboratories and universities, the motivations for technology transfer are somewhat different:

- Governments or universities may transfer technology from outside organizations if it is needed to accomplish a specific goal or mission (for example, universities may transfer in educational technologies), or if that technology would add value to a technology the government or university is hoping to transfer out to a company.
- Government laboratories and universities commonly transfer technologies to other organizations for economic development reasons (to create jobs and revenues for local firms), as an alternate source of funding, or to establish a relationship with a company that could have benefits in the future.

HOW DO YOU TRANSFER TECHNOLOGY?

The first requirement for an organization to transfer a technology is to establish legal ownership of that technology through intellectual property law. There are four generally recognized forms of intellectual property in industrialized nations:

- patents, dealing with functional and design inventions
- trademarks, dealing with commercial origin and identity
- copyrights, dealing with literary and artistic expressions
- trade secrets, which protect the proprietary capabilities of the firm

Under U.S. law, a patent is granted only by the federal government and lets the patentee exclude others from making, using, selling or offering an invention for a fixed term, currently 20 years from the date the patent application is filed. The number of patents granted by the U.S. government is up by 21 percent in 2003. A trademark, as defined under the Trademark Act of 1946 (The Lanham Act) is "any word, name, symbol, or device, or any combination thereof

(1) used by a person, or

(2) which a person has a bona fide intention to use in commerce…to identify and distinguish his or her goods, including a unique product, from those manufactured or sold by others, and to indicate the source of the goods, even if that source is unknown."

A copyright seeks to promote literary and artistic creativity by protecting, for a limited time, what the U.S. Constitution broadly calls writings of authors. The general rule in the United States for a work created on or after January 1, 1978, whether or not it is published, is that copyright lasts for the author's life-time plus 50 years after the author's death. The copyright in a work made for hire or in an anonymous work lasts for 75 years from publication or 100 years from creation, whichever is shorter.

A trade secret is information that an inventor chooses not to disclose and to which the inventor also controls access, thus providing enduring protection. Trade secrets remain in force only if the holder takes reasonable precautions to prevent them from being revealed to people outside the firm, except through a legal mechanism such as a license. Trade secrets are governed by state rather than federal law.

The second step in technology transfer is finding a suitable recipient for that technology—one that can use the technology and has something of value to offer in return. Firms are now studying more systematically the process of licensing and technology transfer. There are five information activities needed to support technology transfer:

- Technology scouting—searching for specific technologies to buy or license.
- technology marketing—searching for buyers for a technology, the inverse of tech scouting; also searching for collaborators, joint venture or development partners, or for investors or venture capital to fund a specific technology.
- Technology assessment—evaluating technology, aimed at answering the question "what is this technology worth?" Includes research of any intellectual properties, and market and competitor assessments.
- transfer-related activities—information about the transfer process itself, such as licensing terms and practices, contracts, conducting negotiations, and how to do the transfer most successfully.
- Finding experts—to assist in any of the above areas. A common saying in the field is, "technology transfer is a contact sport."

These information needs are often supported by service companies, such as licensing consultants, and by electronic media, including databases and online networks. Some new online networks use the Internet to help firms in these information activities.

The information-transfer process is one of the most critical steps in technology transfer. New licensing practices are designed to address this process. For example, many licenses now bundle both the basic technology and the equipment needed to utilize that technology in a single agreement. A license may also include a "know-how" agreement, which exchanges relevant trade secrets (with appropriate protections) to the licensee to help in exploiting technology. In some industries, such as petroleum exploration, firms even practice wet licensing, whereby employees of the licenser are loaned out to the licensee to teach how a technology should be properly used.

The major barrier to the increase in technology transfer among firms is organizational behavior. In the past, cultural blocks such as the "not invented here" syndrome prevented firms from even showing interest in technology transfer. New concepts along the lines of knowledge management are changing behaviors and beliefs, leading firms to realize the enormous gains to be made through the active pursuit of licensing.

Once the organization has at least started to establish ownership of the technology, there are several possible legal and/or contractual mechanisms for transferring technology from one organization to another:

- Licensing—the exchange of access to a technology and perhaps associated skills from one company for a regular stream of cash flows from another.
- Cross-licensing—an agreement between two firms to allow each other use of or access to specific technologies owned by the firms.
- Strategic supplier agreement—a long-term supply contract, including guarantees of future purchases and greater integration of activity than a casual market relationship. One prominent example is the second-source agreements signed between semiconductor chip manufacturers.
- contract R&D—an agreement under which one company or organization, which generally specializes in research, conducts research in a specific area on behalf of a sponsoring firm.
- joint or cooperative R&D agreement—an agreement under which two or more companies agree to cooperate in a specific area of R&D or a specific project, coordinating research tasks across the partner firms and with sharing of research results.
- R&D corporation or research joint venture—the establishment of a separate organization, jointly owned by two or more companies, which conducts research on behalf of its owners. A notable example is Bell core, which originally was established by the seven Regional Bell Holding Companies of the United States and which would conduct research and set standards for the local telephone system.
- research consortium—any organization with multiple members formed to conduct joint research in a broad area, often in its own facilities and using personnel on loan from member firms and/or direct hires. The Microelectronics and Computer Technology Corporation (MCC) and Semiconductor Manufacturing Technology (SEMATECH) are examples of such organizations.

The choice of which mechanism to use in a particular technology transaction depends on many factors, including the stage of development for that technology, what the company receiving the technology is willing or able to pay, what technology or other assets it might be able to offer in place of money, the likely benefits of establishing a longer-lasting partnership between the organizations instead of a onetime transfer; and the exact legal status of ownership over that technology. For example, if a small firm simply wants to sell its technology to a large firm in exchange for money, it will probably choose to license the technology. If the small firm also wants access to the large firm's complementary assets, such as its production facilities and distribution network, it will try to negotiate a more substantial and permanent relationship, such as an R&D contract or a cooperative R&D agreement.

PRIVATE TECHNOLOGY TRANSFER

Technology transfer between private companies is most commonly accomplished through licensing, although other mechanisms such as joint ventures, research consortia, and research partnerships are also quite popular. Licensing is a big business by itself. In 2002 U.S. companies received over $66 billion in payments on technology licenses from other organizations, of which $58 billion was from domestic sources. Data from the U.S. Department of Commerce compiled in the mid-1990s indicated that international technology licensing was rising at approximately 18 percent per year, and domestic technology licensing was rising at 10 percent per year.

Another growing mode of private technology transfer is the formation of research joint ventures (RJVs) between companies in the United States. For years, such joint ventures were rare, mostly due to fears among companies that joint ventures would provoke antitrust litigation from the government. Passage of the National Cooperative Research Act (NCRA) in 1984 and the National Cooperative Research and Production Act in 1993 relaxed antitrust regulation of such partnerships, leading to a substantial increase in RJVs.

Studies of the filings of RJVs registered with the Department of Justice under the NCRA shows some interesting trends:

- Although multi-firm consortia such as SEMATECH and the Microelectronics and Computer Corporation (MCC) attract the most interest, about 85 percent of RJVs involve only two firms.
- Most RJVs focus on developing process technologies rather than product technologies, as processes are viewed as pre-competitive technologies in many industries.
- The largest concentration of RJVs focuses on telecommunications, while software and computer hardware are also leading industries for RJV activity. These industries have significant impact on technological advances in other industries, and therefore attract much interest for partnering firms. Not surprisingly, RJVs are less common in the chemical and pharmaceutical industries, probably because process technologies have greater competitive impact in those industries than in others.

Research joint ventures are an advantageous means of acquiring high-risk technologies, for several reasons. First, joint ventures enable the risks and costs involved in early research in technology to be shared across multiple firms, reducing the burden on each individual company. Second, the resources and expertise needed to develop certain technologies may be distributed across multiple firms, so RJVs are the only way to combine those resources in one effort. Third, in industries where technology advances quickly, RJVs are an effective way to keep up with new developments. Finally, RJVs are often used to develop and set critical technical standards in certain industries, especially telecommunications. These reasons indicate that RJVs will continue to increase in significance as a tool for technology transfer.

Technology Transfer from Government to Industry

In an effort to increase the application of government research results to industry technology problems (and therefore fuel technology-based economic growth), the United States government has passed a series of laws since 1980 to encourage the transfer of technologies from government laboratories to industry. Technology licensing was the earliest focus of activity, based on the notion that government laboratories were like treasure chests of available technologies that could easily be applied to corporate needs. In fact, government technology licensing activity is extremely limited, except in the National Institutes of Health. The NIH has been the source of several groundbreaking therapies and other medical technologies and enjoys close relations with the pharmaceutical industry, enabling the agency to gain large amounts of licensing revenue.

Other agencies face substantial difficulties in licensing technologies. Often, their technologies require substantial development before commercialization, reducing their value to firms. Also, most government laboratories do research in areas where there is no clear, consistent path to commercialization as exists in the pharmaceutical industry. The uncertainty of commercialization also diminishes the willingness of firms to purchase technology licenses from laboratories.

Instead, most agencies have focused on signing Cooperative Research and Development Agreements (CRADAs), a mechanism developed under the 1986 Federal Technology Transfer Act. CRADAs are contracts to conduct joint R&D projects, where the government laboratory contributes personnel and equipment, while the partner contributes these assets and funding as well. The number of CRADAs signed by government agencies has increase steadily in recent years.

There are several potential benefits and potential difficulties involved in CRADA research relationships:

- Transfer of product and process technologies can have a significant impact on recipient firms' business performance. For example, the invention of an improved method for delivering the medication paclitaxel was licensed by the National Institutes of Health to Bristol-Myers-Squibb as the product Taxol, which has since become a leading treatment for breast and ovarian cancer. However, there is no data to show what portion of transfers is successful versus those which are not.
- Technology transfer may or may not result in commercial products. A survey of 229 technology transfer projects at 29 federal laboratories, conducted by the Georgia Institute of Technology, found that 22 percent of the projects resulted in new commercial products, while 38 percent contributed to products under development. Interestingly, in 13 percent of the projects, new product development or product improvement was never a goal.
- Laboratories' views on technology transfer can affect success. Now that most of the legal barriers to technology transfer have apparently been eliminated by congressional legislation, the true barriers are generated by the culture of the laboratories and the attitudes of researchers and laboratory administrators. For example, in several cases firms have complained that laboratory researchers were not used to meeting the strict timetables on project completion that private sector researchers must observe.

- Technology transfer, especially in joint research, can aid the government laboratory as well. A report by the GAO examining ten CRADA projects found that the laboratories can also benefit from technology transfer, for example, through enhanced expertise for researchers, development of technologies that also support the laboratory's mission, acquisition of sophisticated equipment and infrastructure, and increased laboratory revenues from industrial sources.
- The **technology life-cycle** (**TLC**) describes the commercial gain of a product through the expense of research and development phase, and the financial return during its "vital life". Some technologies, such as steel, paper or cement manufacturing, have a long lifespan (with minor variations in technology incorporated with time) while in other cases, such as electronic or pharmaceutical products, the lifespan may be quite short.
- The TLC associated with a product or technological service is different from product life-cycle (PLC) dealt with in product life-cycle management. The latter is concerned with the life of a product in the marketplace with respect to timing of introduction, marketing measures, and business costs. The *technology* underlying the product (for example, that of a uniquely flavored tea) may be quite marginal but the process of creating and managing its life as a branded product will be very different.
- The technology life cycle is concerned with the time and cost of developing the technology, the timeline of recovering cost, and modes of making the technology yield a profit proportionate to the costs and risks involved. The TLC may, further, be protected during its cycle with patents and trademarks seeking to lengthen the cycle and to maximize the profit from it.
- The *product* of the technology may be a commodity such as polyethylene plastic or a sophisticated product like the integrated circuits used in a Smartphone.
- The development of a *competitive product* or process can have a major effect on the lifespan of the technology, making it shorter. Equally, the loss of intellectual property rights through litigation or loss of its secret elements (if any) through leakages also work to reduce a technology's lifespan. Thus, it is apparent that the *management* of the TLC is an important aspect of technology development.
- Most new technologies follow a similar technology maturity lifecycle describing the technological maturity of a product. This is not similar to a product life cycle, but applies to an entire technology, or a generation of a technology.
- Technology adoption is the most common phenomenon driving the evolution of industries along the industry lifecycle. After expanding new uses of resources they end with exhausting the efficiency of those processes, producing gains that are first easier and larger over time then exhaustingly more difficult, as the technology matures.
- **Negotiation** is a dialogue between two or more people or parties intended to reach a beneficial outcome over one or more issues where a conflict exists with respect to at least one of these issues. This beneficial outcome can be for all of the parties involved, or just for one or some of them.
- It is aimed to resolve points of difference, to gain advantage for an individual or collective, or to craft outcomes to satisfy various interests. It is often conducted by putting forward a position and making small concessions to achieve an agreement. The

degree to which the negotiating parties trust each other to implement the negotiated solution is a major factor in determining whether negotiations are successful. In many cases, negotiation is not a zero-sum game, allowing for cooperation to improve the results of the negotiation.

- People negotiate daily, often without considering it a negotiation. Negotiation occurs in organizations, including businesses, non-profits, and within and between governments as well as in sales and legal proceedings, and in personal situations such as marriage, divorce, parenting, etc. Professional negotiators are often specialized, such as union negotiators, leverage buyout negotiators, peace negotiator, or hostage negotiators. They may also work under other titles, such as diplomats, legislators, or brokers.

Types

Negotiation can take a wide variety of forms, from trained negotiator acting on behalf of a particular organization or position in a formal setting to an informal negotiation between friends. Negotiation can be contrasted with mediation, where a neutral third party listens to each side's arguments and attempts to help craft an agreement between the parties. It can also be compared with arbitration, which resembles a legal proceeding. In arbitration, both sides make an argument as to the merits of their case and the arbitrator decides the outcome. This negotiation is also sometimes called positional or hard-bargaining negotiation.

Negotiation theorists generally distinguish between two types of negotiation. Different theorists use different labels for the two general types and distinguish them in different ways.

Distributive negotiation

Distributive negotiation is also sometimes called positional or hard-bargaining negotiation and attempts to distribute a "fixed pie" of benefits. Distributive negotiation operates under zero sum conditions and implies that any gain one party makes is at the expense of the other and vice versa. For this reason, distributive negotiation is also sometimes called *win-lose* because of the assumption that one person's gain results in another person's loss. Distributive negotiation examples include haggling prices on an open market, including the negotiation of the price of a car or a home.

In a distributive negotiation, each side often adopts an extreme position, knowing it will not be accepted—and then uses a combination of guile, bluffing, and brinkmanship to cede as little as possible before reaching a deal. Distributive bargainers conceive of negotiation as a process of distributing a fixed amount of value. A distributive negotiation often involves people who have never had a previous interactive relationship, nor are they likely to do so again in the near future.

In the distributive approach each negotiator fights for the largest possible piece of the pie, so it may be quite appropriate—within certain limits—to regard the other side more as an adversary than a partner and to take a somewhat harder line.

Integrative negotiation

Integrative negotiation is also called interest-based, merit-based, or principled negotiation. It is a set of techniques that attempts to improve the quality and likelihood of negotiated agreement by taking advantage of the fact that different parties value various outcomes differently. While distributive negotiation assumes there is a fixed amount of value (a "fixed pie") to be divided between the parties, integrative negotiation often attempts to create value in the course of the negotiation ("expand the pie").

Integrative negotiation often involves a higher degree of trust and the forming of a relationship. It can also involve creative problem-solving that aims to achieve mutual gains. It is also sometimes called *win-win* negotiation.

In the integrative approach, unlike the distributive approach, parties seek to find an arrangement that is in the best interest of both sides. A good agreement is not one with maximum gain, but optimum gain. Gains in this scenario are not at the expense of the other, but with him.[3]

A common negotiation technique in integrative negotiations involves trading one favor for another, commonly referred to as logrolling. It focuses on the underlying interests of the parties rather than their arbitrary starting positions, approaches negotiation as a shared problem rather than a personalized battle, and insists upon adherence to objective, principled criteria as the basis for agreement.

Perspective taking in integrative negotiation can be helpful for a few reasons, including that it can help self-advocating negotiators to seek mutually beneficial solutions, and it increases the likelihood of logrolling (when a favor is traded for another i.e. quid pro quo). Social motivation can increase the chances of a party conceding to a negotiation. While concession is mandatory for negotiations, research shows that people, who concede more quickly, are less likely to explore all integrative and mutually beneficial solutions. Therefore, conceding reduces the chance of an integrative negotiation.

However, negotiators need not sacrifice effective negotiation in favor of a positive relationship between parties. Rather than conceding, each side can appreciate that the other has emotions and motivations of their own and use this to their advantage in discussing the issue. In fact, perspective-taking can help move parties toward a more integrative solution. Fisher et al. illustrate a few techniques that effectively improve perspective-taking in their book *Getting to Yes*, and through the following, negotiators can separate people from the problem itself.

- **Put yourself in their shoes** – People tend to search for information that confirms his or her own beliefs and often ignore information that contradicts prior beliefs. In order to negotiate effectively, it is important to empathize with the other party's point of view. One should be open to other views and attempt to approach an issue from the perspective of the other.
- **Discuss each other's perceptions** – A more direct approach to understanding the other party is to explicitly discuss each other's perceptions. Each individual should openly and honestly share his or her perceptions without assigning blame or judgment to the other.
- **Find opportunities to act inconsistently with his or her views** – It is possible that the other party has prior perceptions and expectations about the other side. The other side can act in a way that directly contradicts those preconceptions, which can effectively send a message that the party is interested in an integrative negotiation.
- **Face-saving** – This approach refers to justifying a stance based on one's previously expressed principles and values in a negotiation. This approach to an issue is less arbitrary, and thus, it is more understandable from the opposing party's perspective.

Additionally, negotiators can use certain communication techniques to build a stronger relationship and develop more meaningful negotiation solution.

- **Active listening** – Listening is more than just hearing what the other side is saying. Active listening involves paying close attention to what is being said verbally and nonverbally. It involves periodically seeking further clarification from the person. By asking the person exactly what they mean, they may realize you are not simply walking through a routine, but rather take them seriously.
- **Speak for a purpose** – Too much information can be as harmful as too little. Before stating an important point, determine exactly what you wish you communicate to the other party. Determine the exact purpose that this shared information will serve.