Title: New Product Introduction: Reducing Time to Market Using Internet and Intranet Technology

Course: EMGT 520
Term: Fall
Year: 1996
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Report No: P96058

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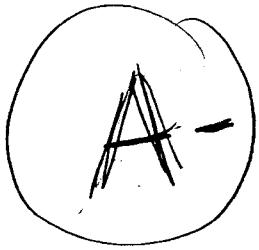
EMP-9658

EMGT 520



TERM PROJECT:

NEW PRODUCT INTRODUCTION: REDUCING TIME TO MARKET USING INTERNET AND INTRANET TECHNOLOGY

Prepared for:

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Management of Engineering and Technology

Fall 1996

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December 9, 1996

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1. Abstract

The rate of technological advances over the past five to ten years has resulted in shortened product life cycles, making it necessary to engage in a continuous and rapid introduction of new products. The ability to anticipate and respond to market pressures makes the timely introduction of new products a crucial competency within many industries. While technological advances have driven the need for a reduced time to market, they also have provided tools to aid in the reduction of product development cycle time. This paper examines how the use of the Internet and Intranet in the new product introduction process can reduce time to market by facilitating increased levels of communication within a company and between a company and its customers, based on literature searches as well as interviews.

2. Introduction

There are almost as many ways of handling the development and introduction of a new product as there are companies that do it. The process of new product introduction (NPI) varies widely between industries, and even between companies in the same industry. The particular process that exists within any given company depends on a wide variety of factors, some related and some not. The industry within which one operates dictates certain conditions that include competitive pressures, new product introduction cycles, product life cycles, and so on. Certainly a computer hardware company with a product life cycle of 18 months, and an industrial machine tool manufacturing company with a product life cycle of 5 to 10 years, face different market forces, and they probably have different internal resources and organizational structures.

The organizational implications can be significant. Organizations vary widely in how they implement their management structures. These management structures are often variations on the traditional structures that include the functional, matrix, and project orientations. Existing knowledge, and organizational inertia, also play important parts in determining the structure and methodology of NPI within a company. Sometimes things are done in an organization because that's the way they have always been done. Sometimes things get done a certain way because the organization possesses certain resources or talents that dictate a recommended path.

With a minimum of observation, it is easy to see there are a variety of organizational structures that we may expect to see in the marketplace, and those organizations probably have a variety of ways of implementing the NPI process. One strategic characteristic that is fairly universal, especially among firms that are in highly competitive industries, is "How do I make my NPI process faster, or more efficient?" To this end an enormous variety of techniques have been developed. These tools range from the purely functional to the purely organizational and everywhere in between.

Functional tools concentrate on making the accomplishment of a specific task easier, faster, or more efficient. They are usually very directed. Rapid prototyping tools like stereo lithography have been developed with the sole purpose of producing prototypes of parts much more quickly than traditional methods. For industries with lengthy prototype cycles (this includes the aircraft and automotive industries), faster prototypes mean engineers can examine actual parts much faster and thus reevaluate their designs much faster. CAD/CAM is another example of a functional tool that speeds up processes like drafting, engineering, and machine tool programming.

Organizational tools focus on making the organization use the resources they have in a more effective manner. Concurrent engineering, cross functional teams, and supplier

involvement are all ways to organize labor in a (hopefully) more efficient way. It is this second class of tools that we wish to focus on.

Organizational tools tend to be communication intensive. The theory behind them is to allow the organization to see how they can combine the existing processes and resources in a way that shortens the overall development time with an equal or better result, sometimes even using fewer resources. The difficulty arises in devising an efficient communication and logistics structure to handle the increase in complexity. It is easy to see that an organization that has distinct functional groups, each of which hold a strictly serial role in the product development, has a simpler communications model than a group that involves engineering, manufacturing, marketing, customers, and suppliers in an interconnected web throughout the design process.

Organizing and sharing ideas, knowledge, feedback, decisions, and schedules between all the groups who could be involved is a task that slows even the most ardent supporter of concurrent engineering or other organizatinal tools. These tools are not easy to implement, but the rewards can be considerable. Thus there is a need for additional tools and methods that can help mediate this increased web of communication complexity. We will examine such a tool in this paper.

In this paper, we hope to define the new product introduction process, as well as examine the internet and intranet. Through interviews and literature we will investigate opportunities to reduce the cycle time through the integration of these technologies into the NPI process

3. New Product Introduction

To better understand what is involved with reducing the cycle time of new product introduction it is important to first define the scope of the process. For this paper, new product introduction involves the development cycle of a new product from concept to market. Once this has been defined various accepted models must now be explored to ensure an understanding of the process.

3.1 Models

There are various models for the new product introduction in the literature. In the following section, we will present models for NPI. These models are popular among researchers and practitioners. Although most models appear to consist of several sequential steps, in truth these steps are concurrent, or there is not a clearly defined boundary between the end of a step and the beginning of its successor.

3.1.1 Cooper's Model

Cooper [10, 11] developed one popular, yet primitive seven step model that is still widely used today (Figure 1).

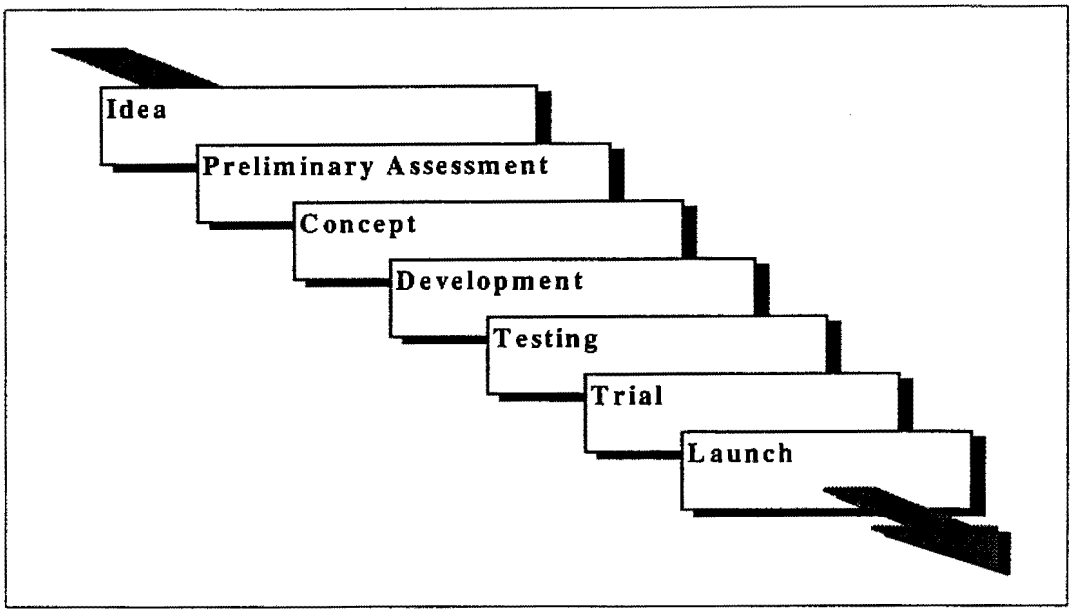

Figure 1. The Seven-Step New Product Process

The first stage of this model involves the generation of a new product idea and undertaking a tentative evaluation and screening of the idea. The concepts generated in this stage are then used to initiate the initial product project. This then leads to the second step, preliminary assessment. Preliminary assessment consumes significant resources to gather information regarding the feasibility of the project. During this phase, preliminary market and technical assessment are used in conjunction for preliminary evaluation. If feasible, the process is then followed by concept definition, the final stage of predevelopment. In this stage, the decision of whether or not to bring the product to fruition or not is made. The products concept and strategy are more fully expanded upon to give direction to development. Concept identification, concept development, concept testing and concept evaluation are the basic steps of this stage.

The next stage, development, is where the design of a new product is made by taking market conditions into account [9]. Testing is typically done to evaluate the validity of the design. If testing reveals shortcomings of the product, the product is then returned to development where a new approach may be taken. If an acceptable solution has been found, the product is then tested in the market and the development is finalized during the trial period. The product is released to the rest of the market, if it has gained acceptance during the trial stage.

Throughout these stages activities are sometimes undertaken jointly by the technical and marketing departments [7, 15] as shown below.

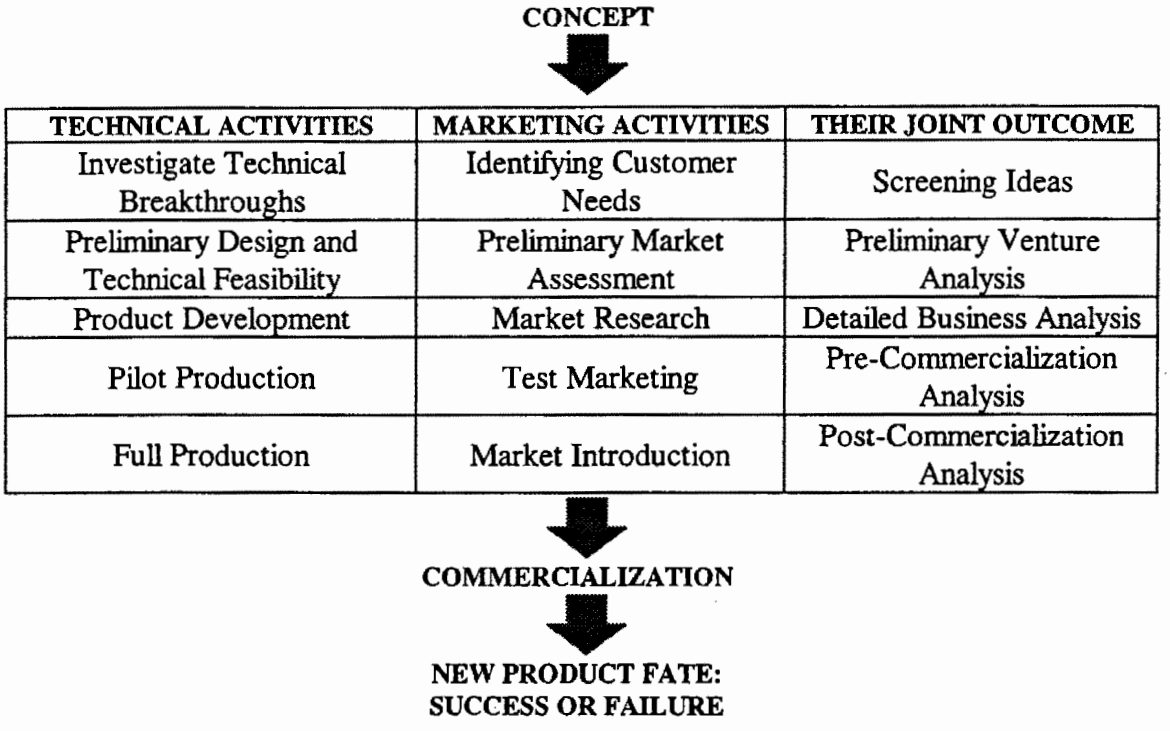

Figure 2. Some Marketing and Technical Activities in the New Product Development Process

The outcome of an activity on the above table acts as an input to the succeeding activity. As one can see, Cooper's model mostly takes into account only activities carried out within the firm.

3.1.2 Souder's Model

A broader model was developed by Souder [39] to take into account additional environmental and organizational variables. This model is oriented towards the strategic management of new product development and incorporates three types of new product development that can be tailored to different organizations:

- Stage Dominant (SD), where formal groups or organizational entities are technically and organizationally specialized.
- Process Dominant (PD), where no discrete transfer points exist between organizational groups.

- Task dominant (TD), where staff are all strongly oriented to completing the task and achieving the and product. This model is known as a contingency model of the new product development process and displayed in the following figure.

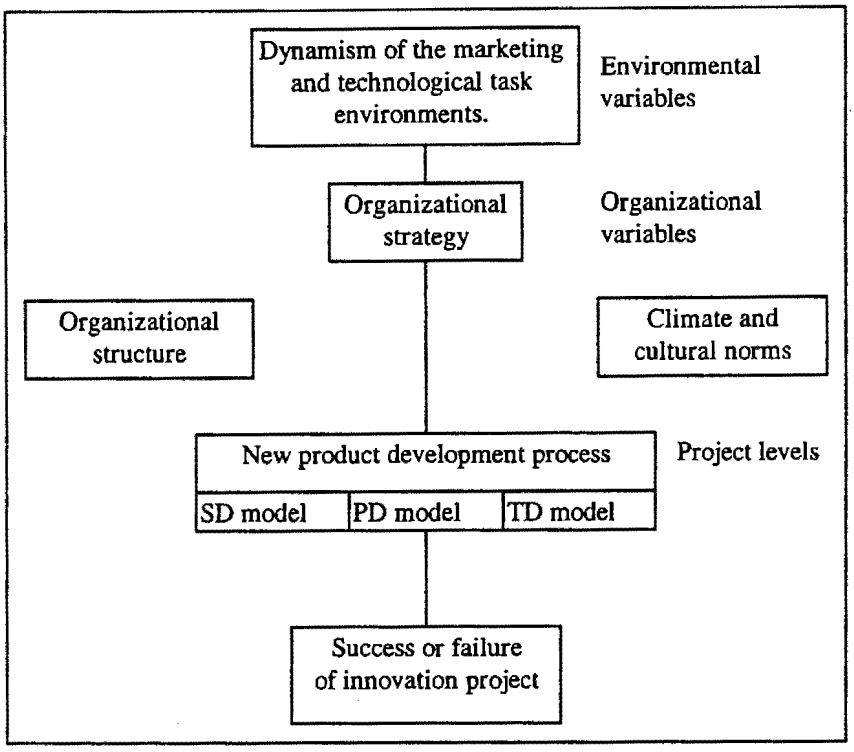

Figure 3 - Souder's Contingency Model

Today's new product development efforts have the characteristics of process and task dominant types. It is clear that they are not of the stage dominant type because today's business world requires the parties involved in the new product development process to interact highly with each other and to make joint decisions. The above model can applied across a variety of situations. A multi-disciplinary approach is needed with many parallel developments, not only between departments but also within departments. A company's internal development process needs to be closely tied in with its corporate objectives and linked to the external environment to allow new ideas into the organization. Cooper's model tends to be the basis of managerial procedures while the contingency model offers a greater range and flexibility for conceptual and organizational applications.

3.1.3 Peterson's Model

Another model proposed by Peterson [31] is illustrated in Figure 4. As one can see, it is very similar to the sequential Cooper's model. However, Peterson claims that the process is not always orderly and can, in fact, be quite chaotic. Since the considerable time involved in test marketing can seriously delay new offerings, Peterson recommends its

elimination. Procter & Gamble and a number of other astute marketers have already done this.

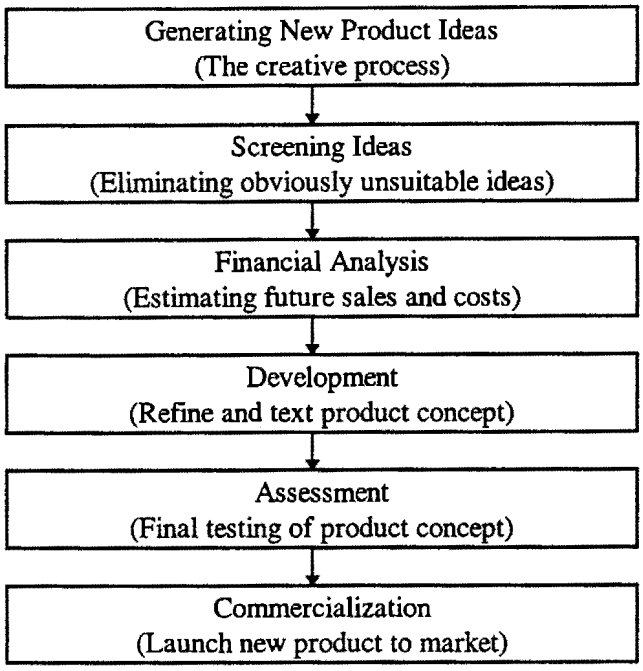

Figure 4. Steps Involved In New Product Introduction

Many other conceptual models have been proposed describing the new product introduction process in a variety of ways, including as a series of events, decisions, activities, or departmental stages. There is no one model or type of model that can adequately describe the whole process [5]. These procedures are carried out sequentially or parallel, although in life most processes are carried out as a series of parallel events.

3.2 Parties Involved In NPI

Each of the presented models depends on an orchestration of various organization resources in a company. The resources involved are marketing, design and product engineering, production engineering, manufacturing, finance and materials management [37]. Traditionally, these teams act independently. Today, activities in the new product introduction process may be carried out by cross-functional teams that include representatives from each function. For example, marketing and design engineering work jointly to identify the market needs and integrate them into the product design [35]. This concept is known as Quality Function Deployment (QFD). The cross functional teams assume joint ownership of all steps over the entire process, combine talent, and create a synergy of capabilities from previously separated functions [43]. Essentially, they tear down the functional barriers to engage in an integrative effort.

The following table illustrates parties traditionally and currently involved in performing some activities of the new product introduction process [37]:

Activities	Traditional Process	Current Process
Marketing Research	Marketing	Cross Functional Team
Product Design	Design Engineering	Cross Functional Team
Production Planning	Production Engineering	Cross Functional Team
Materials Acquisition	Material Management (Purchasing, Procurement)	Cross Functional Team
Product Manufacturing	Manufacturing	Cross Functional Team
Product Launch	Marketing	Cross Functional Team

Figure 5. Parties involved in some activities in the traditional vs. current new product development efforts

3.3 Challenges in NPI

There are many challenges that companies face during the NPI process. Among these, the major ones are described below.

3.3.1 Communication

As can be seen by the previous section, communication is one of the major areas that must be established and maintained amongst organizations in new product introduction. This does not only pertain to intradepartmental communication but also to interdepartmental communication. A clear understanding of the wants and needs of each department must be acknowledged by every department in order to get an accurate picture of the situation.

As can be deducted, for marketing and engineering to work well in conjunction it is absolutely essential that they be able to relay ideas accurately and succinctly to each other. QFD is an attempt to tackle this obstacle, however it is essential that the communication be clear between the organizations to effectively implement this tool. By taking a standard sequential approach, problems are brought forth through the time involved with passing off various stages of the design to other organizations. If considerations are not given to other departments early on in the process, the result is typically lengthened development times due to rework. Another fallout of this is difficult to manufacture products that do not meet customer needs. Either one of these difficulties can be a result of miscommunication on the part of engineering, marketing, or manufacturing.

3.3.2 Resources

Frequently NPI is restricted by the available resources of an organization. Resources include personnel, equipment, capital, and time. Any one of these can place limits on the NPI process, due to restricting the possible output. These resources are often tied to capital, but are not entirely dependent upon it. In many cases, it is physically impossible to hire the required talent or buy the necessary equipment in the time allotted. Due to this, these physical restraints are often unavoidable and must be dealt with in the most efficient manner. Any tools to overcome these challenges are extremely useful. They are often fairly independent of capital requirements, however they do require expertise.

4. Reducing Cycle Time

In today's business world, the ability to execute NPI quickly is considered a core competency. According to a survey conducted among Japanese, European, and American manufacturers, NPI is one of the top 15 competitive priorities. [24] These priorities include, product flexibility, volume flexibility, process flexibility, delivery speed, production lead time, and product reliability. The competitive ranking of NPI as a priority among US, European, and Japanese manufacturers is 8^{th}, 6^{th}, and 11^{th}, respectively.

4.1 Reasons to Reduce Cycle Time

Speed is vital in product development and introduction [31]. In the past, the major concerns have been sales, profits, share of market, return on investment, net present value, and the like. The majority of companies placed getting products to market rapidly low on their list of priorities. Today, product life cycles have accelerated and shortened in many industries, making it necessary to have a continuous and rapid introduction of new products.

Given the substantial costs incurred in the introduction period of the product life cycle, shortening this period can substantially reduce the introduction cost. Another advantage of fast new product introduction is that technology and consumer wants are now so volatile that slow new product introduction may make new offerings obsolete by the time the target is reached or about to be reached.

The introduction must always be time sensitive. Success depends on being in the right place at the right time. Being too early or late may lead to failures. Time is a commodity that cannot be generated, purchased, or borrowed, and when it is gone, it will never come back [38].

Competition in the market place has revolved around the speed of introduction of new products into the market. Delayed introduction of new products not only reduces the life time profit potential by as much as 33 percent but also makes it harder to enter the market against an established player [30].

There is broad agreement that rapidly changing technology and improved mass communications are two important causes of shorter product life cycles [36]. Improved communications have an impact because information about the newest new product reaches the intended user or purchaser faster, which promotes an earlier switch away from the existing product. Rapidly changing technology also makes it easier to develop an innovative new product that offers advantages to users. This change can make the existing product obsolete. Some companies have fallen into the "mature product trap," which makes it more likely that others will exploit changing technology.

Fast cycle time is the ongoing ability to identify, satisfy, and be paid for meeting customer needs faster than anyone else [27]. The competitive position of industry is increasingly challenging. In an increasingly competitive environment, to sustain growth, a firm has to refine current products continually as well as introduce new ones. The benefits to reducing cycle times can be divided into two categories [25, 27]. External benefits are those that help the company in the market, while internal benefits cover those that increase efficiency and effectiveness within the company.

4.1.1 The External Benefits of Reducing Cycle Time

The external benefits of reducing cycle time include the following [12,13]:

- Yields higher margins/profits
- Increases market share
- Provides a tough-to-copy organizational capability
- Establishes industry standards
- Looks up distribution channels
- Positions one as an innovator
- Enables more accurate market forecast
- Incorporates the latest technology
- Increases quality and decreases cost
- Customer responsiveness increases and lead times drop

4.1.2 The Internal Benefits of Reducing Cycle Time

The internal benefits of reducing cycle time include the following [12,13]:

- Process focus reduces the time to detect and correct problems
- Reduces overheads
- Drives information flow across and within functions
- Empowers people and builds trust
- Increase quality quickly

4.2 Common Approaches

Companies have employed several approaches to reduce cycle. Some of them are quite simple, while others are complex. Every element relies on very good communication to assure definition of purpose and direction. The following approaches assist in shortening the NPI, however they are still constrained by available resources and communication. In addition the mind set of the corporation may further hinder the implementation of these solutions.

4.2.1 Increasing Resources

Often times it is the magnitude of the task at hand that makes it difficult to meet the required deadlines. By hiring more people for the task, it is possible to put more man hours into the project in a shorter amount of time. This is not typically a linear approach as the added complexity of additional resources often will take more resources to support and maintain. The resulting bureaucracy can often put a strangle hold on design processes. To effectively counter this, very open means of communication must be established and maintained. A clear understanding across the board of what it is that needs to be accomplished and when should be presented to each member of the product development team. Checklists and interaction should be presented and permitted among various functions in the development process.

However, the needed talent may not be available for hire at the time of need. In cases where this is the problem, optimization of current resources should be exercised through reorganization, or reallocation of resources. Often times, over talented people are doing rather mundane tasks. Reorganization can free up these needed resources.

4.2.2 Outsourcing

Another convenient means of reducing cycle time is outsourcing. By means of outsourcing, sub-components of the overall design are performed by vendors. Some companies actually choose off the shelf components for their product, reducing the need to create unique subsystems. The personal computer industry is a perfect example of this. Very few hardware manufacturers actually make any of their parts. For the most part, these pieces of equipment are standard building blocks available to the mass market. By doing this, it is easy for the manufacturer to choose the parts they need to make the system as a whole and release it in one package in a relatively short time.

Disadvantages with this include the fact that the technology may not be as modern as desired and lack of entire control over the end product. Since these products have already been generated by another company at times, it is not always possible for the designer to get everything that they want out of the product. Certain features may not be available unless the company is a very important customer to the supplier, or they have a working relationship to expand mutual functionality.

4.2.3 Vendor Related Issues

By taking control of various vendor related issues, it is possible to streamline the NPI process. These include relations as well as the number of vendors that a company is dependent on. Through intimate relationships with parts' vendors, it may be possible to get their assistance. It may also be possible to obtain prerelease versions of their products to allow for earlier beta testing and prototyping. By doing this, it is possible for the company to achieve a lot more in a shorter amount of time.

In cases where the vendor and customer are very close knit, it may also be possible for the customer to ask of the vendor for additional features and capabilities. This in turn may be developed separately by the vendor, reducing the resources needed by the initial design team.

When involving the vendors, a company must be careful not to lose control by selecting too many vendors. Likewise by selecting too few, a company may find itself prone to the weaknesses or dependent on the few.

By reducing the number of vendors, the complexity of the design for manufacture task is greatly reduced. Variance is decreased and it is possible to work with more definites. This also assists in boosting vendor relations to the point where some cooperation among organizations is feasible.

4.2.4 Concurrent Engineering

Concurrent Engineering (CE) is developing the product and all its associated processes, including, manufacturing, service, and distribution, at the same time [26]. Two primary aspects of CE reflected in this definition are cross-functional integration and concurrency. Many well-known companies have responded to the increasing demands of new product introduction by adopting CE approaches to NPI, including General Motors, Chrysler, Ford, Motorola, Hewlett Packard, and Intel [8, 47].

By using cross functional teams instead of a series approach design, problems can be caught early on in the process, reducing the amount of time needed to rework projects. For Boeing this is expected to have saved $4 billion on development on the 777 and resulted in 90 percent less manufacturing rework [29, 40]. It also shaved a year off Ford's Taurus team development time [10]. These efforts to massively parallelize require tremendous resources, and cause the initial stages of product development to be dragged out due to increased resources in the early design stage.

There are significant differences in the ways CE is conceived and implemented in different project, company and industry contexts. CE implementation approaches may be influenced by product characteristics, customer needs, technology requirements, company

experience, corporate culture, manufacturing issues, project size and project duration [41, 42]. Early CE approaches that focused only on identifying part fabrication issues early in the development process have given way to expanded approaches that include assembly issues and groups of parts in design decisions. Market-oriented approaches to CE tend to focus on integrating customers' needs and marketing strategies into design processes, emphasizing the roles of marketing and R&D personnel in fostering information between the two groups [28].

Functional groups or teams integrate their knowledge of techniques, processes, and data. However, the intensity of interactions among groups varies according to the needs and challenges of the development program [16, 17]. At least three opportunities exist for concurrent processing of development activities, as described below:

Project phase concurrency. Simultaneously developing market concepts, product designs, manufacturing processes and product support structures.
Design concurrency. Overlapping design disciplines (e.g. system, software, and electrical and mechanical engineering) so that system level and component level designs are produced concurrently.
Product concurrency. Overlapping of separate but related new products requiring coordination between NPI processes.

As more types of concurrency are attempted, the number of relationships that must be managed increases rapidly. As degrees of overlap among activities become more intense, decisions that are dependent on information from upstream processes become more uncertain.

4.2.5 Design For Manufacture (DFM)

One of the frequent practices employed during the NPI process is Design For Manufacturability. Customer needs and product specifications are useful for guiding the concept phase of NPI process; however, during the later development activities teams often have difficulty linking needs and specifications to the specific design issues they face. DFM is aimed at reducing manufacturing costs while improving (or at least not inappropriately compromising) product quality, development time and development cost. It requires a cross functional team, which commonly draws upon expertise from manufacturing engineers, cost accountants, and production personnel in addition to product designers [44]. DFM utilizes information of several types, including 1) sketches, drawings, product specifications and design alternatives; 2) a detailed understanding of production and assembly processes; and 3) estimates of manufacturing costs, production volumes, and ramp-up timing [45].

4.2.6 Rapid-Design Transfer

An offshoot of concurrent engineering, rapid-design transfer brings the parallelism to another level. In this model, designs themselves are performed in a massively parallel approach. While base designs are still being determined, future designs are being implemented and used as feedback on the original design. Although taking longer initially, this allows a company to release a suite of related products in a relatively tight time frame. It also reduces the total cycle time between products significantly [21].

This cross project and product organization is very dependent on the transfer on information from one element to the other, and such a transfer must be done carefully and accurately. This offers the power of quick concept to market times throughout a suite of products, but may delay the initial cycle time due to the increased complexity. Integrating a multi-project team in these efforts is typically very difficult and takes time and effort by upper management.

5. Internet and Intranet Technologies

One promising solution to increasing communication and reducing cycle time is through internet technology. By using intranets and internets, it is possible to disseminate a large amount of information to multiple individuals quickly and efficiently. It permits a single point of information to be shared throughout the platforms and departments of an organization. With this in mind, internet technology offers a method to facilitate the processes to reduce NPI cycle time.

5.1 Internet/Intranet Technology

Recently, there has been much speculation regarding the future role the Internet will play in corporations and in everyday life. Technological advances in communication now more than ever can contribute to reducing cycle time to market [20]. The Internet will prove to be one of the most important tools that can be used in this arena. Institutions that establish a presence on the Internet can provide product information and can collect valuable customer and market data [32, 33]. The Internet is an inexpensive means of delivering a wide variety of data, flexible and fast [6].

The company with an Internet presence can [46]:

- Promote extensive information about their products to a global audience using multiple media like text, graphics, and audio.
- Process requests for information.
- Obtain feed-back from consumers and business partners through the use of forms in their Internet site.
- Use the Internet as a market research tool to reach the customers.

The Internet and company intranets will cause IS solutions to evolve rapidly in the near term as they are already [34]. The new technologies are being built on infrastructure that is already in place—infrastructure that will continue to deliver value for many years to come [48]. These internal infrastructures can then be used to implement intranets.

Intranets are the integration of Internet paradigms and standards with a corporation's existing network, desktop, and server infrastructure to create dramatically more effective business management systems [22]. Intranets take existing Internet technologies and allow corporations to benefit in several ways.

Today's cost-cutting environment demands that you do more for less [3]. But you cannot eliminate internal communications tools. In fact, we know that increased communication is absolutely essential within companies [1]. Also, we know these increased demands on staff mean they do not have the time to waste on locating the correct information. Timely access to accurate information has never been as crucial as it now is.

The solution to the communication problem requires technology that can deliver information on demand, as and when needed; guarantee that the information is the latest and most accurate available; ensure that information is held at a single source; and allow the information to be maintained by the people who originally prepared and distributed it.

5.2 Integration of Internet/Intranet Technologies to NPI

The integration of internet and intranet technology within the NPI process offers many advantages, as well as some disadvantages.

5.2.1 Advantages with Internet Integration

In its current state the intranet/internet technologies offer a tremendous although limited potential. Since the most universally accepted and currently standard interfaces with the internet involve email and html, it is possible to add immense functionality to an organization. Regular documents can be relayed to all facets of the organization to communicate goals, progress, schedule, checklists, and objectives.

The simple reduction of email and paper notes ensures a single locale where it is possible to get up to the minute information as needed. Progress reports can be maintained as well as functional specs. Interdepartment communique's, message boards, and informational pages can be posted for viewing by large audiences. Marketing can post desired specs and targets, while engineering can counter on line. The applications are not limited to the current technology.

Another field of promise are proposed devices such as "The Online Engineers Design Notebook Environment" [19] This would allow near zero lead time for a virtual design team based throughout the country or office building. By using HTML, hyperlinked documents and resources, it may be possible to streamline NPI even further. Such

globally accessible platforms would allow multiple engineers to append, amend, and reason on a design online. A virtual dream? Not so. Lockhead Martin recently spent $3 million on developing such a system [18] for their engineering staff to use in design. For software designers at Hewlett-Packard Co., software objects are openly available on the intranet to reduce work done solving the same problems [23]. J.D. Edwards & Co., a software developer, also uses the internet and intranet for reducing the time associated with travel amongst its offices to nearly nothing [14].

HTML, a universal markup language, enables people to provide formatted documentation with basic text functionality. Although sometimes awkward to the non-technical, it is a breeze for those who are. One company cited instances where engineers still used archaic filters such as nroff and troff to present their papers. These old text formatters were infinitely more complex than HTML, yet are still currently being extensively used by software engineers to present their data to the masses.

This ability may permit organizations such as marketing to post up to the minute design requirements, modifications, or trends to engineering teams at large. Integrating these systems is essential for communication among all team members. By introducing a universal computer systems interface, the speed and accuracy of communications within a group are enhanced [14]. The availability of information may aid engineers in achieving a better understanding and flexibility in the design process.

In summary, the advantages with integrating internet technologies with the NPI process are as follows [2, 4, 23]:

- Facilitates communication among team members and departments.
- Centralized location of key documents.
- Appropriate ownership of documents.
- Concurrent use of data due to centralized location.
- Up-to-date information.
- Consistent form of communication.
- Ease of access to customers.
- Unlocks hidden information.
- Inexpensive to start.
- Trackable conversations.
- Offers more than point to point communication (eg. group collaboration).
- Significantly more timely and less expensive than traditional information (paper) delivery.
- Distributed computing strategy uses computing resources more effectively.
- Efficient access to information and all network resources regardless of where they are located.

5.2.2 Drawbacks of Internet/Intranet Technology in NPI

There are disadvantages with integration of internet technology in NPI as well. One of the primary concerns is security. For those companies in highly competitive industries the threat of industrial espionage is real. If all the design information is available online, it may only take one security breach to ruin the future of a company.

Additionally, the openness and naiveté of the industry do not have a lot to offer by means of other tools beyond standard text and forms.. For additional tools, it is necessary for companies to generate them. This often results in highly customized yet questionably supported utilities on which a company depends. Additional weaknesses include the following:

- Maintenance of controlled documents.
- Maintaining the network.
- Security.
- Changing corporate mentality.
- Training.
- Most support must be in house.
- No critical applications currently available.
- Increased traffic beyond specified bandwidth.

6. Interview Methodology

Interviews were conducted with companies to determine current new product introduction processes, if and how companies used Internet and intranet technology, and how the Internet and intranet technology had helped the new product introduction process. The interview questionnaire form is included in Appendix A.

The interview process examined a variety of industries to obtain an understanding of how technological advances in communication tools have been applied in different industry types. For example, computer-based firms may be expected to employ internet/intranet technologies to a greater degree than traditional manufacturing companies.
Three employees per company were targeted for interviews. The employees represented a cross-section of job functions within each company, as shown in Table 1. A cross-section was chosen to temper any bias of a single individual within a company. Interview questionnaire forms from each interview are included in Appendix B.

The prospective interviewees were given only a general overview of the term project when the interview was set up in an effort to eliminate any preconceived ideas or notions the interviewee might have. Interviewees were given a general definition of what we perceived NPI to be. The first question in each interview established the interviewee's position and responsibilities within the company. The second and third questions were

Company by Type	Employees	Employees Interviewed by Job Function
Major Automobile Manufacturer	220,000	Product Design Engineer (Brakes)
Heavy Mining Manufacturer	1,000	Engineer Forecaster/Planning Analyst
Door Hardware Manufacturer	800	Design Engineer New Product Developer Manufacturing Engineer
Internet Service Provider	35	CEO VP Marketing
Computer Systems Manufacturer	2,500	Project Manager Technical Support Engineer
PCB Systems Manufacturer	200	Director of Program Management Program manager
Electronics Test Equipment Mfg.	6,500	Product Design Engineer Purchasing
Software Manufacturer	350	Corporate Sales Executive Product Manager
Large Computer Manufacturer	4000	Product Development Manager

Table 1: Job Function By Company Interviewed

designed to discover the individual's understanding of what the NPI process was within the company and its strengths and weaknesses. The fourth question detailed what technology tools the company used in the NPI process. Internet and intranet were not brought up until the fifth question, which asked if the company used internet/intranet, and if so, if it was used in the NPI process. The last question was specific to those companies using internet/intranet technology, detailing how the internet/intranet technology has helped or hindered.

The results of the interview process are discussed in detail in Section 7. The interviews were a valuable tool in discovering how different companies, and even representatives within each company, defined the NPI process.

7. Questionnaire Results

Interviews were conducted and the results have been categorized into five sections based on the survey questions.

7.1 NPI Processes Within Companies

The interview revealed that most companies do not adhere to a specific academic model of the NPI process. For the most part, these companies display a mix of various models

and attributes that often make them difficult to classify. Universal amongst them all is the series nature of their process. Although much has been said of concurrent engineering, it does not really affect the nature of Peterson's and Cooper's models. It is the allocation of resources themselves that is used to determine concurrency. For this reason, most companies seemed to follow the series approach of NPI as defined by both Peterson and Cooper.

The differences between Cooper's and Peterson's models are fairly similar, and as such little was done to differentiate between the two in this study. Souder's model has been used in an attempt to classify the nature of the processes in question. All companies in question with the exception of one seemed to be stage dominant, where specialized departments took their own tasks. This more traditional approach to development dominated every organization except for the Door Hardware manufacturer, which seemed more focused on the process and tasks.

Task dominance was the second most common attribute among the companies, listing off stages where it was the task at hand that was necessary to accomplish. In these cases coordinated efforts were cited as being necessary to accomplish each task. Most companies who displayed this trait only did so for one or two phases of their development. This was followed by a process dominant model in the end.

The most variation seemed to be the PCB manufacturer who displayed the gambit of the contingency model. Early on their task dominant process centered on accomplishing individual tasks with cross functional teams. This cooperation dropped off in the main design phase, focusing more on engineering than the rest of the company. Manufacturing, though welcome, typically did not join the process until later in the development cycle. Marketing also left the process early on only to return close to the arrival of delivery.

The most effective methods seemed to be centered around task dominant and stage dominant roles. This is probably because there are certain elements that require individual expertise beyond what is feasible to attack in a team environment. In this it may be said that this mixture of approaches may be purely task dominant with the necessary resources being allocated to handle the task at hand. In these cases, the necessary resources may rest mainly with a single facet of an organization. Process dominance itself may be a good idea to keep on track, but companies often find themselves catering to processes more than to the customer. In cases such as this, problems can arise due to poor or insufficient processes.

7.2 Strengths of Current Process

Most companies interviewed listed few strengths of their processes. Common factors included tight knit teams and open communication. In addition, strengths were attributed to well known procedures and routines which ensured company success. Most companies acknowledged exceptional talent in their engineering departments. Common purpose and

goal were among the major issues raised, as well as high quality and competence. The main strengths such as common goal and process seemed to revolve mostly around good communication and the ability to relay accurate information throughout the organization.

7.3 Weaknesses of the Current Process

Although each company listed company independent or procedure dependent shortcomings, nearly every company listed communication as a major issue. For those that did not specifically list communication, issues that were problems seemed to be related. In addition, interviews also revealed inconsistencies between parties, which could be attributed to communication.

In companies that listed teams as strengths, it was said that sometimes teams were not consulted or notified of changes to processes or requirements. Some cited miscommunication by a different department such as marketing, others cited management. The process and task dominant organizations seemed to list poor communication with the customer and marketing. The PCB manufacturer also had two people who worked very closely list teams as strong and weak, two completely different sides of the coin.

Another common issue was the reliance on one source of information in an organization. This restricted knowledge to the whim or availability of one individual or source of information. In these cases a centralized source of information may have been copied without control of the information. These outdated documents or communiques result in misunderstanding or different expectations.

Supplier issues were both a strength and a weakness. The PC manufacturer listed its intimate relationship with its vendors as a very good thing in that it allowed them to better adapt to the technology as it was being presented. This unfortunately was also a draw back. Heavy reliance on vendors and the lack of notification of product delay, often postponed production. The company cited that some vendors provided adequate notification while others did not. Feedback loops between customers as well as internal departments were also cited as being weak at times.

In our research, one local manager named communications as a key obstacle to driving new products to market, citing several instances where a majority of his time was spent relaying the same information to people throughout the company. "What exactly is our new product?" was a common question from people throughout the organization, including those who were trying to build it.

7.4 Technology Tools Implemented in NPI

Most companies currently use a wide variety of technology tools for NPI. These are often traditional or engineering-specific tools in addition to non traditional or administrative tools. Tools listed by organizations for NPI include the following:

- CAD/CAM
- Email
- Project Planning Software (e.g., MS Project)
- Oracle RDBMS, Manufacturing, and Financials.
- CD-ROM based lessons
- Video Taped "technology transfers"
- Internal websites
- Text formatters
- Paper
- Lotus Notes
- MS Office
- List Serve
- Message boards
- Voice Mail

Most companies did have in place a high technology network based infrastructure which could be used for implementing an intranet throughout the organization. These companies were fairly reliant on these tools, and used them frequently. The most commonly used tools were the Microsoft Office Suite, MS Project, and email. Other derivations of these were used, but each company had its own implementation of various different applications from different vendors.

7.5 Intranet/Internet Usage

Companies usage of internet technology varies widely. Many have an internet home page for customers to look at the company. Most have some form of communication mechanism within the company in the form of an intranet. This typically holds information such as HR forms and policies as well as other commonly referenced information throughout the organization. Reiterated information is also an issue addressed by company implementation.

One Vice President's solution to this was to "post everything that I need to say twice" to the intranet. In this way, there is a clear repository for all information involving direction, functional specs, plans, schedules, policies, and notices. This company's implementation was unique. Being a very young company whose business is the internet, it was much easier for them to start where many companies aspire to be. The intranet was built into their process, and since it was also their product it could not be avoided. Prototypes were placed on the net instead of "virtual" designs that must be created and or represented by other companies. Message boards were erected in order to discuss design issues, which although flawed seemed to be of great help to the engineering department. Email and other means made it very easy for information to be exchanged throughout the company. Each person was encouraged to develop their own page to relay to other company employees their responsibilities and projects. Additional interface with the customer is

also facilitated through a "the future of" section where new features are previewable by customers. The result seems to be a fairly smooth process that effectively communicates issues company-wide.

For the other companies, intranets are used mostly for vendor information, status reports, processes, and technology transfers. Rarely used by design teams in some organizations for little more than status reports, it is seen as a potential venue for future corporate-wide development communication. Sales teams currently ramp up on the latest and greatest products through the introduction of marketing white papers and sales information on the intranet from their remote sites. This saves in training time and cost as well as preparing the field for increased productivity.

7.5.1 Strengths

Unfortunately, the one company with the most experience in the intranet is also the one that never had another process. The ISP is an eight month old company that has never used anything else to compare the results to. They have cited some disadvantages with the system that seem to be present in non intranet utilizing firms. This relates to the issue that sometimes the best communication is on a one to one basis, and can not be relayed by typed text. Other companies do believe that they are helpful, however sometimes tedious to maintain the information. This, however, is an issue with any medium of information, unless of course it is word of mouth. In these instances, it is the very weakness of the system which reduces the amount of work needed in cases where everything is going well.

By centralizing the information, massive email messages are avoided and time is saved by the individuals wishing to access the information. Processes that are online allow for convenient access and quick answering of questions as to the desired steps to complete the task at hand. In some cases specific examples were given to the time saved by reducing the need to finger through outdated catalogs and references as well as phone calls to determine vendor information. It simplifies information relays to sales, marketing, and engineering. Additional time is saved and resources are freed by centering the information in one location. Since individuals who previously needed to update everyone on the same information post the information to one location much of their time can be better spent elsewhere.

Proof of the concept is furthered by the successful implementation of the tool for HR. In this process, commonly used forms are simply disseminated throughout an organization effectively and efficiently.

7.5.2 Weaknesses

Some of the weaknesses associated with the process include wariness as well as the required maintenance of the pages. Since the technology is fairly new, people are often

hesitant to use it. This, when combined with the fact that previously undocumented information must now be kept up-to-date in order to ensure accuracy, often leads to complaints from those maintaining the information.

The security issue was specifically listed by one company that desired the access but was not confident in the intranet's ability to keep out intruders, even with the firewall installed. In-house support was not an issue because the maintenance was relatively low compared to the already present IS involved with file servers and client server technology. Bandwidth, although for some an up and coming issue, was relatively low in concern due to the high bandwidth already consumed by Client Server architecture.

For the most part, the lack of critical applications was not a major issue since this is an up and coming tool for NPI. Currently companies are not to the stage where they could use such tools, nor do they wish to abandon current procedures in order to change to a new tool.

8. Conclusions

Much of our research and conclusions were supported by the survey. One company in particular named communication as the key element to implementing change throughout the organization. Several other problems were listed, but communication seemed to be the number one issue, regardless of industry, company size, or organizational type. Companies who implemented the internet and intranet, cited time saved due to centralized data, easy access, and convenience as major benefits of implementing the technology. By saving time for relatively non-value added procedures, cycle time can be reduced. Team oriented approaches can be assisted by providing core information to the team at large.

A company of 40 to 50 employees has different requirements than one of 200 to 300 and more than 2,000. One company interviewed sited growing pains as one major issue. The paradigm shift is from personal, tight knit groups to larger companies where face to face contact is not easy. In fact, it can be concluded that the demands of the larger company are the exact opposite of the smaller ones. Face to face contact is still the best means to relay information to other people at times due to body language inflection and other intangibles. In small organizations this is often an essential part of their development. However as companies grow larger, the sheer number of people make this an impossible task. The result is a need for a centralized set of standards with which to communicate to the whole. For a larger company, the time involved in creating web pages or centralizing information is more than offset by the time needed to inform each person individually.

It is not the goal of internet technologies to replace personal communications but to supplement them and to assist in presenting a common data set for all involved parties to operate from. With this in mind internet technologies should be used as an additional tool to assure a common foundation from which to communicate. For larger companies

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