Traditional New Product Development

Project Management Objectives

From Project Management, we know that projects have three main issues: time, cost, and technology/performance. Project Management and its tools can help dramatically with managing these sometimes conflicting issues.

Digital Design, Globalization and the Changing Landscape of NPD

Globalization and Development
The integration of the Internet and web-based tools, 3D CAD, has allowed a global network of suppliers and manufacturer companies to develop products at a much faster rate using fewer resources and a virtual development team (Eppinger and Chitkara, 2006).

Over the last 10 years, there has been a vast change in the way we approach new product development and project management. This is the combination global supply networks, 3D CAD, and web-based tools and services. Firms that effectively leverage these are more successful at innovation than those that do not.

**Digital Design Proliferation**

![Diagram of product development phases](image)

Here is a graphic of how digital design has proliferated throughout the design process. Be careful, though, the process still needs to be managed well in order to succeed.

**Migration of Development Tools**

![Diagram of product development solutions](image)
Product development is increasingly becoming more open and social, just like our culture. New products from Autodesk include social aspects to collaboration and design. Firms are increasingly adding open innovation efforts into their process. This image is showing that the tools used to design and engineer products has changed over time. Whereas once you would design a part in Cad, and send it to someone to comment, we now - through the influence of social media and Web 2.0 tools - have a much more collaborative approach to design. What I call PD (product development) 2.0.

An Expanded Landscape

The combination of digital design and fabrication tools on one hand, and social networking and new forms of collaboration and sharing on the other, have created an expanded innovation landscape that is substantially larger and more diverse than the one that became known throughout the 20th century. With these two technical forces enabling significant performance improvements for some and lowering the barriers to entry for others, and the social force extending the sets of possible organizational forms by including collaborative and virtual arrangements based at least in part on trust, the identification of four distinct innovation modes in the new innovation landscape becomes possible.

In this expanded innovation landscape of the digital era, we identify four separate innovation modes, and label them specialist, maker, community, and network. The innovation landscape has become more diverse and dynamic, and these changes are only accelerating. Firms can now use multiple modes of innovation to survive and thrive in this environment. Multimodal firms embrace the challenges and opportunities afforded by technological and social change by leveraging the maker movement, communities of users, networks of engaged experts, and advancing sets of smart tools to their advantage.

Please read the following article from HBR: Four Main Ways to Innovate in the Digital Economy.

Research and Design, New Product Development Spectrum

<table>
<thead>
<tr>
<th>Agile</th>
<th>Traditional</th>
<th>Science Push</th>
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<tbody>
<tr>
<td><em>Quick Prototype and Test with Consumers</em></td>
<td><em>Market Research, Followed by Design</em></td>
<td><em>Heavy R&amp;D, Long-lead science</em></td>
</tr>
<tr>
<td>Software, Consumer Products</td>
<td>Complex Consumer Products, Bio devices</td>
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From research we know that research and design and new product development projects are benefitting from this expanded innovation landscape, allowing all to be closer to software and agile development. We are all moving leftward on the continuum. We continue to get faster, allowing teams to iterate quicker with these new tools, services, and a global network.

Please read this article on Stage Gates to learn what a Stage Gate is and how they are implemented to control a project: [Stage Gate Systems for New Product Success](#).

**New Product Development Fundamentals**

**Fundamentals for Success (Cooper, 2001)**

- Doing the project right. Based on common success factors among successful NPD companies, these include cross-functional teams, up-front market planning, listening to the customer, and early product concept definition.
- Doing the right projects. Even if a company has an excellent NPD process, if the wrong product is developed, the product will fail. Product selection and product planning methodology are essential to a successful product launch and lifecycle.
- Robert Cooper is a famous professor of NPD. He has studied firms for over 30 years, and has found fundamentals for success. These are simple, yet powerful.

**Traditional Stage-Gate**

In managing the NPD process, think about the project lifecycle. Remember how costs and resource use really escalates during design and development? One of the important items is that we select the appropriate project (the right projects) to work on. This process needs to be controlled, as we don’t want to invest money into projects that may not succeed.

Almost two-thirds of firms use a form of control called stage-gate. This enables team members and executives to have checkpoints, to decide whether or not to continue working the project. The first phases, opportunity investigation, business case formation, and concept development are lower cost, so there tend to be more of these at the beginning of the process. Selection is made, and only a small percentage of projects enter into full development.
But is there a downside? Yes! Some firms have too many decision points and the process becomes too bureaucratic. Also, cutting projects too early may stop highly innovative projects that may not have a fully vetted opportunity case.

Read this article about Microsoft and how killed off a potentially innovative product. Stage Gates have benefits, but they also can sometimes limit innovation: [Microsoft Courier Tablet Story](#).

**The PaperPro 3000 Case**

Please read this article about PaperPro: [New product development practice application to an early-stage firm: the case of the PaperPro® StackMaster™](#)

**New Models and Processes**

This is a simplified stage-gate new product development process, tailored to be more flexible and agile for new ventures and fast moving technical projects.

PaperPro is a company founded in 2003. Their mission was to develop the world's best stapler. They successfully entered the market with a single model but wanted to expand to other segments. Since their development was done internally, they were resource constrained. So, they worked with an outside firm to augment their internal resources.

Part of the development of this project was to implement a stage-gate system tailored to a small company. This was a step-by-step, sequential process to give PaperPro some discipline in the process, while not developing too many onerous procedures.

**Case Study: PaperPro**
PaperPros original products were developed by an expert inventor. They had excellent manufacturing support with a firm in China. For the 3000 project, they added support in multiple areas across the US, from industrial design to 3D printed prototypes.

Takeaways:
- Small development team, led by an inventor
- Global development and component sourcing
- Stapler technology and intellectual property the main focus

Case Study Phase 1

* PaperPro's latest stapler, the 3000 100-sheet was developed using NPD

Step 1 - Formulate Product Idea:
PaperPro's product strategy is to leverage its stapler technology into all market segments. One of them is the high-margin, high-capacity market.

Step 2 - Form Cross-Functional Team:
A cross-functional team was formed between management, engineering, outsourced design and engineering, and off-shore manufacturing resources. Preliminary development began April 2005.

Steps 1 and 2

In the beginning, they needed to develop their market strategy and think how they can best leverage their technology. Remember Professor Meyer's platform strategy? PaperPro implemented a similar line of thinking. They formed a cross-functional team comprised of internal team members and an outside design firm.
Step 3 - Define the Product:
A competitively priced, high quality, superior functioning high-capacity stapler.

Step 4 - Perform Market Research:
Market research was performed looking at competitive products, speaking to potential customers, sales representatives, and retailers. They then developed a strategic product roadmap.

Step 5 - Develop Market Segmentation Grid and Product Roadmap:
A market segmentation grid defined the current market space and allowed early definition of the product and product platform architectures for all PaperPro models.

Steps 3, 4, and 5

PaperPro spent a good deal of time defining the product, pricing, and performance. They spend a good deal of time talking with potential customers, sales representatives, and retailers. They then developed a strategic product roadmap.

Step 4 Market Research on Competitive Products:

More on Step 4 – Market Research and Competitive Products

Here are some of PaperPro’s competitors, which were purchased and analyzed. The main target of the Light Tough Heavy Duty Stapler was to be able to staple at least 100 sheets. The PaperPro product would also be a heavy duty item, designed for office use in such places like law firms. It is important to note that the Light Tough required a force of over 40 pounds to staple! In interviews, people expressed how much they disliked using it.
Step 6 – Investigate Intellectual Property (IP):
The 3000 is covered under existing patents for functionality of the stapling mechanism.

Decision Gate Point 1:
This is the first decision gate, which the development team with input from management can collectively decides on whether to terminate project or perform additional research on Steps 1-6. Feasibility analysis was performed and the development team agreed to proceed with the design.

Step 6 and Decision Gate Point 1

Market Definition
Properly defining your product and specifications are key. Can you beat the competition on every front? That’s the goal. Check out the video below of Steve Jobs introducing the iPod in 2001. He goes feature by feature, detailing why the iPod is a superior product.

Case Study Phase 2

Step 7 – Develop Customer Needs:

<table>
<thead>
<tr>
<th>No.</th>
<th>Metric</th>
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<tbody>
<tr>
<td>1</td>
<td>Must staple 2 - 100 sheets (20lb. Paper)</td>
</tr>
<tr>
<td>2</td>
<td>Actuation effort: &lt; 17lbs</td>
</tr>
<tr>
<td>3</td>
<td>Lifecycle: 10,000 &lt; x &lt; 15,000 cycles</td>
</tr>
<tr>
<td>4</td>
<td>Fit standard 23-13 staple</td>
</tr>
<tr>
<td>5</td>
<td>Contain PaperPro safety mechanism</td>
</tr>
<tr>
<td>6</td>
<td>Auto-open feature for staple replacement</td>
</tr>
<tr>
<td>7</td>
<td>Low jamming frequency (&lt;1%)</td>
</tr>
<tr>
<td>8</td>
<td>Familial resemblance, but unique</td>
</tr>
<tr>
<td>9</td>
<td>Retail price of $34.95 (&lt; $6.00 mfg. cost)</td>
</tr>
</tbody>
</table>

Step 8 – Implement Design Tools:
Design tools are applied at this step in order to solve engineering issues, identify platform elements, and reduce costs.

Step 7 and Step 8
In developing a new product or service, it is important to be crystal clear on developing the list of top customer needs and the specifications that the product needs to have. Think of the iPod video. You can essentially list the top 10 items/features Steve Jobs listed. Music capacity, speed to download, size, design, etc... During this phase, detailed design begins and with it, increased resource spending.

**Step 8 - Application of Design Tools:**
These included the use of design tools such as the EMS diagram, which can form the basis for TRIZ analysis.

**More on Step 8 – Application of Design Tools**
There are some tools that help teams think about the components and systems, and how they interact. Simple block diagrams can help. This also applies to software and APIs.

**Step 9 - Ideate Concepts with Industrial Design:**
Step 9 is the development of many concepts that have the potential of fulfilling the list of customer needs.
Step 9
Design was important to PaperPro, and many different design themes were explored. From expressive shapes to angular stealth fighter designs. In the end, the company wanted a conservative tool, so the red staple was chosen.

Phase 2 Continued...

Step 10 - Select Concepts:
Based on results from Step 9, concepts are evaluated and rated on their ability to meet customer needs. This step can include a selection matrix, as proposed by Ulrich and Eppinger (2004), or based on quality function deployment (QFD) and the resulting analysis of customer need and product attribute rating.

Step 10
During the design, much attention was paid to sizing and how the design could be scaled, and how it fit with the other products PaperPro offered.

Step 11
During detailed design, it is an iterative process with issues that arise and issues that need to be solved. Prototype plays a key role, and PaperPro used the latest tools and techniques to aid this process.
Step 12

Cost engineering is essential during the process, particularly with consumer products. PaperPro was in continuous discussions with the manufacturer to quote all the components on what is called the bill-of-materials.

Decision Gate Point 2:
Based on the outcome of the cost modeling analysis, the 3000 design was modified and readied for tooling. This is the second and final decision point in the NPD process.

Decision Gate Point 2
Case Study Phase 3

Step 13 – Define and Refine Product Specifications:
Product specifications are intended to mean the precise description of what the product has to do. Other terms for these specifications include “product requirements” or “technical specifications” (Ulrich and Eppinger, 2004). These are typically used as a guide for developing the exact function and attributes of a given product as it is transferred into production.

Step 14 - Finalize Design:
The product design is finalized, prototyped, tested, and readied for production. Based on final prototypes, the 3000 design was modified prior to tooling in July 2006.

Step 13 and Step 14
During the final phase, final specifications are developed and translated to manufacturing. This is vital.

Step 15 – Initiate Tooling Development and Prepare for Launch:
Production, tooling, and the supply chain are set-up during this step. Testing continues, and the product is readied for launch. Tooling for the 3000 stapler began in July 2006, and pilot production begin in mid-2007.

Step 15
Here is a prime example. It took many months to get everything just right with the 3000, now named the StackMaster 100. Part fits, durability, and jamming frequency required a lot of attention.
This image shows the process of testing, design, cost engineering, CAD and physical fast prototyping are essential to a lean innovation process.

As a case study, the PaperPro 3000 has some interesting points.

- The deployment of a limited, yet disciplined stage-gate process was helpful for the project
- The use of new prototype tools allowed for relatively fast iterations
- New collaborative tools like FTP sites (first gen Dropbox) to allow the team to share files and revisions
- The tension between design wants and cost reality played a big role in the project
- CAD design comprised most of the cost, and to do it effectively, you need the best engineers and designers you can get. Project efficiency is directly related to this

**Early Results**

Here are some results from the case, and these still resonate today.

- New ventures use NPD practices differently than large firms. They focus on a "less is more" approach i.e. flexible, simple, and truncated practices
- Adoptions is unique, often tailored to firms needs
- Onerous procedures and methods are eschewed
- Guerrilla-style, agile development and testing
- Industrial design and cost engineering are impactful for outcomes such as project breakeven timing
- Many new ventures are partnering with outside design firms to realize more efficient and effective outcomes
- Globalization and virtual development are pervasive
Agile Guerrilla Development

This is showing that the tension between cost engineering and design, can create better outcomes than each alone. It is the back and forth between making things cost effective and pleasing to the user can enhance the end product. When a small team does this, and iterates quickly using the latest prototyping techniques, you can speed to process.

Start-up Types and Specifics

<table>
<thead>
<tr>
<th>Start-up Type</th>
<th>Defining Characteristic is...</th>
<th>The Team Should Include...</th>
<th>The Development Process is...</th>
<th>Market Data is Gathered by:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software, Web</td>
<td>Ability to cheaply develop and iterate rapid prototypes in response to consumer testing and feedback.</td>
<td>Less than (5) hyper-functional individuals. Design functions may be outsourced depending on product scope and team capability.</td>
<td>Very limited, driven by project task lists and no more than one approval meeting (prior to tooling investment).</td>
<td>Speaking directly to potential customers. Web and store-based search. Limited use of traditional marketing tools.</td>
</tr>
<tr>
<td>Applications, General Consumer Products</td>
<td>More expensive development. Need to scope competitive market space and potential user needs before detailed design.</td>
<td>Less than (7) hyper-functional individuals. Design and engineering functions maybe be added or outsourced depending on project scope. Internal team maintains dominance and authority over all subcontractors.</td>
<td>Limited and flexible. Driven by subsystem and complete system milestones. Limited reporting to upper-level management. No more than two decision points by investors or upper-level management (prior to detailed design and prior to tooling).</td>
<td>Detailed ethnographic investigation of potential users. Resource draining methods such as focus groups and surveys are not used. More information is gathered from less sources.</td>
</tr>
<tr>
<td>Complex Consumer Products, Type I and II Biomedical Devices</td>
<td>Long lead R&amp;D and Science. Heavy investment into long-term science and R&amp;D. Uncertainty in commercial viability.</td>
<td>No more than (8) individuals. 2-3 hyper-functional individuals and 3-5 technical resources. Team is predominantly full-time and collocated.</td>
<td>Flexible based on science milestones. Team meetings held every two weeks based on scientific progress. Full team sessions if science progress drifts.</td>
<td>Little or no resources are used on market data. Product driven by science capability, not market need.</td>
</tr>
</tbody>
</table>

Here are some characteristics of the many firms we have investigated on the R&D spectrum. This graphic shows the characteristics of development, team structure, and how they approach up-front market investigation.
Digital Design and Design Iterations – Process Discipline Still Matters

Iteration Seems Easy

Product A was developed in 2001, using traditional communication methods. Product B was developed in 2010, using the latest collaboration tools and wikis. It is show that there was more communication and more iterations in Project B, which actually resulted in a longer development cycle.
Don’t Forget the Front End…

Ultimately what we have seen is that these teams can cut short concept development, which may not be helpful. Cutting these important up-front (stage 1 in NPD Early-Stage) can lead to increased development time during production ramp, making the slow finish even slower!

Research and Design, New Product Development Spectrum

This image illustrates that more complex products, as a result of the new tools, are moving to be more like software development i.e. agile development processes. Research and Design and New Product Development is moving towards Agile, but this does not mean fundamentals should be removed. Overall, these new ways to develop products and software are moving all projects leftward, becoming more similar to software.
The Expanded Landscape: Open Innovation Networks and Communities

The Network

In the expanded innovation landscape, some firms have embraced the concept of development engaged communities of contributors. One is Local Motors. Leveraging outside communities is termed "open innovation."

Local Motors Web Page

Watch this video to see how Local Motors works

The Community
Quirky was another example. This is the development process Quirky used, and how the community and inventors where plugged into their system of developing new products. They had an active community of over 1 million members helping to create consumer products.

Please read this article: Quirky Case Study.

Innovation

But, the jury is still out on the true effectiveness of open innovation. Quirky went bankrupt in 2015. Their system developed a wide array of products, each credible in their category, but no real market leaders.

An example is above. An ice scraper. The product on the right is Quirky’s, the product on the left is a traditional development model. Quirky’s development took longer, was more expensive, and resulted in a lower rated product (as rated on Amazon).

So it may be that open innovation can help engage potential customers, and develop a wide array of concepts and opportunities, but not be counted on to develop impactful innovations with less effort.

Value Stream Mapping – The current and Future State