Design for Marketing: Interactive Market Research Tools

by

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BS Mechanical Engineering, Massachusetts Institute of Technology, 1998

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Submitted to the Department of Mechanical Engineering
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Abstract
Incorporating customer feedback in every stage of the design can make the difference between a successful product in the marketplace and a product that cannot be sold. 

Design for Marketing is an approach to improve the product development process using customer feedback for those products that can be profitably market driven. In order to stay in touch with customer needs, different techniques can be used in every stage of product development. This thesis is devoted to explaining the marketing tools that can be used in every stage of product development, as well as discussing at which stages of design each tool becomes useful. The thesis builds around the idea of an integrated modeling environment, trying to propose tools to link the enterprise to the customer longitudinally through the product development steps, focusing on how to collect consumer input in every stage of the design. Conjoint analysis tools that are interactive were developed and used in the pilot projects that were performed in industry as part of this thesis work.

Thesis Supervisor: David Wallace
Title: Esther and Harold E. Edgerton Associate Professor of Mechanical Engineering
Acknowledgements

I would like to start by thanking Professor David Wallace for his guidance and support. It is when things are not as great as they could be, that you see the truly great people. And Dave is one of the people that I most respect because he allowed me to grow as a person, in the process of allowing me to get yet one more degree from this prestigious institution. I do not think that I would have finished my degree if I did not have his support. I know that I have an enormous debt of gratitude towards him and I would like to acknowledge this. I don’t think I will ever be able to say how grateful I am or how indebted I feel but I wish that in the future I might be able to give to others as much as I received from him. And I wish that he is always recognized and achieves what he wants.

Professor Ely Dahan helped me find a topic and a place in the graduate world at MIT. I didn’t always understand his style and motivations but because of this I think that he helped me a lot to grow as a person and understand the boundaries of the world.

I also want to thank my professors because some of them had a very strong influence in my life, in my two current passions: marketing and entrepreneurship. Professor Drazen Prelec, Ken Morse, Professor Barbara Bund, Noubar Afayan. I don’t know what to say except thank you for choosing a profession that lets you help and direct people. I would like to particularly thank Professor Russ Olive for believing in me and helping me achieve my goal of creating a company to help people.

I would like to thank my family who supported me for so many years and in many ways still does. My father, Ioannis, is an inspiration to many people because he left his country and moved to France and then later to the United States to provide what was best for his children. My mother, Anna, gave up everything she cared for to follow my dad half way around the world always building a house for us in every new country and city we went to. My older brother, Peter, in his way supports our unity. My younger brother, Manolis, even though the youngest was so wise he taught me many things about life that helped me grow as a person. I would never have been a happy person without him.

I would like to thank my friends for their love and support. It is because of them that I managed to go through so many years of MIT and still stay happy. I am not sure who to start with so I will just say a few words in alphabetical order about those that gave me so much love I never felt alone.

- Alexandra was my roommate for a year and has been my friend for many. I turn to her for her wisdom because even though she is only a few months older than I am, she was always wiser. I would like to thank her for the many times she made me laugh, when catching me take the elevator, when she knew everything I did, when she tickled me from a distance.

- Bassam has been my friend for years and was the first person that believed in me even before I had a chance to prove anything to the world. He loved me in so many ways that I never understood how I got so lucky to have him. Even now that
he is in California, he is still there for me and would never let me down, no matter what I do.

- Ben was there for me when I needed support and gave me his unconditional love. He gave me the self-confidence I needed to face the world in a new way. I even owe to him my formal training in massage. I never paid him back in the way he deserved but I love him with all my heart for the friend he turned out to be.

- Corinne was my French partner in crime. We started our criminal activities when we were both working for Xerox in Rochester. We had uncountable moments of fun and long conversations. She influenced me in many ways and helped me see myself in a new way.

- Elaine was there to support me in my thesis work and thanks to her I never felt pressure to do anything I wasn’t ready to do. She helped me every chance she got and also gave me her advice for all those problems I could come up with all the time.

- Manolis is not simply my brother, he is one of the most important people among my best friends as well. So many things to say I don’t even know where to start. Dancing or taking pictures, or being the star of the entire MIT graduate community, life is never boring on planet Manoli. He is one of a kind. I just feel lucky to be his older sister.

- Qi turned out to be a wonderful friend. Qi with Ohno and Iq are just one happy memory following the next: tea and long conversations, hobby shop, hanging out or just catching each other by chance. Now she is even my new office mate.

There are so many people who gave me their love, advice and support, I would like to at least mention them, because each in their way they made me the person I am now. I feel that this is a chance to thank the people who were part of a long chapter of my life. I feel so grateful for such an amazing experience the least I can do is thank them. I could go on for hours but I am just going to state their names. And if by accident I left a name out, you know who you are and I thank you doubly for being such a good sport. Alex, Bill, Ben, Ben, Diana, Ed, Fernando, Jamie, Jeff B, Jeff B, Jeff M, Kristie, KumaLisa, Kostas, Lillian, Maria, Marta, Nikki, Peter, Patrycja, Shane, Stefan, Tim, Tristram, Yu Feng.

- French Mafia: Thanks to them I discovered one of my passions in life: sailing. We were sailing in the Virgin Islands for a week and after this amazing trip life cannot be the same again. I discovered paradise on Earth and something that made me realize that life can only be good. Timothy was the closest to me even though we are different in so many ways I think I never understood him. But through our long conversations I saw a new perspective that only someone so different could have shown me. The rest of the mafia are always so important to me. Maxime cannot forget my memorable morning move “et hop, dans le chenal!” Anne his princess is finally here and they have built their palace. Le capitaine Antoine with sa femme Marie helped me learn so many things about boats... Alex and Gwenaelle were so great always. Especially when Alex taught my fish that if it moves it is bad for it. The rest of the French mafia members were also instrumental: Andre, Franck, Sandrine, Veronique.

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- Startups: I fell in love with startups when I was 19 and this is when I started my first one. I hope it is going to stay a life-long romance. In that crowd of entrepreneurs, CEOs, VCs and startup lovers I found myself and my true passion and motivation. Some people had the chance to play a very important role in my life, even before it all got started. John P. provided me with the motivation to finish my thesis when all I wanted to do was drop out and start my new company. He gave me the right advice I think. Mike G. helped me get sharper. Bob J. made me feel that I could do it. Jeff B. simply made my life easier.

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PART I: Overview and Evaluation of Market Research Techniques in a Product Development Setting
Chapter 1: Why Design for Marketing

The MIT Center for Innovation in Product Development promotes the idea that in today’s competitive business environment, a company’s ability to effectively commercialize technology can determine whether it thrives or perishes [1]. Incorporating customer feedback in every stage of the design can make the difference between a successful product in the marketplace and a product that cannot be sold. Successful companies identify acute customer needs through rigorous market research and then create a compelling whole product solution to address those needs. Translating the voice of the customer to highly focused segmentation and selective product offerings is an important starting point for design [2]. Market research can also help shape a strategy to differentiate the product in a competitive marketplace.

*Design for Marketing* is an approach to improve the product development process using customer feedback for those products that can be profitably market driven. The motivation for this effort is a belief that the customer has a primary importance in product development, and serving the needs of the customer is the ultimate purpose of design. Needs are not restricted to functional needs, although they are often the most apparent needs. Market research is intended to imply anything that the company or developers do to understand markets and customers.

Market research can be part of each step of the product development, addressing specific needs encountered during each development phase. Ulrich and Eppinger [3] determine the steps for a generic product development process as described below. For each step Table 1 highlights the necessary customer input and desired marketing objective.

i. **Planning**: This phase includes assessment of technology developments and market objectives. In this phase the target market for the product is specified.

ii. **Concept Development**: The needs of the target market are identified, alternative product concepts are evaluated and one or more concepts are selected for further development and testing. A concept is a description of the form, function and features of the product. In this phase also specifications are defined and a competitive analysis is done.

iii. **System-level Design**: At this level is defined the product architecture and the product’s sub-systems. At this level forced comparison techniques, like system-level conjoint analysis that will be discussed in Chapter 3 of Part II, can help determine at a higher level what subsystems are the most desirable to the customers.

iv. **Detailed Design**: At this level is defined the complete specification of the geometry, materials and tolerances of all the unique parts in the product. The output at this level typically includes CAD files. An innovative approach to market research would involve user-design that is briefly mentioned and described in this thesis, but that does not yet exist in a practical form.

v. **Testing and Refinement**: This involves the testing and evaluation of pre-production versions of the product (prototypes). Alpha prototypes are tested to determine whether or not the product will work as designed and whether or not it
satisfies the key customer needs. Beta prototypes are used by intended customers, in their real environments.

In order to stay in touch with customer needs, different techniques can be used in every stage of product development. This thesis is devoted to explaining the marketing tools that can be used in every stage of product development, as well as discussing at which stages of design each tool becomes useful. Those techniques are discussed and evaluated in Part I of this thesis. Table 1 highlights the specific challenges each company faces in every stage of design. I also tried to explain as how an integrated internet-based marketing approach could provide some answers to these problems.

Table 1: Solutions provided by an integrated internet-based approach to company's unmet needs for each product development phase.

<table>
<thead>
<tr>
<th>Steps of design development</th>
<th>Company's unmet needs pertaining to marketing in product development.</th>
<th>Solutions provided by an integrated internet-based approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Planning</td>
<td>• Many ideas get lost because it is difficult to promote an entrepreneurial environment in a large company.</td>
<td>• Can provide the forum of lead users in the product development phase. Provides access to lead customers internal or external in a variety of settings and locations</td>
</tr>
<tr>
<td></td>
<td>• In a specific product area planning needs to lead into developing an idea into a consumer product.</td>
<td></td>
</tr>
<tr>
<td>2. Concept Development</td>
<td>• Once the product is chosen there is a real problem with time to market and aggressively pursuing competitors</td>
<td>• Understanding the challenges of translating consumer feedback into engineering terms: “what features mean what, to whom and why”</td>
</tr>
<tr>
<td></td>
<td>• There are limits in the flexibility and applicability of the design</td>
<td>• Translating feedback into consumer requirements</td>
</tr>
<tr>
<td></td>
<td>• Cost of this development phase can be high both in terms of the actual development as well as in lost opportunities, if this phase takes too long.</td>
<td>• Links engineering development to marketing. Results are easier to evaluate</td>
</tr>
<tr>
<td></td>
<td>• Determining consumer trends and preferences is a guessing game at best.</td>
<td>• Immediate feedback</td>
</tr>
<tr>
<td></td>
<td>• Process of evaluating new marketing techniques and possibilities</td>
<td>• Possibility to get evaluation on multiple designs more easily</td>
</tr>
<tr>
<td>3. System-level design</td>
<td>• There is a need for physical prototypes that would allow for market predictions, quite accurately for traditional product</td>
<td>• Make engineers understand what the consumers are really saying (one step remote)</td>
</tr>
<tr>
<td></td>
<td>• User-design and virtual prototyping could be used to successfully predict market response without spending a lot of development time and money</td>
<td>• Lock-in of consumers to limited spectrum of evaluation possibilities</td>
</tr>
<tr>
<td>4. Detailed Design</td>
<td>• Evaluate the design and features fast and accurately</td>
<td>• This can be a new way of reducing iteration time and cost as early in the design phase as possible using consumer specs to develop modular design</td>
</tr>
</tbody>
</table>


lines, with a reduced price tag benefits

5. Testing and Refinement

- Tradeoffs between product features have to be made
- This is a last chance to discover if the product truly meets the intended needs.
- Verifying if the product addresses true costumer needs.

However, there is a significant gap between the desired plan to involve marketing research in product development and the actual development practice. This gap comes from the fact that the engineering team needs to be involved in the process in order to truly understand the feedback received from customers and in order to incorporate the changes made. Table 2 summarizes the challenges for the engineer in each stage of product development, as discovered in industrial pilot programs described in Part II of this thesis.

Table 2: The Challenges presented to engineers in meeting marketing needs during each step of the product development process.

<table>
<thead>
<tr>
<th>Steps of design development</th>
<th>Need for marketing (internal and external communications)</th>
<th>Challenges for the engineer (applicable to marketing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Planning</td>
<td>• Evaluate idea</td>
<td>• Develop concept</td>
</tr>
<tr>
<td></td>
<td>• Jump from concept to development phases</td>
<td>• Find applications for concepts</td>
</tr>
<tr>
<td></td>
<td>• Lead consumers (Von Hippel)</td>
<td>• Lock-in to favorite technology</td>
</tr>
<tr>
<td></td>
<td>• Realize more targeted research efforts</td>
<td>• Hard to understand market potential of an idea and even harder to compare between ideas</td>
</tr>
<tr>
<td></td>
<td>• Pull from need, not push from engineering</td>
<td>• Might spend unnecessary time developing the wrong idea</td>
</tr>
<tr>
<td>2 Concept Development</td>
<td>• Evaluate design. Find the design that has the most appeal to the consumer</td>
<td>• Limited possibilities for real marketing evaluation (market sizing, estimated life of product, adoption expectations...)</td>
</tr>
<tr>
<td></td>
<td>• Size the market</td>
<td>• Closed feedback loop</td>
</tr>
<tr>
<td></td>
<td>• Target specific needs</td>
<td>• Understand what the consumer feedback relates to (house of quality, etc...)</td>
</tr>
<tr>
<td></td>
<td>• Use marketing tools and translate results into product attributes.</td>
<td>• Need of consumer specifications</td>
</tr>
<tr>
<td></td>
<td>• Translate consumer needs in features that really appeal to them and for which they would be willing to pay a premium price (targeting and segmentation)</td>
<td>• Accurate representation of design</td>
</tr>
<tr>
<td>3. System-level Design</td>
<td>• Logit - consumer preferences (Little)</td>
<td>• Difficult to change and re-evaluate</td>
</tr>
<tr>
<td></td>
<td>• ADA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Virtual User forums.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Voice of the customer (Prelec)</td>
<td></td>
</tr>
<tr>
<td>4. Detailed Design</td>
<td>• Solve only the problems that will matter to consumers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Consumer perceptions</td>
<td></td>
</tr>
<tr>
<td>5. Testing and Refinement</td>
<td>• Voice of the customer (Prelec)</td>
<td>• Evaluate the appeal of design</td>
</tr>
<tr>
<td></td>
<td>• Evaluate prototype</td>
<td>• Time pressure</td>
</tr>
<tr>
<td></td>
<td>• Marketing the product (Bund)</td>
<td>• Can test for very few factors</td>
</tr>
<tr>
<td></td>
<td>• Increase awareness</td>
<td>• Understanding the implications of criticism</td>
</tr>
<tr>
<td></td>
<td>• Justify the buy</td>
<td>• Ramp up to correct volume</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Debug</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Test</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Discontinue or change to follow market trends (just in time.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Building of the prototype (visual CAD representations and physical prototypes: Sacks.)</td>
</tr>
</tbody>
</table>
This effort to involve marketing research in all stages of design, should be only the seed for a broader use of the internet in performing better tasks that are currently performed, and for inventing new ways for a company to improve its performance, delivering better products, faster, to a willing customer. The DOME project [4] is an enterprise-wide effort to link the various departments of the company internally. This thesis builds around this idea trying to propose tools to link the enterprise to the customer longitudinally through the product development steps. Figure 1 is a diagram illustrating how the consumer can be involved in every stage of product development. The importance of the involvement of each department shifts as the product evolves from seed idea to production stage.

![Diagram illustrating consumer involvement in product development](figure1.png)

*Figure 1: how consumer input can be useful during each phase of the product development effort.*

---

1 This figure was developed as part of the internship work of the author supervised by Brendan Gnall.
This thesis focuses on how to collect consumer input in every stage of the design and which tools can be used.

Part I, Chapter 2 provides more depth about how to approach market research in a product development setting, breaking down the steps that need to be performed in order to accurately collect consumer feedback. Chapters 3 through 5 are summary descriptions and evaluations of the many marketing tools that can be employed in product development, describing more which tools can be most useful in each design stage. Chapter 3 focuses more on the traditional marketing tools. Chapter 4 describes more in detail a choice-modeling tool: conjoint analysis. Conjoint analysis was used in the pilot projects that were performed in industry as part of this thesis work. Chapter 5 explores new interactive market research tools that have been put forward in industry in an effort to collect consumer feedback faster and more accurately.

In Part II, more concrete applications of the tools described in Part I are evaluated. Chapter 1 describes some industry examples that have pioneered this field. Chapters 2 and 3 describe industry pilot projects based on the effort to involved consumers in design using interactive market research tools. Chapter 3 focuses more on the design of a new interactive tool for doing conjoint analysis done as part of a pilot study. Chapter 4 offers the conclusions for this thesis work and recommendations for future work.
Chapter 2: How to approach market research in a product development setting

As discussed in the previous chapter, market research is an important part of the product development process. In an ideal case market input is obtained in order to give a direction to the product development team’s efforts. In a very general sense, Ulrich and Eppinger [3] define market research as a 5-step process. The steps it consists of are:

i. Identifying the problem
ii. Designing the test
iii. Collecting the responses
iv. Analyzing the results
v. Feeding back into the design cycle.

2.1 Identifying the problem

The first step, identifying the problem, is one of the hardest steps to perform. The management wants the product to be successful and to provide a good revenue source for the company. The engineering team is mostly concerned with the design of the product. The product planning team needs to meet a schedule and meet the appropriate goals. But what the customers care about is if the product is meeting their needs, implicit or explicit, functional or aesthetic.

The problem at this stage is translating the questions and uncertainties that the development team has into questions that the customer can answer, and into input that can be fed back into the design process. In this stage it would be beneficial to determine how many modification options the customer would be allowed to make.

The type of questions to ask varies depending on the stage of product development. For early stage development, input can be gathered in terms of developing new concepts. Potential lead users and inventive individuals, involved at this stage, could allow the designers to think through what the possibilities are. It is also important to determine what direction to take, which market segments to target and what options to offer for any product.

In the stage in which the concept is chosen, but the realization of the design is still not done, the designers might have to compare sketches, prototypes. They can gather input from customers by evaluating the reactions that their designs produce. Analyzing these reactions can be a meaningful input to the design. Questions at this stage would allow the team to select from among very different concepts.

In the development phase, the questions will be more focused towards direct tradeoffs that can be made in the design in order to better serve the customer needs. This can involve understanding needs that are important versus trivial. This process will force the development effort around what are the real needs of the customers. The work we have
done with pilot industry projects, described in Part II, was aimed at understanding tradeoffs at this stage.

2.2 Designing the test

The test design depends again on the stage of the development process. As always, different tests are applicable to different stages of the development process [5]. The first step in designing the test is to identify who the customer is and who should be involved at what stage of the development process.

At the early stages lead users might be the appropriate customers because they are the people who might prompt new ideas or offer their ideas to the development team. There are still many products that were developed from the vision of one of the developers, and break free of conventionality, in which case it can be argued that customer involvement can be unnecessary or hurtful. These products tend to be developed though in smaller companies. Also involving your current customers has been argued to be hurtful for radically different products [6].

It is necessary to involve customers at any stage, and at the early stages customer involvement could simply be a way of generating new ideas and being made aware of new fields of development. Products that are created for human use can profit at this stage from a human factors analysis. Von Hippel [7] tries to address this problem with his idea of lead users. The Lead User Market Research Method is built around the idea that the richest understanding of new product and service needs is held by just a few “Lead Users”. They can be identified and drawn into a process of joint development of new products and services concepts. Yet there is a very hard question that has not been addressed in this area: how does market research need to be done when technology innovation is the goal? The scope of this thesis is more humble and this question has not been central in its development, even though it is a very important one.

It is interesting to think of ways in which the opposite problem can be solved. How can you find a market for a technology that has been developed? In universities and research institutions around technologies are developed without a market in mind. This thesis is more concerned with developing tools for involving customers by eliciting their wants and needs.

At the early stages it is best to use exploratory market research. Exploratory market research helps discover what is new or missing. It is a way of broadening the vision.

At later stages, market research is more humble in scope (defining features). Market research at that stage can be easier to use and apply, since this for a long time has been the traditional way of doing market research in industry. Multiple techniques exist for very specific applications.

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2 Xerox has done extensive testing trying various methods for promoting innovations and new product development trying to create a market for the products and inventions that they created out of the Xerox Parc facility.
At this stage the goal is to narrow options and make tradeoffs that would help create a product with a market in mind. Also it is possible to estimate production volume, market size, and profits. (The accuracy of the results is always debatable.)

At the later stages it is best to use confirmatory market research. Confirmatory market research helps make the right choices in tradeoff situations and anticipate the product’s performance results.

Lastly, after the product has been deployed, market intelligence can serve as the analog of experience in life. Current customers offer patterns of use and problems that can be traced and analyzed to provide with valuable information for future development. Tracing click patterns for example in a computer environment would fall under this category. One distinction here is between market research focused on customers (human beings, emotional, research based on psychology) and research focused on markets (aggregates of human beings, grow and shrink, concentrate or fragment, research based on economics).

2.3 Collecting the responses

This is a time-consuming process traditionally. Recruiting the respondents and collecting their responses can take up to several months. Extensive databases of relevant people can be bought but sorting through these is also a tedious process. Moreover, care must be taken to establish a statistically valid qualified group.

Because it's costly and often impractical to get feedback from every customer, a representative sample of the customer group is used. The way a sample is chosen will have a significant impact on the accuracy of the research. A relatively small, well-chosen sample can provide extremely accurate information. On the other hand, a carelessly selected sample, even if it's based on a large number of customers, can lead to incorrect conclusions and, ultimately, poor decisions.

The first step in any sample selection decision is to ask who can provide the necessary feedback. Once the population has been defined, the next topic to consider is projectability.

Random samples are the key to collecting projectable data. Random sampling ensures there is no unknown and unwanted bias in the results. A random sample of 2,000 people produces results that are (about) equally accurate whether the population is 200,000 or 2 billion.

There are a few ways to implement random sampling on the web. The first way is true random sampling. Random means that each person has an equal chance of being entered in the sample, independent of everyone else. Another way is systematic random sampling. Systematic random sampling means every nth user is surveyed. (An example of this can be found in the selection of the respondents for the industry pilot study discussed in Part II of this thesis.)
Establishing a panel:

To create an ongoing dialogue with consumers and consumer advocates as part of company planning and management, it is beneficial to establish a long-term consumer advisory panel whose members represent identifiable, organized constituencies. To learn how better to serve a particular segment of the population, the panel needs to represent these consumers and experts in the field. Maintaining a panel of respondents can be beneficial for several reasons. The time it takes to gather respondents is eliminated from the process. Results can be traced longitudinally. Several iterations on the same test can be performed.

Although there are many kinds of consumer advisory panels, in order to succeed they have to be carefully planned and some general rules apply to them all: [8]
The purposes and objectives must be clear in advance and the panel members who want to be confident they are not being used. Even though it is up to the company to first determine its objectives in establishing a panel, the panel members must be comfortable with the panel’s purpose and operations, and they must have management’s assurance that they will be able to influence the direction of the panel and the substance of its agenda. The extent of the panel’s potential influence over company decisions and the way that influence will be felt should be clear from the start, particularly when a company considers some topics to be off-limits.

There must be well-understood and mutually acceptable ground rules. The extent and formality of ground rules depends on the nature and longevity of the panel. As part of these rules the administrators of the panel should state the purpose of the panel, define the membership and length of service, state the company’s responsibilities and commitment, state the members’ responsibilities and explain council operating procedures. Top management must support the existence of the panel and be accessible to it. Management must be committed to listen to panel recommendations, to implement those that are feasible and to respond to all recommendations, whether they are adopted or not. It is a good idea for the chief executive officer to attend the first meeting to demonstrate the company’s commitment.

The effective decision-makers should attend meetings. The people in a position to implement the panel’s recommendations, whether they are top management, department heads or store managers, should attend meetings to listen, make presentations and answer questions.

The company must provide back-up support to the panel. Back-up support includes orientation, supplying background information, and serving as a secretariat if the panel so chooses.
2.4. Analyzing the results

Once the results from the consumer have been obtained the next step is to analyze these results. Data analysis can follow three easy steps. [9]

(a) Data Preparation

Before any analysis can begin, the data must be transferred to a machine readable and interpretable format by briefly describing proposed data entry procedures and quality control measures, by stating if the tool is used in-house or if contractor resources are needed to process the data and by describing the procedures used for estimating missing data items.

(b) Analysis

Analysis means categorizing, ordering, manipulating, and summarizing raw data, with the goal of answering research questions and satisfying survey objectives. The analysis method used is particular to each market research tool. (Analysis methods for the conjoint tool are described in more detail in Part I, Chapter 5.)

(c) Reporting Results

The reporting format again varies depending on the tool and audience. For an engineering audience, specifications for the design are the desired results.

2.5. Feeding back into the product development cycle

In the beginning of market research it is important to know who will benefit from the findings and outcome of the market research. It is important to involve these parties in the planning of the market research, if not the entire process. Speed is a key issue. A problem today will stay a problem tomorrow, but will fade away or will be bypassed in a month and most certainly in half a year. Answering questions that will be relevant at the time the results come back needs to be considered.

In the previous chapter the product development cycle was discussed in length and figure I1.1 depicted how customer input can be useful in each phase of the product development effort.

Exploratory market research as defined in this chapter can be used in the beginning stages of product development (research phase and engineering and product development phase.) Some answers that can be obtained from exploratory research in those phases are: obtaining market product variables (MPVs) , validating market analysis parameters (MAPs), validating value proposition, identifying customer needs.

Confirmatory market research can be used at the later stages of product development (CAD development, Supplier Identification. Some answers that can be obtained from
confirmatory market research are: realizing tradeoffs between feature attributes or even features, designing with the market needs in mind, sales prediction, target segment identification, marketing strategy definition and target price setting.

Market intelligence can be used after the product has been produced to gather sales reports and customer support and service data that can serve as useful guidelines for future product generations.

In this chapter the steps in which market research can be broken down have been explored. The following chapter explores the tools used in market research and which tools can be used at which stage of the product development cycle.
Chapter 3: Overview and Evaluation of Traditional Tools

Each product development phase can benefit from marketing in one of more ways. But the tools that can be applied during each phase vary with the requirements of each phase. This chapter in a first part starts by categorizing the tools depending on their utility in each product development stage. The second part of this chapter analyzes more in depth choice modeling tools, along with the pros and cons of each tool.

3.1 Different Tools for each product development stage

It is important to understand that each tool has limitations and is best used in specific applications. McCarrie [10] breaks down the decision cycle associated with any product into four steps.

i Scan the environment
ii Generate options (possibilities, directions worth pursuing, choices)
iii Select an option (functionality that the product needs to offer, target market)
iv Evaluate the success (market intelligence)

Table 3 summarizes the fit of each market research tool type to the product development stages. Secondary research is useful in the early stages of product development and later in evaluating the success of the project. Customer visits can be helpful in determining what the customer requirements are and are thus beneficial in the early stages of product development. Focus groups can be an attractive tool when the design options are generated. Surveys can be used in the very beginning of the design process and for evaluating the later stages of design. Choice models are useful when selecting options for the product in the confirmatory market research stages.

Table 3: Marketing tools useful in each design step.

<table>
<thead>
<tr>
<th>Secondary research</th>
<th>Customer visits</th>
<th>Focus groups</th>
<th>Survey research</th>
<th>Choice models</th>
<th>Experiments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scan Environment</td>
<td>Identify</td>
<td>Describe</td>
<td>Monitor</td>
<td>Generate Options</td>
<td>Generate Define</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>++ ++</td>
</tr>
<tr>
<td>Select an Option</td>
<td>Test</td>
<td>Evaluate</td>
<td>Prioritize</td>
<td>Select</td>
<td>Measure</td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
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<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Evaluate success</td>
<td>Measure</td>
<td>Track</td>
<td>++</td>
<td>++</td>
<td>++ ++</td>
</tr>
</tbody>
</table>

Customer focused product development [11] requires a deep understanding of customer requirements. Traditional methods to gather customer requirements include customer interviews and surveys. Other potent methods include product clinics, real world product use observations and contextual inquiry.
However, to focus designs on the areas that are critical from a customer standpoint, we must know which requirements are most important to meet. Although the best people to rate the importance of the customer requirements are the customers themselves, getting this done is sometimes a challenge and a key decision is selecting the method most appropriate for the situation.

Implementing effective concurrent engineering approaches means that product teams are involved first hand in customer needs research. But in the real world, tension exists between project resources, time for customer research and customer availability and patience on one hand, and obtaining the most discriminating assessment of importance ratings on the other hand.

Consequently the teams must be aware of what techniques are available so they can make intelligent choices in trading off efficiency and effectiveness when determining customer requirement importance ratings.

### 3.2 Choice Modeling Tools

There are a wide variety of techniques that can be used ranging from fairly quick and simple to sophisticated and more time consuming. Generally, the simpler techniques ask customers to rate the importance of each requirement without regard to other requirements. More involved techniques ask customers to rate each requirement in relation to all the other requirements. The most sophisticated techniques ask the customers to go through numerous pair wise comparisons forcing them to rate the importance of one requirement versus another or rating combinations of requirements at different performance levels against each other. The tools described in this section are broken down into three categories:

i. Tools for rating each requirement in isolation
ii. Tools for rating each requirement relative to the other requirements
iii. Tools for forced comparisons between requirements

#### 3.2.1. Tools for rating each requirement in isolation

**Linear Scale Survey:** This is the classical tool for eliciting customer responses. Customer Surveys are probably the most effective way of both determining what the customer needs, and of assessing your current performance in meeting those needs. [12] However, Customer Surveys have had a lot of bad press over recent years - not because they are ineffective, but because they are frequently misused. Surveys should explore all aspects of the relationship (the survey provided in the resources section provides a good example of this) and should look at trends from the past and opportunities for the future. Surveys should be collated into an overall measure of performance for the company, and a source of ideas for future developments. The rating scale for survey questions can be from 1 to 10, the most common being 1 to 3, 1 to 5 and 1 to 7.
Kano Survey: Kano analysis is a model for exploring the three different types of requirements that customers might have for a product/service [13]. These relate to one 'spoken' requirement, and two 'unspoken' requirements.

The spoken requirements are those aspects of the product/service that would normally be explicitly defined within any contract or request. These requirements are "expecteds" and only cause dissatisfaction if not met. These requirements are depicted in a straight line in figure 2 because if the spoken requirements are met or exceeded the customer is likely to be satisfied, becoming progressively less satisfied with each compromise that is made. The 'unspoken' requirements are linear "satisfiers" - the more provided, the more satisfied customers are. They are assumed by both the customer and the supplier, and as such have no potential to satisfy the customer, but a tremendous potential to dissatisfy when they are found to be missing.

The other unspoken requirements are "exciters" - they excite customers because they weren't expected. In this case it is because the customer has not even thought about them. They have the potential for the supplier to surprise or delight the customer with ideas, innovations or additions that really add value to the customer, but often at little cost to the supplier. Because the customer is unaware of them - missing them has no potential to dissatisfy, but including them can make the customer feel 'special'. Excitement quality has real potential to make a customer feel that the relationship is more than a purely commercial transaction. This is depicted by a line lying only on the positive customer satisfaction curve in the Kano diagram.

A customer survey designed in a Kano format simply asks each question in two ways. One question says, "If this requirement was met what would your reaction be?" The second question says, "If this requirement was not met, what would your reaction be?" By evaluating the survey data, a quantitative indication of importance of each requirement is calculated. In the calculations, "exciters" have much more weight than "expecteds" or "linear satisfiers" and "linear satisfiers" have more weight than "expecteds".

![Figure 2: Kano diagram.](image-url)
3.2.2. Tools for rating requirements relative to other requirements

**Priority Ranking:** Forced Ranking or Priority Ranking allows the group to prioritize a set of initiatives from the most important, or rank products from the most favorable. X-Y Mapping allows for strategic planning by evaluating an initiative against two sets of criteria. Demographic comparisons gain insight into the different groups that compose the audience.

Priority ranking test provides customers with a stack of cards with each card having a separate requirement. Each customer arranges the requirements cards from most important to least important.

**Multi-voting:** The purpose of the tool is to accomplish "list reduction" and assignment of priorities quickly and with a high degree of group agreement. Multi-Voting is a structured series of votes used to help teams assign priorities in a list of many items, and reduce the list to a manageable few. Multi-Voting may be used at team meetings whenever a Brainstorming session has generated a list of items that is too lengthy for all to be addressed at once.

The procedure used for the tool is to take a first vote; then each person votes for as many items as desired but only once per item. Subsequently, the items receiving a relatively higher number of votes than the other items are circled (e.g., with a team of ten members, items receiving five or more votes are circled). Then a second vote is taken; each person votes for a number of items equal to one-half the total number of circled items, again only once per item (e.g., if eight items received five or more votes during the first vote, then each person gets to vote four times during the second vote). The procedure is repeated until the list is reduced to three to five items, which can be further analyzed.

**Affinity Diagram Extensions:** The affinity diagram [16] is used to generate ideas, then organize these ideas in a logical manner. The first step in developing an affinity diagram is to post the problem (or issue). This can be used in conjunction with the constant sum scale tool or anchored scale tool to structure customer requirements into high level, second level and third level requirements. Details about what these tools entail can be found in table 4.
Table 4: Summary procedure and deliverables for choice modeling tools that rate requirements relative to the other requirements.

<table>
<thead>
<tr>
<th>Method</th>
<th>Procedure</th>
<th>Deliverable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority Ranking</td>
<td>Rank from highest to lowest</td>
<td>Rank order importance</td>
</tr>
<tr>
<td>Multi-voting</td>
<td>Distribute votes, = 1/3 # of items</td>
<td>Number of votes per item</td>
</tr>
<tr>
<td>Affinity Diagram</td>
<td>Divide up 100 points. Biggest need gets 10, rate other items relative to that.</td>
<td>Number of points per item 1-10 item rating. Indicators of how customers make buying choices and what suppliers do best</td>
</tr>
<tr>
<td></td>
<td>Distribute $100 among requirements and $1000 among suppliers as rewards</td>
<td></td>
</tr>
</tbody>
</table>

3.2.3. Tools for forced comparisons between requirements.

**Analytical Hierarchy Process:** The Analytical Hierarchy Process Model was designed by TL Saaty as a decision making aid [17]. AHP asks people to make choices between pairs of customer requirements and select whether one requirement is equal, 1/2 or 1/4 as important as the other. AHP is especially suitable for complex decisions that involve the comparison of decision elements that are difficult to quantify. It is based on the assumption that when faced with a complex decision the natural human reaction is to cluster the decision elements according to their common characteristics. It involves building a hierarchy (Ranking) of decision elements and then making comparisons between each possible pair in each cluster (as a matrix). This gives a weighting for each element within a cluster (or level of the hierarchy) and also a consistency ratio (useful for checking the consistency of the data).

**Conjoint Analysis:** Conjoint analysis (also called Multi-attribute Utility Analysis) is used to determine what combination of customer requirements (product and service attributes) has the most appeal to targeted customers and when price is included, what combination of attributes and price will provide the company with the best market share and profitability.[18] In essence, it helps compute a utility curve for each customer requirement. A utility curve shows what amount of each customer requirement must be provided to satisfy customers and it also can show when providing more is not better. Therefore, the utility curve provides valuable insight into the return-on-investment for each design improvement effort. (Chapter 4 is devoted to conjoint analysis since it was the tool primarily used in the pilot projects described in Part II of this thesis.)

Love [19] in a consulting report offers an evaluation from the industry perspective of the tools described above, as displayed in table 5.
**Table 5: Evaluation from industry perspective of choice modeling tools**

<table>
<thead>
<tr>
<th>Tool</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tools for rating each requirement in isolation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linear Scale Survey</td>
<td>Quick to complete</td>
<td>Even using a 10 point scale, there is not always a wide spread of importance ratings. Rates requirements independent of each other rather than relative to each other. &quot;Central tendency&quot; may creep in when there are many requirements to rate (e.g., over 20 items) and customers just starting putting down middle-of-the-road ratings.</td>
</tr>
<tr>
<td>Kano Survey</td>
<td>Provides very discerning importance values</td>
<td>A little tedious to complete because the questions are asked twice. Fairly complicated to analyze survey results.</td>
</tr>
<tr>
<td></td>
<td>Surfaces &quot;exciters&quot; which offer competitive advantages if met.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Identifies leverage from &quot;satisfiers&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Identifies &quot;expecteds&quot; that should not be overlooked in the design.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Automatically, importance ratings are expressed as a % or fraction and all total to 100% or 1.0.</td>
<td></td>
</tr>
<tr>
<td><strong>Tools for rating requirements relative to other requirements</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Priority Ranking</td>
<td>Quick to complete</td>
<td>Begins to get unwieldy when there are more than 12 requirements.</td>
</tr>
<tr>
<td>Multi-voting</td>
<td>Quick to complete</td>
<td>Not a rigorous forced comparison.</td>
</tr>
<tr>
<td></td>
<td>For long lists of requirements, works better than Priority Ranking technique.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Introduces some relative rating</td>
<td></td>
</tr>
<tr>
<td>Affinity Diagram Extensions</td>
<td>Constant Sum Scale: Forces some relative rating but not as much as Anchored Scale method.</td>
<td>Since some items may be assigned no points, you can get a very wide variance in response ratings.</td>
</tr>
<tr>
<td></td>
<td>$100/$1000 Distribution: Forces some relative rating. Shows how customers make buying choices.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shows how well suppliers are meeting customer requirements.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tools for forced comparisons between requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Analytical Hierarchy Process (AHP)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forces many specific judgments between customer requirements. Requirements are rated relative to each other. Automatically, importance ratings are expressed as a % or fraction and all total to 100% or 1.0. Software checks for consistency in response ratings. Provides quite discerning importance values.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Software costs about $500. Takes time to learn the software. AHP can be a little tricky to design. If not careful, it asks responders to differentiate beyond their level of patience.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Conjoint Analysis</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forces many specific tradeoffs not only between requirements but at different levels of intensity for each item. Puts the customer in the framework of the actual buying decision. Helps position the product offering in the market place by identifying the right combination and level of product attributes that will sell best at specified prices.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can practically handle only a limited number of customer requirements (e.g., 6 attributes at 3 levels would require 54 cards). Can be quite tricky to design. If not careful, it asks responders to differentiate beyond their level of patience.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This chapter categorized marketing tools depending on their utility in each product development stage in a first part, and in a second part presented more in depth choice modeling tools. The following chapter is entirely devoted to Conjoint Analysis, one of these choice modeling tools, since it was the tool that was primarily used in the pilot projects described in Part II of this thesis.
Chapter 4: A Review of Conjoint Analysis (Choice Modeling)

A tool that has a particular importance in this thesis is conjoint analysis, since it was a first step in trying to develop a tool for interactive market research, more of which will be described in Chapter 5. This chapter explores more in depth conjoint analysis, in terms of its theoretical background.

4.1. What is conjoint Analysis

Conjoint analysis (also called Multi-attribute Utility Analysis) is used to determine what combination of customer requirements (product and service attributes) has the most appeal to targeted customers and, when price is included, what combination of attributes and price will provide the company with the best market share and profitability. The virtue of conjoint is that it asks the consumer to make choices in the same way the consumer presumably does: by trading off features, one against the other.

In essence, conjoint helps compute a utility curve for each customer requirement. A utility curve shows what amount of each customer requirement must be provided to satisfy customers and it also can show when providing more is not better. Therefore, the utility curve provides valuable insight into the return-on-investment for each design improvement effort [18].

Conjoint analysis is utilized to analyze the preference structure of a given subject (e.g., a consumer) with respect to a given object (e.g., a new bicycle). Conjoint analysis assumes that each object under evaluation is composed of several features or attributes (for a bicycle these attributes would be price, color, size). It is important to determine which are the relevant attributes for a product selection (for the bicycle is it size that matters really or weight? Is color more important than shape as an attribute?). It is also assumed that for each attribute one can identify separate levels (for the bicycle price $100, $150, $300; for the bicycle color blue, yellow, green, red; for the bicycle size small or large). The choice attributes are not presented on single attributes alone, one at a time. Conjoint analysis presents choice alternatives between products defined by a specific set of attributes (e.g., do you prefer a small, red bicycle that cost $100 or a large, blue bicycle that costs $300?)

The fundamental concept on which conjoint analysis is based is the possibility to estimate for each customer the utility value associated with each level of each object's attribute, by determining both the relative importance of each attribute as well as which levels of each attribute are the most preferred. This is defined by means of some statistical model (the simplest being the Ordinary Least Square or OLS model) applied to the ratings and/or rankings of the alternative object profiles. The utility function for the product associated with the example described above would be of the form:

\[ U_x = U$100 + U_{red} + U_{large} + \text{constant} \]
In this respect, conjoint analysis results in being a decompositional approach, which differs from a compositional approach in that it is a self-explicated model in which the subject directly indicates the utility value he/she associates to each attribute/level combination.

4.2. What assumptions do you make when you use conjoint?

When using conjoint analysis some assumptions are made that determine whether it is reasonable to use this tool or not. There are some assumptions that govern conjoint analysis and are fundamentally important in its design. The conjoint measurement model assumes that:
- The set of objects being evaluated is at least weakly ordered (may contain ties),
- Each object evaluated may be represented by an additive combination of separate utilities existing for the individual attribute levels, and for each attribute one can identify separate levels
- The derived evaluation model is interval scaled and comes as close as possible to recovering the original rank order [non-metric] or rating [metric] input data.
- These assumptions are derived from the one fundamental assumption, that the attributes are orthogonal and independent, which in reality is not always the case. For predictive validity constraints to be satisfied these assumptions have to be valid.

The product is thus assumed to be defined in terms of a few important characteristics. And it is also assumed that when the consumer makes a decision about which product to choose, the decision is based on tradeoffs among these characteristics. Because the consumer makes the tradeoffs between products, utility score, called part-worths are estimated. Utility scores measure how important is each characteristic to the respondent’s overall preference of a product.

4.3. What conjoint analysis can be used for

A conjoint analysis module is used in order to find out the relative importance of the different key success factors. The use of the conjoint analysis is more important in those cases where the management board does not have a common understanding of these factors. After identifying the company specific key drivers according to the company strategy and mission, conjoint analysis can be used in setting the defined key drivers into the order of importance. The most important key drivers can be taken for sub setting of the questions. [20]

This technique can be used to answer a wide number of questions [21] including:
- What product attributes are important or unimportant to the consumer?
- What product and level attributes are the most or least desirable ones to the consumer?
- Which new products will be successful?
- Which features or attributes of a product or service drive the purchase decision?
- Do specific market segments exist for a product?
- What advertising appeals will be most successful with these segments?
Will changes in product design increase consumer preference and sales?  
What is the optimal price to charge consumers for a product or service? Can price be increased without a significant loss in sales?

Conjoint analysis can be good. But with many attributes, the number of cards can get overwhelming. Using more than 30 cards is not useful. Using more than 6 attributes is also not helpful. Adaptive Conjoint Analysis is a method to address the too many attributes problem. Research shows that where the number of attributes and levels exceed 32 Adaptive Conjoint Analysis is preferred over a full-profile conjoint analysis. Variations to the Adaptive Conjoint include “person in the loop” designs. [23]

Conjoint analysis can also be used for predicting the profitability and/or market share for proposed new product concepts given the current offering of competitors.
- Predicting the impact of new competitor products on profits or market share if we make no change in our competitive position.
- Predicting customer switch rates either from our current products to new products we offer (cannibalism), or from our competitors products to our new products (draw).
- Predicting the differential response of items 1-3 by key market segments purchasing our product.
- Predicting competitive reaction to our strategies of introducing a new product. Specifically, should a new product be introduced, and if so, what is the optimal design configuration for this new product? Further, should pricing or other attributes of our current products be modified in response to the competition).
- Predicting the impact of situational variables on customer preference.
- Predicting the differential response to alternative advertising strategies and/or advertising themes.
- Predicting the customer response to alternative pricing strategies, specific price levels, and proposed price changes.
- Predicting competitive response to distribution strategies studying such diverse problems as determining the optimal channel of distribution, number or type of outlets, vendor selection, or sale person quotas.

4.4. Analyzing the results

Conjoint analysis comes in a variety of forms. Sawtooth Software offers three different conjoint software packages: Adaptive Conjoint Analysis (ACA), Choice-based Conjoint (CBC) and Conjoint Value Analysis (CVA). Each package brings unique advantages to different research situations. [23, 24, 25]

Another widely available package, SPSS, was used as part of this thesis work to analyze the results and to create an analysis tool that would automatically work with engineers to help them deploy a market research effort. The tool description is done in Part II, Chapter 3. In the rest of this section a brief description of the analysis capabilities and methodology used in the automated analysis tool designed for conjoint analysis purposes [26].
The method that SPSS uses is composed of three procedures: Generate Orthogonal Design, Display design and Conjoint Analysis. SPSS uses the full concept approach for conjoint analysis, in which respondents rank alternative products defined by particular levels of all attributes, as for example, continuing the bicycle example of this chapter, the set of cards that would represent possible product alternatives are presented in figure 3. Cards 1 through 9 are the cards necessary for the model to be computed, and cards 10 through 15 are holdout cards, generated by SPSS to test the validity of the test.

The full-concept approach used by SPSS utilizes fractional factorial designs, which present a suitable fraction of all possible alternatives. Fractional design allows for fewer cards to be used and thus the test is less time-consuming, less costly and less fatiguing for the respondent. The respondent is asked to rank, order or score a set of profiles, or cards, according to preference. On each of these profiles all factors of interest are represented and a different combination of factor levels (features) appears. In this way a full concept (that is a complete bike) is described on each profile [27, 28]. The respondent’s task is to rank or score each profile from most to least preferred, most or least likely to purchase, or some form of preference scale. From these rankings or scores conjoint derives utility scores for each factor level, called part-worths and used to find the relative importance of each factor. This can be useful when deciding which combination of factor levels is best for a new product or service and when predicting various outcomes, such as sales [26].

When deciding the possible card combinations, not all combinations can be tested (in the simple bicycle example it would already represent $3 \times 3 \times 2 = 18$ combinations.) Because only a subset of all possible profiles can be used in a test, because of size constraints, an orthogonal array, a subset of all possible alternatives, is used. By using an orthogonal array the part-worths for all the main effects can still be calculated. The orthogonal design assumes that only main effects are considered and interactions are deemed to be negligible. (Here the example is too simple to show the true benefits associated with orthogonal design, but if more attributes were to be considered, 5 for example, the possible cases would rapidly increase $3 \times 3 \times 2 \times 3 \times 2 = 108$ cases.)

![Figure 3: Cards generated by SPSS to represent a certain bicycle configuration.](image-url)
The cards in figure 3 can be translated into cards that the respondents can rank, as shown in table 6 below.

Table 6: Formatted cards generated by SPSS to represent a certain bicycle configuration.

<table>
<thead>
<tr>
<th>Profile</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Color of the Bike blue</td>
</tr>
<tr>
<td></td>
<td>Price of the Bike cheap</td>
</tr>
<tr>
<td></td>
<td>Size of the Bike small</td>
</tr>
<tr>
<td>2</td>
<td>Color of the Bike red</td>
</tr>
<tr>
<td></td>
<td>Price of the Bike expensive</td>
</tr>
<tr>
<td></td>
<td>Size of the Bike tall</td>
</tr>
<tr>
<td>3</td>
<td>Color of the Bike green</td>
</tr>
<tr>
<td></td>
<td>Price of the Bike cheap</td>
</tr>
<tr>
<td></td>
<td>Size of the Bike tall</td>
</tr>
<tr>
<td>4</td>
<td>Color of the Bike red</td>
</tr>
<tr>
<td></td>
<td>Price of the Bike cheap</td>
</tr>
<tr>
<td></td>
<td>Size of the Bike small</td>
</tr>
<tr>
<td>5</td>
<td>Color of the Bike blue</td>
</tr>
<tr>
<td></td>
<td>Price of the Bike average</td>
</tr>
<tr>
<td></td>
<td>Size of the Bike tall</td>
</tr>
<tr>
<td>6</td>
<td>Color of the Bike green</td>
</tr>
<tr>
<td></td>
<td>Price of the Bike expensive</td>
</tr>
<tr>
<td></td>
<td>Size of the Bike small</td>
</tr>
<tr>
<td>7</td>
<td>Color of the Bike red</td>
</tr>
<tr>
<td></td>
<td>Price of the Bike average</td>
</tr>
<tr>
<td></td>
<td>Size of the Bike small</td>
</tr>
<tr>
<td>8</td>
<td>Color of the Bike blue</td>
</tr>
<tr>
<td></td>
<td>Price of the Bike expensive</td>
</tr>
<tr>
<td></td>
<td>Size of the Bike small</td>
</tr>
<tr>
<td>9</td>
<td>Color of the Bike green</td>
</tr>
<tr>
<td></td>
<td>Price of the Bike average</td>
</tr>
<tr>
<td></td>
<td>Size of the Bike small</td>
</tr>
</tbody>
</table>

Each respondent in the study is given a complete set of profiles and is asked to indicate his or her preference for the product. Figure 4 displays the ranking by 10 customers of the cards displayed in table 6.
The conjoint procedure is used to estimate utility scores for each individual respondent and for the whole sample. The results show which combination of features is most preferred, which feature most influences preference for the total product and which is the relative importance of each factor. Since there is typically in between-subject variability, conjoint focuses on single subject results. To generalize the results a random sample from the target population is selected so that group results can be examined [20]. Separate output for each subject and the group is obtained. Figure 5 shows the output for subject 10 as well as the group output for the bicycle example. The output shows the utility (part-worth) scores and their standard error for each factor level. By adding these values the total utility of a specific combination can be computed. For example the average total utility for a tall, green bicycle that costs $100 is:

\[
\text{Utility(tall)} + \text{Utility(green)} + \text{Utility(cheap)} + \text{constant} = .47 + .56 + (-.47) + .627
\]

whereas for a small, blue bicycle that costs $300 is:

\[
(-.40) + (-.475) + (-1.91) + .627
\]

Clearly the first alternative derives an average higher utility for the customers sampled.

By using the importance scores, the total utility of any combination, even ones not rated by subjects, can be predicted.
SUBJECT NAME: 10.00

<table>
<thead>
<tr>
<th>Importance</th>
<th>Utility(s.e.)</th>
<th>Factor</th>
<th>** Reversed (1 reversal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLOR</td>
<td>Color of the Bike</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48.28</td>
<td>-1.0000 (1.7039)</td>
<td>red</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.3333 (1.7039)</td>
<td>green</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.6667 (1.7039)</td>
<td>blue</td>
<td></td>
</tr>
<tr>
<td>SIZE</td>
<td>** Size of the Bike</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.48</td>
<td>-.2500 (1.2780)</td>
<td>small</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.2500 (1.2780)</td>
<td>tall</td>
<td></td>
</tr>
<tr>
<td>PRICE</td>
<td>Price of the Bike</td>
<td></td>
<td></td>
</tr>
<tr>
<td>37.24</td>
<td>-.4286 (.9660)</td>
<td>cheap</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-.8571 (1.9321)</td>
<td>average</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-1.7143 (3.8642)</td>
<td>expensive</td>
<td></td>
</tr>
<tr>
<td>B = -.0857 (.1932)</td>
<td>6.0833 (2.5912)</td>
<td>CONSTANT</td>
<td></td>
</tr>
</tbody>
</table>

Pearson's R = .359  Significance = .1713
Kendall's tau = .222  Significance = .2021
Kendall's tau = .333 for 6 holdouts  Significance = .1738

SUBFILE SUMMARY
Averaged

<table>
<thead>
<tr>
<th>Importance</th>
<th>Utility</th>
<th>Factor</th>
<th>** Reversed (1 reversal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLOR</td>
<td>Color of the Bike</td>
<td></td>
<td></td>
</tr>
<tr>
<td>42.47</td>
<td>-.1667</td>
<td>red</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.5667</td>
<td>green</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-.4000</td>
<td>blue</td>
<td></td>
</tr>
<tr>
<td>SIZE</td>
<td>Size of the Bike</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.23</td>
<td>-.4750</td>
<td>small</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.4750</td>
<td>tall</td>
<td></td>
</tr>
<tr>
<td>PRICE</td>
<td>Price of the Bike</td>
<td></td>
<td></td>
</tr>
<tr>
<td>38.30</td>
<td>-.4786</td>
<td>cheap</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-.9571</td>
<td>average</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-1.9143</td>
<td>expensive</td>
<td></td>
</tr>
<tr>
<td>B = -.0957</td>
<td>6.2750</td>
<td>CONSTANT</td>
<td></td>
</tr>
</tbody>
</table>

Pearson's R = .742  Significance = .0111
Kendall's tau = .479  Significance = .0374
Kendall's tau = .467 for 6 holdouts  Significance = .0942

Figure 5: SPSS output of conjoint results for subject 10 and summary group results.
A method for designing a conjoint test is described in Part II, Chapter 3. For the purposes of this thesis a tool that automatically computes the average utilities of the sampled customers was developed and in the future a tool that uses this analysis in conjunction with DOME will be developed.

This chapter described conjoint analysis and a simple analysis tool that was developed to utilize SPSS analysis capabilities and automate the conjoint test task for product development was mentioned. This tool was not yet tested in a practical application setting and future work will be performed to verify its validity. The following chapter resumes back into the main thread of this thesis, using interactive market research tools for product development, by describing the current state of some of these tools.
Chapter 5: Interactive Market Research Tools

Interactive market research tools have been an object of study for many years both by the academic world and the industry. This chapter describes more in depth some of the newest interactive market research tools that were studied before the pilot studies described in part II of this thesis were deployed.

5.1 Adaptive Surveys

Adaptive surveys are surveys that allow for real-time screening, interactively adapt to responses, and are intuitive, engaging and adaptable. Based on the respondents’ answers the system decides which questions they should answer next. The system can thus check real-time for errors and the data from the survey can be continuously analyzed. Multimedia surveys provide graphic stimuli absent in traditional surveys. The respondents can thus concentrate more and provide higher quality answers than in traditional forms. It was also determined that web-based respondents tend to be more frank than their traditional counterparts (anonymity gradient.) An example of the use of adaptive surveys is described in the next chapter, in the Amway pots and pans example, in Section 6.2.2.

5.2 Adaptive Conjoint Analysis

Adaptive conjoint analysis (ACA) is similar to standard conjoint analysis except the tool “learns” what the respondent likes and dislikes and adjusts the option sets dynamically. The respondents are asked to evaluate bundles of product attributes. ACA limits the number of items the respondent must evaluate by only asking questions to determine new information. ACA helps product designers manage trade-offs and enables projections on price, market share and future profits. Data can be continuously analyzed and refined but this technique is not applicable in analyzing new products. Sawtooth software is the leader in administering ACA in industry. Figure 6, which is an extract from their homepage, describes the differences between ACA and traditional conjoint.
Many of the criteria that govern choice of method are summarized in the table below. We have placed check marks under the product(s) that satisfy each criterion.

<table>
<thead>
<tr>
<th></th>
<th>ACA</th>
<th>CBC</th>
<th>CVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Six or fewer attributes</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>More than six attributes</td>
<td></td>
<td>X</td>
<td>(a)</td>
</tr>
<tr>
<td>More than nine levels per attribute</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computerized questionnaire</td>
<td>X</td>
<td>X</td>
<td>(b)</td>
</tr>
<tr>
<td>Paper questionnaire</td>
<td></td>
<td>X(a)</td>
<td></td>
</tr>
<tr>
<td>Interactions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small sample size</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual-level utilities</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(a) CVA can measure up to 10 attributes, but for most conjoint projects, respondents may not be able to process more than 6 attributes effectively.

(b) When used with CI3.

(c) When used with the CBC Paper-And-Pencil Module.

Figure 6: Comparison of ACA versus other conjoint approaches.

5.3 Lead User Forums

A lead user forum is considered to be any method for bringing Lead Users, experts with a need and an ability to innovate, into the development process. Lead Users are described in more detail in Section 6.1.4. Lead Users are experts in a field with innovative needs and the ability to translate these needs into applications. They are very useful in developing products that address functionally new ideas. By adding lead users to the development process, the development team is enriched with more innovators that are willing to share their breakthroughs. Lead users are not the same as early adopters and they are not necessarily captured by traditional screening methods.

5.4 Virtual Focus Groups

Virtual focus groups are focus groups in which members communicate via the Internet or other virtual media (i.e., video conferencing). This method allows for more diversity within the group since members of the groups need not be in the same location. Providing incentives is essential for maintaining the interest of forum members (e.g., reducing attrition rate). Virtual focus groups can be very cost effective but the role of a moderator becomes all the more difficult.
5.5 Virtual Prototyping

Virtual prototyping is a software-based engineering discipline that entails modeling a mechanical system, simulating and visualizing its 3D motion behavior under real-world operating conditions, and refining/optimizing the design through iterative design studies. Figure 7 depicts a virtual prototype image created by ADAMS software [29].

![Virtual Prototype Image](image)

**Figure 7: A virtual prototype image.**

Using existing Web technologies like 3D VRML and video streaming, simple, realistic prototypes can be created quickly (either by designers or customers) and viewed by a large population. They can be thus evaluated in a cost-efficient manner. Virtual prototypes are orders of magnitude cheaper to build than traditional physical prototypes and they are much easier to adjust as well. In Sections 6.1.2 and 6.1.3 examples of research that tries to allows the customers to modify virtual prototypes is given. Figure 8 is also an extract from Adams software and depicts the list of benefits associated with virtual prototyping models [29, 30].
These virtual prototypes allow for ideas to be tested in parallel. Virtual prototypes are more easily changed to flexibly respond to market and technology shifts. Virtual prototyping use may shorten the product development time.

**5.6 Contextual Inquiry / Empathic Design**

This technique allows gathering, analyzing, and applying information gleaned from observation of users in the field, either live or via videotape. This is a technique for identifying latent customer needs that are currently unsatisfied or satisfied only through less than optimal workarounds. It helps identify triggers for use and unarticulated intangible benefits of the product. This technique requires human reflection and analysis of the results, thus making it difficult to automate the collection and analysis of data. It can be done interactively for certain products and is for example used to track click-stream-data in homepages. This is a very new and uncertain interactive tool overall.
This chapter described some of the newer interactive market research tools: adaptive surveys, adaptive conjoint analysis, lead user forums, virtual focus groups, virtual prototyping, and contextual inquiry/empathic design techniques. The following chapter provides academia and industry examples of what tools are the latest developments in interactive market research. Some examples and their outcomes are also described.
Chapter 6: Best Practices Study for Interactive Marketing Tools

Interactive market research tools have been an object of study for many years both by the academic world and the industry. This chapter is a collection of some prominent examples of successful implementation of interactive market research tools both in academia and industry. This chapter also gives information about some commercial firms specializing in interactive market research tools. 3

6.1 Results of academic research on improving existing market research tools and building multi-tool applications.

In this section the most relevant research in interactive marketing tools is presented. The first piece of research is user design, and the examples here stated are the work performed by Loosschilder in Interactive Concept Testing, the work performed by Van Buiten in user design qualifications and by Ferara in simulation driven mass customization. Then the work of Von Hippel on lead users is presented. Last because of its relevance in the second part of this thesis, the work of Dahan on combining virtual prototyping and conjoint analysis.

6.1.1. The Interactive Concept Test

Loosschilder [31] developed a tool whose aim is to create a framework to assess the product’s attribute acceptance by consumers, especially useful in new product development design. A concept test has two aims: to assess the new product’s market potential and to support development by determining the idea(s) with the best market potential and the optimum product design based on consumer preferences. The interactive concept test (ICT) was developed as an alternative to improve customer use (only 26%) and satisfaction (modest) of concept test testing. A drawback of concept testing is that the respondent’s preferences in the concept test may have little or no predictive validity for future market situations. A concept test might not be able to capture the complexity of the market. If the idea is new to the respondent, he/she should be able to form an adequate mental image of the idea to develop an adequate preference. ICT proposes to alleviate the validity problem by introducing CAD in concept testing methodology.

Loosschilder tried to answer two questions in his thesis:
Thesis question 1: Does the validity of concept testing results improve if a more realistic concept (CAD) is used? ICT allows for flexibility to change a product design on the spot, once visualized by means of CAD, and stored in a database. This should allow the

---

[3] Parts of this chapter research was performed for a project with Nana Admadjaja, Heidi Grenek, Robb Wirthlin and Marc Wohlfarth aimed at evaluating current industry practices, under the supervision of Prof. Ely Dahan at the Sloan school of management. The information presented here was not considered a trade secret by the companies.
respondent to have time to establish an adequate preference, and thus allow to better capture his/her true preferences.

Thesis question II: Does the validity of a concept test improves if an interactive measurement method, such as ICT, is used, allowing the respondent to optimize a concept in accordance with his/hers personal preferences?

The theory around which the ICT was designed is depicted in figure 9, where CAD models are generated using input from sources internal and external to the company. A concept test seems to have a low internal validity (doesn’t measure what it is supposed to) as well as a low external validity (not truly predictive.)

Figure 9: ICT proposes to alleviate the validity problem by introducing CAD in concept testing methodology.

Concept testing refers to consumer research techniques aimed at the collection of consumer evaluations of a new product idea, or its execution by means of a product design. Figure 10 shows the steps of ICT:

- The description of the product’s functionality in response to a consumer need or benefit sought
• An image or a model representing the product design
• A prototype simulating the product’s design or functionality.

ICT is used to assess the market potential, to select and screen a product idea that is mostly likely to be accepted, to explore the relationship between subjective and objective attributes of the product, to test the idea and its execution. The problem comes from a lack of realism attributed to concept tests.

![Diagram](image)

**Figure 10: Design synthesis of ICT.**

In concept testing it is assumed that the respondent’s experience with the concept is more similar with his/her experience with the product. With a realistic concept, it is assumed that it is easier to understand the product’s functionality or to grasp its future benefits in the future purchase and usage situation. This should make it easier to develop a valid mental image of the new product’s design.

At the concept stage it is often not possible to give consumers the same amount of information as in later stages of design, either because the product design is not yet available or because the degree of realism is simply not the same as a true physical prototype. Concept tests provide a verbal description, a pictorial representation and a model. One can show the product in a normal purchase situation. Additionally information can be provided using geometry: in terms of primitive forms; material Characteristics and graphic details: colors and more complex impressions; rapid Prototyping: physical prototype; simulation: multimedia enhancements; animation: realistic multimedia animation

This helps provide for additional external validity that would be lost should you separate the product from its natural, sub-cultural environment.
It would be ideal to make the concept test virtually indistinguishable from the final product. It is best to aim for as much realism as possible within reasonable cost levels (software, resources, etc.). The degree of realism should depend on the amount of information available on the new product: early in the process main decisions are made on the product's specifications, performance characteristics, price points and presence of certain functions and features. The degree of realism should fit the purpose of the test: if input is needed on only a few details it is not necessary to represent the product as a whole. (Note: focus troupes might be a good way of representing functionality.) Unnecessary costs should be avoided.

ICT is interactive because it provides the respondent with feedback on the design and price consequences of the attribute level change. To make an informed decision, one should inspect the options that are available. ICT provides more accurate precise feedback. These are the assumptions and benefits of ICT summarized:

Assumptions of ICT:
- The number of attributes is large enough that the respondent can find the truly preferred design.
- The task is motivating enough so that the respondent will process as many design alternatives as is necessary to find the truly preferred design.
- The feedback on the design and price consequences is pertinent in the respondent's search process.
- The respondent will explicitly trade off the change of an attribute level against the change of the product's price and design consequences.

Benefits of ICT:
- ICT uses flexibility of CAD systems to make variations on product design. Respondents design product according to their preferences.
- ICT is most similar to a feature modeler.
- In ICT all possible design and the design parameters that can vary are well defined.
- Respondents can form their preferences within the design choices available in ICT.
- Conjoint analysis brings out inferred preferences. ICT collects stated preferences.
- ICT provides enough design options to cover a broad enough level of changes, so that the respondent can find his/hers best option.
- The respondent decides how much information is necessary to form his/hers preference.
- ICT does not need to assume that utilities associated with the product's attribute levels are independent and that the product total utility can be computed using a summation of the part worth utilities.
- No assumptions are needed about the level of interactions.

Concept tests are important in order to inform about the validity of the product idea, to select the best product idea from a set and to support the optimization of an idea in the direction of market demand. ICT improves the performance by increasing the realism of the representation.
6.1.2. Simulation Driven Mass Customization

Ferara [32] developed a tool in his thesis for simulation driven mass customization. He used the Distributed Object-based Modeling Environment (DOME), an integrated modeling environment developed at MIT and build a framework using product design simulations as the basis for product configurators. Ferara created a richer form of mass customization, continuous mass customization: rather than choosing from a predetermined lists of options, customers have the ability to make continuous changes to a product's configuration. The product design simulations used in the configurator also provide the customer with real-time performance predictions of the current configuration.

A product configurator, depicted in figure 11, for a road bicycle was implemented as an internal pilot project to demonstrate the proposed concepts. DOME was used in the construction of an integrated product model.

Figure 11: Advanced configurator screenshot.

The RealityWave viewer allows the user to examine a three-dimensional model of the current configuration.

The power simulation estimates the amount of power required from the user in different situations.
6.1.3. Customer Participation in conceptual design

Van Buiten [22] performed research to discover how the customer can be allowed to participate better in the conceptual design of new product (figure 12). Using the customer during conceptual design allows the fuzzy front end to be less fuzzy. Van Buiten wrote, "The new product development success can be correlated with a firm’s ability to understand user needs. Interestingly, this research also shows that new product development success can be correlated to the firm’s ability to translate customer needs into technical specifications."

![Figure 12: Product simulations in Van Buiten's thesis.](image)

Six principles were established that should be included in any user based design experience.

- Get the customer involved in product and service development as early as possible and at all subsequent stages.
- Encourage customers to focus on what is wanted rather than what is not wanted.
- Encourage customers to think beyond what is currently available by focusing on what they would like ideally (starting from a clean slate).
- Get customers to go beyond simply telling what they would like by involving them in designing the product or service.
- Encourage customers not to worry about likelihood of implementation (feasibility) but to be concerned with durability.
- Probe for the reasons why consumers want what they want.

Van Buiten emphasizes the importance of realizing that not all customers are alike. The skill levels a customer brings are particularly differentiated. Therefore, the design process must be somehow scaleable to take that into account (not to overload some customers or totally bore others). Other ways must be found to overcome the “sticky” knowledge that exists in the minds of both the user and developer.

Customers are motivated for different things. There may need to be some incentives in place for a customer to use an Internet web site for user based design. This is also scaleable according to the time required to participate in the design process as well as the difficulty. Recall, the motivation for a user to use the Internet might be much greater as
they realize that their inputs have the potential to greatly influence the outcomes. This is not so in high volume, commodity type markets.

Advantages and disadvantages of Internet based consumer research:

**Advantages**
- Low cost access to large numbers of customers
- Global access to customers
- Forces feedback/communication/data capture
- Data capture infrastructure exists with servers
- Demographics of users
- Speed
- Customer convenience
- Computational/database format
- Corporate image; integration with existing customer interface
- Easy to use/friendly, familiar interface

**Disadvantages:**
- Demographics of users/availability
- Current bandwidth limitations
- System robustness

The internet is most helpful because of its ability to receive feedback from the user as well as the lower costs (i.e., the initial cost of developing the survey, database, etc., plus maintenance fees of a website, versus the costs of focus groups, paper surveys, etc.)

Therefore a customer based design tool has the following requirements:
- Is usable by the customer with little training or transition time
- Permits capture of the 'whys' as well as the 'whats'
- Provides as close to idealized conceptual design point
- Its utility functions are choice based or self-explained
- Provides with constraints
- Facilitates/encourages iterations by customer
- Is highly portable
- Is internationally usable (language, equipment, browser)
- Can be used by a customer alone or can be used with a designer and customer together
- Encourages continued feedback/dialog
- Includes and tracks all driving constraints
- Facilitates archiving and recalling of data
- Enables simultaneous, multi-user capability
- Integrates other marketing research tools

Using the collected data you can develop 'radar' charts that show the outcomes of the different attributes according to the analysis. This can further be refined into distributions of customer design selections along the different attribute selections. Doing
this would allow for product segmentation opportunities. Other concept selection techniques can also be used at this point, like Pugh selection, where the best of the different concept features are trying to be combined.

In one experience, when foreign military users were asked about their intentions, they were told that their plans were in the conceptual phase. After a few minutes exposure to the physical method after which Van Buiten’s internet idea is modeled, these officers, by moving 'building blocks' around, “conceptually” designed several different helicopters and variants thereof in less than eight hours (a process which normally would have taken months). Engineers and designers who were in the room with the officers captured these different design requirements. Van Buiten’s application allows for the same thing to occur without needing physical models and representations to play with or having several engineers and designers at the same place. Designs and other representations can occur at any time, and are recorded for later analysis by the company’s designers and engineers.

6.1.4. Lead Users at 3M

In order to innovate in a product area, Von Hippel and Sonnack[33] argue that designers should seek out “lead users.” These lead users allow a company to find radically new applications for existing products or breakthrough innovations that lead to new products at a fraction of the normal development cost. Lead users are typically people on the very edge of the customer group and occasionally completely outside the group who have developed their own solution to a problem that a product could solve. They can share their knowledge with designers but locating these users can be a challenge.

Lead user processes have been used for several years at a number of 3M’s 55 divisions to develop breakthrough product ideas and address the “unarticulated needs” of customers. Previous research by Von Hippel has uncovered that many commercially important products trace their source of innovation to product users at the “bleeding edge” of a field – lead users – rather than manufacturers, particularly for products that addressed functionally different needs rather than simply improving on a known problem. These lead users have strong incentive to innovate because they are ahead of the normal target market with respect to one or more important trends. Since they are often generating product ideas on their own, the real task is for manufacturers to seek out and learn from these lead users. One additional reason lead users can be better than in-house product developers is that there are simply more of them with more varied backgrounds, leading to a greater probability for breakthrough insights.

An example of lead users is described by Professor Von Hippel: Sony recently set up a website to support computer hacker-users interested in developing and playing games on Sony Playstation. They quickly attracted 10,000 active participants. This is compared to 100 in-house and contract game developers.

There are two key aspects to tapping into lead users: locating them and working with them to transform their ideas into useful insights for product teams. Locating is critical because this is a non-uniformly distributed population. Screening surveys are not
efficient. The answer is networking: people with a serious interest in an area tend to know people who know even more about it than they do – the people they turn to for advice. 3M uses telephone interviews to track along that network until they reach the lead users. The desired outcome is achieved when reaching what seems to be the end of the network, the ultimate specialists in that field that can often lead to people from a different industry who are working on similar ideas.

As for transforming their insights, 3M has found that lead users are usually very willing to share their product ideas, almost always for free. This is because the knowledge is usually of little commercial value to them and would be costly to protect anyway. 3M conducts interviews and brings small groups (6-8) to 2-3 day problem-solving workshops with members of the product development team.

Finally, a word of caution is needed. Lead users are not the same as early adopters of today’s products. If designers are not looking for true lead users and not setting ambitious goals for product development (cannot be incremental improvement) they may be disappointed in the results.

Although 3M has significantly reduced its product development cycle by using lead users, it has not yet embraced internet-based interactive methods to locate and use additional Lead Users. It is not known if 3M has any plans to move into the internet area. Internet interactivity seems a logical extension of 3M's efforts with Lead Users.

6.1.5. Combining Adaptive Conjoint with Virtual Prototyping

Dahan’s and Srinivasan [34] evaluate an interactive application that combines adaptive conjoint analysis and virtual prototyping. The research goal was to explore how companies can integrate product design, marketing and manufacturing. This happens through a modeling of tradeoffs between customer preferences and company costs and competencies. The techniques used here are aimed at evaluating parallel versus sequential prototyping.

Dahan and Srinivasan write, “We measure the predictive accuracy of Internet-based product concept testing that incorporates virtual prototypes of new products. The method employs a two-factor conjoint analysis of prototypes and prices to enable a design team to select the best of several new concepts within a product category. Our results indicate that virtual prototypes on the Web provide nearly the same results as physical prototypes. As virtual prototypes cost considerably less to build and test than their physical counterparts, design teams using Internet-based product concept research can afford to explore a much larger number of concepts. In short, the Web can help to reduce the uncertainty and cost of new product introductions by allowing more ideas to be concept tested in parallel.”

The virtual experiment closely matched the actual performance of those products in the marketplace. This experiment validated the use of the Internet, and specifically the Web, as an acceptable means of doing market research, concept testing, and iterative design.
6.2 Industry Examples

A few companies are already employing integrated interactive market research techniques in their design and delivery process. The four examples described in this chapter highlight the potential power of interactive market research.

6.2.1. Texas Instruments

One of the first examples in industry of using interactive market research tools was the TI92, at Texas Instruments, which was designed through interaction on the World Wide Web (figure 13).

Ralph Olivia, now at Penn State University, in a phone interview described how this process occurred at Texas Instruments while he was in charge of the web practice there:

"The process began in 1995 soon after the TI web site was established. The TI-92 was in the early design phase. The lead designer was relatively new to TI and this was his first design project. The nature of the design was to develop a calculator design that teachers would want to use as well as students.

"He was somewhat familiar with the Internet and began looking on Internet chat rooms and AOL chat rooms for information about teachers and use of calculators in the classroom. He wanted to use this information to help define the design. He came across several that were devoted to teachers and integrating/using calculators in the curriculum. After spending some time observing the dialogue, he decided upon several product features that would be essential. The goal of this design was to please teachers as well as students. The product features were: the calculator had to be small but yet be capable of graphic displays; it had to be inexpensive; and students needed to be able to manipulate formulas in a way to see how changing one item of a mathematical expression would affect the outcome (i.e. it would allow students to experiment and better understand mathematical expressions)."
"One day he sketched a conceptual drawing of a calculator that tried to do all of the above. He posted it on the TI web site and then went to the chat rooms and asked the teachers that were logged into the site to go to the TI web site and give him some feedback.

"What happened next was phenomenal! He received all kinds of emails that were very explicit in what was right, wrong, and/or needed to be changed. They made recommendations about everything, including the color, key locations, screen size and placement, and functions that needed to be included and why.

"He would get responses, sketch out a new concept, re-post it on the web, and inform users of the chat rooms that a new one was online. Unfortunately, there are no concrete numbers of the number of iterations that occurred. However, as the emails became less dynamic and more cosmetic in nature, the design concept was frozen and development really began.

"What were the outcomes of this new way of designing a product?
- It reduced cycle time by orders of magnitude.
- It cut down the need to do customer sampling (i.e. prototyping - alpha & beta testing).
- State governments and school districts across the country were willing to purchase the calculator without the usual testing of concepts (they relied upon the set of specifications and the manner in which it was developed).

"The market share numbers (again in the business to business market of which school districts and other government agencies are considered a part) were unbelievable. They had a lock on the market. TI’s numbers were so great, for the first few months, they didn’t believe the numbers at all, and to this day, these numbers are considered ‘proprietary’ and may not be divulged.

"The aftermath is informative as well. The designer of the product was nearly canned because he posted these things to the ‘unsecured’ web without consulting management. (In fact, when briefing management about the success of the TI-92 product, the IT folks were wary of what was presented to management, and only with reluctance and very sanitized briefing charts, were any presentations made.)

"TI now hosts their own chat site, and can be commended, as they do not censor it. This provides a wealth of information to the current perceptions, gripes, and complaints with their products. It is also teaching them about product platforms and the transitions to newer, updated products, as customers are giving them real-time feedback."

This example is one of the most successful first uses of interactive market research tools in industry. The outcome was that there was incredible market loyalty and word-of-mouth about the calculator. The on-line market considered this calculator to be ‘their’ machine. They owned the product. In fact, when other calculators entered the market with the same features or more at a lower price, the on-line market was offended and became more entrenched in their devotion to the TI-92 calculator.
Amway Queen/Gourmet Cookware is a Gold Standard business that has been in the Hometech line for more than 30 years. Over the past several years, competition in both retail and direct sales has closed the gap in the competitive edge Amway once had, eroding its exclusivity and differentiation claims. As a result, Amway, in cooperation with the cookware manufacturer Regal Ware and a design firm (Fitch), undertook a study of its cookware to explore ways to improve the product and provide Amway Queen/Gourmet Cookware with effective sales messages, aesthetics and/or technology design qualities.

The study described here resulted in several design concepts that were evaluated in distributor focus groups in four markets - US, Japan, Taiwan and Germany. Based on these results, the team further narrowed the design concepts to one overall cookware body design with two redesigned handle/knob options. Wirthlin Worldwide, a leading research-based consulting firm, conducted the necessary research. This example is described as reported by the owner of Wirthlin Worldwide.

Figure 14: The study of cookware designed by Wirthlin Worldwide.

Two cookware design options were presented to an audience of direct and non-direct distributors for preference evaluation (figure 14). The goal of that research was to determine the overall redesign concept evaluation (design acceptability, purchase interest, concerns, suggested improvements, etc.); handle/lid knob option preference and reasons for preference; lid knob logo treatment preference and reasons for preference. The question remained: should Amway replace the current design with this new design?

The sample sizes aimed to have 100 Direct Distributors, 50 merchandisers of current Queen Cookware (likely to also be owners), 50 non-merchandisers of Queen Cookware
(could be owners or non-owners), 200 Non-Direct Distributors, 100 owners of Queen Cookware, 100 non-owners of Queen Cookware

The internet was used for data collection and the form of this data collection was a simple non-adaptive survey with four parts. The reasons Wirthlin choose to use the Internet for this survey include the facts that this method: is cost and time-efficient; incorporates the graphics and colors of the Queen Cookware concepts with ease; controls the order in which the concepts are viewed and how they are displayed; rotates the concepts such that the respondent gets them at random, which improves the assessments in that any order effect is eliminated; conducts the survey quickly and efficiently. Data processing becomes faster and less costly than in other survey methods; shows progress dynamically, incorporating changes in the reports as they happen.

The outcome of this study was that Amway used the Internet based design option to facilitate interaction between Fitch, Regalware, and their distributors/customers. This was one of the first examples of using very sophisticated adaptive surveys over the internet.

6.2.3. Mattel – Barbie.com (MyDesign)

This next example is of Mattel, who has designed a site that allows a pseudo user-based design. Customers are given the option of creating a 'friend' for Barbie. They are able to pick the doll's skin tone, hair color, eyes, and hairstyle. Next, they select clothes style and accessories, as well as a personality for the doll.

This is not a true user-based design, but rather option selection. However, by being able to select options, customers think they are part of the design process. This is similar to HP's method of post-production customization (i.e., putting in the right power supply for the appropriate part of the world).

Figure 15 shows an example of a doll created at this site and the accompanying text of the site is included below.

"Presenting Robin, specially made for Maria by the makers of Barbie® doll! Robin has sparkling brown eyes and wavy dark brown hair. She is wearing her new Cool Stripes Outfit with extra City Shopper accessories. Her birthday is in August. She lives in the mountains and spends a lot of time at home. She's interested in music, loves to help others and enjoys being with her husband. Robin is a special friend of Barbie, personalized for you, Robin, from Maria!"

Figure 15: The example of a doll created at the Mattel site using a commercial application of user design.
Mattel has enabled customers to personalize their dolls. Mattel could take this process further by allowing additional customization (i.e., fill in the blank forms), and also by asking for feedback on the options that are currently available. They could also become more sophisticated in the options offered by asking a few simple demographic questions (i.e., an on-line adaptive conjoint analysis, for example) that would present the user with options that would most likely appeal to them. This could drive further sales, since two or three dolls would need to be purchased in order for the user to get all of the satisfaction that was possible.

This is the example of the limit of where market research is currently envisionable as far as user design is concerned. Technical limitations, that are discussed in more detail in Ferara’s thesis, will prove the adoption of the technique not yet foreseeable in the near future.

6.3 Commercial Firms Specializing in the administration of interactive market research tools.

This list, while far from exhaustive, describes a few companies that are doing innovative work in fields related to the method we have described.


Greenfield Online is an Internet-based marketing research firm. They seek answers to important business questions using valid research methodologies and innovative technologies. They offer custom and syndicated research, Internet-based focus groups and idea-generation.


Socratic Technology is a full-service research agency specializing in computer-based and interactive research techniques. The methods that they employ range from quantitative and qualitative research to usability testing and beta-testing. They maintain a base of 12,000 customers that they incentivize to participate in their market studies.

6.3.3. Wirthlin Worldwide - [http://www.wirthlin.com](http://www.wirthlin.com)

Wirthlin Worldwide is a leading opinion research and strategic consulting firm. They offer a complete range of traditional opinion research services (telephone surveys, focus groups, in-depth interviews, etc.) as well as proprietary research techniques. A sample survey is posted online at: [http://www.wirthlin.com/aapor/surfram1.htm](http://www.wirthlin.com/aapor/surfram1.htm)
The purpose of this thesis is to bridge academic market research with industrial applications in an effort to ameliorate industry practices. This first part of the thesis was mostly concerned with exploring the tools available for market research in product development. The second part of this thesis is an attempt to carry over the tools here described to industry through pilot product efforts.
PART II: Implementing Interactive Market Research Tools in Industry
This second part of the thesis is concerned with more practical applications of interactive market research tools.

**Chapter 1: Interactive Market Research Tools: Past, Present and Future**

In order to further the current development of interactive market research tools, combinations of these tools can feasibly be used in industry. This chapter describes and evaluates interactive market research tools and proposes tool combinations that can be deployed in order to improve the product design and development processes. These tools could have a significant payoff in terms of reduced cost, improved time to market, better predictability of market success, and breakthrough innovation.  

In this chapter a process is developed that combines current market research tools and interactive technologies in new ways to deliver innovative marketing applications for input into the product development process. The tools are evaluated against a set of important criteria using a Pugh chart. This evaluation can be used to help a market researcher select tools that are appropriate to his or her objective and the stage of the development process the product is in. Small sets of combined applications that complement each other and can be deployed concurrently are also explained. In addition a list of interactive delivery mechanisms that can be used to deploy these integrated applications was generated. Finally, several ways for the market researcher to identify and target respondents for the study are highlighted. By balancing the selection of applications, delivery mechanisms, and target groups against the researcher’s objectives, an innovative and economical market research plan can be formulated.

First the method for evaluating the tools can be described in four sections covering each of the elements needed to use current market research tools and existing technology to improve the product design and development process:

1. **Evaluation and Selection Process** for current interactive market research tools
2. **Options for Integration** of those tools into a coordinated product design and development application
3. **Delivery Mechanisms** for using those tools in the field
4. **Target Groups** for any applications developed

1.1 **Evaluation and Selection Process**

Advances in technology have ushered significant changes in the field of market research. Many market research techniques are currently making the transition from traditional to cutting edge, making a more interactive approach to market research possible. Since each market research tool is making the transition from traditional to interactive at a different

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4 This chapter is the outcome of a project performed with Nana Admadjaja, Heidi M. Grenek, Robb Wirthlin and Mark Wohlfarth aimed at creating a framework for understanding and evaluating current industry practices.
pace, some tools are more sophisticated than others. This chapter is concerned solely with
the current state of each tool by considering the tool's level of interactivity based on
information on current practices, as depicted in figure 16.

**Market Research Tools**

![Figure 16: How traditional tools can be linked with future progress in marketing research.](image)

To help determine the characteristics of each market research tool, a Pugh chart was
used: the best results could be obtained by developing a robust chart that encompasses a
comprehensive list of criteria. This is only a preliminary evaluation of current tools. The
columns of the Pugh chart list the market research tools that are currently making the
transition to interactive; the rows list criteria that we feel a consultant to a product design
and development process would want an application involving these tools to fulfill. The
Pugh chart is depicted in figure 17.

**Columns: Interactive Market Research Tools**
- *Adaptive Survey:* Surveys that allow for real-time screening, interactively adapt to
  responses, and are intuitive, engaging and adaptable.
- *Adaptive Conjoint Analysis:* Similar to standard conjoint analysis except the tool
  "learns" what the respondent likes and dislikes and adjusts the option sets dynamically.
- *Lead User Forums:* Any method for bringing Lead Users, experts with a need and an
  ability to innovate, into the development process.
- *Virtual Focus Groups:* Focus groups in which members communicate via the Internet
  or other virtual media (i.e., video conferencing).
- *Virtual Prototyping:* Using existing Web technologies like 3D VRML and video
  streaming, simple, realistic prototypes can be created quickly and viewed by a large
  population.
- *Contextual Inquiry / Empathic Design:* Gathering, analyzing, and applying
  information gleaned from observation of users in the field, either live or via videotape.

**Rows: Criteria for applications involving these tools**
- *Cheap to Design:* Measured in terms of labor and infrastructure.
- *Cheap to Implement:* Measured in terms of labor and infrastructure.
- *Easy to Implement Technically:* What level of expertise is needed to implement the
  application and how novel the base technologies are.
- *Fast Cycle Time:* The time between initiation of market research and compilation of
  usable data.
- *Easy to Upgrade:* The degree of ease in upgrading the tool for a different product or
  area of research.
- *Continuous Data Flow:* The degree to which the tool is capable of providing a
  continuous stream of valid data to the product design and development teams.
• **High Statistical Accuracy**: The extent to which the tool promotes accurate representative data of the market segment being evaluated.

• **Repeatability**: The extent to which the tool provides a comparable answer when administered more than one time.

• **Easy to Analyze**: The extent to which the output of the tool is clear and easy to use for the product design and development team.

• **Elicits User Needs**: The extent to which the tool detects, defines, and quantifies relevant user needs.

• **Efficient Product Development**: The extent to which the tool leads to efficient product development.

• **High User Attractiveness**: The extent to which the tool attracts user's attention and concentration.

• **High User Friendliness**: The extent to which the user can intuitively use the tool.

An adaptive Survey was used as the reference point because adaptive surveys are among the most widely used interactive market research tools today.

Using standard Pugh notation, the (Datum) sign under the Adaptive Survey column suggests that it is the reference point for other tools. A (S) suggests that the correlation between the tool and the criterion that intersect in the marked box is approximately close to the correlation between that criterion and adaptive survey. A (+) reflects a higher correlation of the market research tool and criterion that intersect in the marked box, whereas a (-) reflects a more negative correlation.

Pugh charts provide only qualitative measures, so this chart should not be used in a mechanistic manner. However, by considering the number and position of (S), (-), and (+) signs, a user can evaluate which tool(s) to use, both independently and in conjunction with other tools based on his specific criteria.

One additional note of caution: interactive market research is a dynamic field that is still evolving. This Pugh chart provides a snapshot of the present state of interactivity of each market research tool listed and is by no means the final answer to the question of perfect market research. The Pugh chart, however, is flexible in that it can continuously be built upon and extended to accommodate future needs.
1.2 Options for Integration

There are multiple applications that can be developed from combinations of these tools. However, for any specific set of criteria or stage of the product design and development process, some tools and combinations will clearly be more effective. Some of the tools can be combined. Different tools are effective in different stages of the product development phase. The listing below is a description of these tool combinations.

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**Figure 17: Pugh Chart of Interactive Market Research Tools**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Adaptive</th>
<th>Conjoint</th>
<th>Lead User</th>
<th>Virtual</th>
<th>Virtual</th>
<th>Contextual</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surveys</td>
<td>Analysis</td>
<td>Forums</td>
<td>Focus</td>
<td>Prototyping</td>
<td>Inquiry / Empathic Design</td>
</tr>
<tr>
<td>Cheap to Design</td>
<td>Datum</td>
<td>S</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Cheap to Implement</td>
<td>Datum</td>
<td>S</td>
<td>-</td>
<td>-</td>
<td>S</td>
<td>-</td>
</tr>
<tr>
<td>Easy to implement technically</td>
<td>Datum</td>
<td>S</td>
<td>-</td>
<td>S</td>
<td>+</td>
<td>S</td>
</tr>
<tr>
<td>Fast cycle time</td>
<td>Datum</td>
<td>S</td>
<td>-</td>
<td>+</td>
<td>S</td>
<td>-</td>
</tr>
<tr>
<td>Easy to upgrade</td>
<td>Datum</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>S</td>
<td>-</td>
</tr>
<tr>
<td>Continuous Data Flow</td>
<td>Datum</td>
<td>S</td>
<td>-</td>
<td>-</td>
<td>S</td>
<td>-</td>
</tr>
<tr>
<td>High Statistical Accuracy</td>
<td>Datum</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>S</td>
<td>-</td>
</tr>
<tr>
<td>Repeatability</td>
<td>Datum</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Easy to Analyze</td>
<td>Datum</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Elicits user needs</td>
<td>Datum</td>
<td>+</td>
<td>+</td>
<td>S</td>
<td>S</td>
<td>+</td>
</tr>
<tr>
<td>Efficient product development</td>
<td>Datum</td>
<td>S</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>High user attractiveness</td>
<td>Datum</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>S</td>
</tr>
<tr>
<td>High user friendliness</td>
<td>Datum</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>$\Sigma+$</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
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<td>$\Sigma-$</td>
<td>2</td>
<td>9</td>
<td>7</td>
<td>3</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>$\Sigma$ same</td>
<td>6</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
• **Lead User Forums + Virtual Prototyping**
  Lead users use virtual prototyping tools to build their own solutions. This method is ideal for identifying “breakthrough” new product concepts.  
  *This would be best applied in early conceptual work when the market is still unknown.*

• **Adaptive Conjoint Analysis + Virtual Prototyping**
  By showing respondents virtual prototypes as they are completing the conjoint analysis, they are able to better conceptualize and evaluate product concepts. Furthermore, this extends the capability of conjoint analysis to testing breakthrough products since respondents can get some “experience” with the product before evaluating it. (Note that standard conjoint analysis is not suited for breakthrough products because respondents need to have some familiarity with the concept before being able to evaluate it accurately).  
  *This would be best applied when the market is known but the product still needs to be defined.*

• **Adaptive Conjoint Analysis followed by a smart survey (with or without virtual prototyping)**
  Using the results of a conjoint analysis, the team can automatically administer a “smart survey” that “drills down” into specific conjoint results. For example, if the conjoint analysis identifies that the product should be “blue”, probe that result to find out why “blue” is so important. Is it because it matches the interior decorating of the intended location for the product? Or is it because the color blue relays a certain perception (i.e. cool, serene, etc.)? The smart survey portion of the application can be particularly effective at exploring apparently anomalous results. Respondents’ answers can be tested to see if there is a real reason behind unusual responses or whether they merely misunderstood the question.  
  *This would be best applied when the product attributes are still being defined.*

• **Adaptive Survey + Conjoint Analysis**
  This tool combines a market segmentation survey with a product-specific adaptive conjoint analysis in order to assist in planning product positioning and cross-segment marketing. This technique allows for validation of market segment assumptions and identifies the set of product attributes that appeals to the broadest market segment. It also can help to predict market share and determine appropriate pricing.  
  *This would be best used to determine tradeoffs between attributes.*

• **Online Focus Groups + Virtual Prototyping**
  This is a tool for facilitating moderated online focus group discussions by showing virtual prototypes and soliciting reactions to the concepts. The focus group may even be able to “modify” the virtual prototypes and send the results back to the product development team, especially for incremental product improvements. This method is lower cost than traditional focus groups and is perceived to be more “fun” by
respondents. Furthermore, studies have shown that by having customers participate in the product design and development process through prototyping, they become “invested” in the product’s success. As a result, they not only become product advocates, but they also are reluctant to switch to other manufacturer’s products, even if they are superior.

This method can be used at all stages of the product development

1.3 Delivery Mechanisms

There are four basic mechanisms for delivering these applications to customers to effectively gather interactive market research data. Like the applications themselves, each mechanism is better suited to particular criteria and target problems.

1. Mail – Expensive and slow but proven to significantly increase response rates and the only practical method for delivering physical prototypes or “look and feel” elements to the home.
2. Email – Fast response and also permits conjoint analysis.
3. Website – Either as an anonymous site or linked to a corporate site, websites are cheap to implement and update but provide little control over number and type of respondents.
4. Kiosks – Located in retailers, kiosks have high fixed and start-up costs but provide control of the technology and opportunity to combine all the major tools, including potentially empathic design.

1.4 Target Groups

The final stage of this method is to map the integrated applications and delivery mechanisms to the appropriate target group. Of course, there is no one-to-one correspondence between a particular application and a target group. Quite often, firms will want to target more than one of these groups with the same application to get a fuller picture of the market and different types of feedback.

There are four basic target groups for integrated interactive market research applications, even though these groups are only a small portion of the market:

1. Current Shoppers – Customers who are already in the market for a product could be easily attracted to an in-store kiosk that allows them to design the next generation of that product range. In return for their input on a survey, conjoint and virtual prototyping exercise, customers would receive a coupon for immediate use at that store.
2. Beta-type Groups – Pre-qualified, motivated users, such as the groups market survey companies like Socratic Technology have set up, can provide statistically accurate and segmentable data on an exhaustive range of current product ideas.
3. Internet Help Desk Users – Current customers can be given an opportunity to provide feedback on their experience with the product and suggests improvements after accessing the company’s internet help desk.
4. *Web Surfers* – Although this group will likely differ significantly from the average customer and the data they provide will be affected by selection bias and other distortions (including competitors polluting the data), reaching out to web surfers for innovative product development ideas provides an opportunity to vastly expand the range of creative ideas at the front end of the development process.

In this chapter some tool suggestions were made capitalizing on the benefits each interactive marketing tool presented here currently has. What is though important when designing such tools is to deploy them in an industrial setting and to evaluate their performance. The following two chapters describe two such pilot projects, their outcome and lessons learned.
Chapter 2: Use of interactive market research tools to gather customer feedback pertaining to issues relevant to the early phases of design: lessons learned from practice.

2.1. Introduction and Objectives

A company, referred to as Nampco here, initiated a collaboration with MIT through CIPD, in a project aimed to introduce Nampco to new marketing techniques that could be used in conjunction with product development to quickly gather accurate and directly useable customer input in the early phases of design. The challenge is to develop an interactive design process where customer and target groups contribute to product development.5

This chapter describes the projects and the issues that were faced during development of the tools, implementation details and data analysis. Finally a vision of future applications is proposed.

2.2. Objective of the pilot

The goal was to run a pilot program that introduces web based tools for doing market research at Nampco. These tools were aimed at shortening iteration time for each market research cycle. This would allow the marketing results to be integrated back into the design of products at an early stage, where the results would still have an effect on the design.

The pilots would also allow testing the transferability of the tools developed at MIT into an industry application. This would give a basis for innovation in order to create templates for multiple tools that would incorporate innovative approaches to market research. Also this would create a working relationship between MIT and Nampco as part of the CIPD program.

2.3. Project Candidates Description

Several candidate projects were evaluated at different stages of the product development process. Because most of the information is considered proprietary it is omitted from this thesis. Two pilots were initiated with products at different stages of the development

5 Summary and Results from the Nampco pilot project, which was a joint effort between Nampco (initiated by Brendan Gnall) and the Center for Innovative Product Development (CIPD) at MIT. Work performed by Professors Ely Dahan of the Marketing group at the Sloan School of Management, and Dave Wallace of the Mechanical Engineering Department.
process. Pilot 1 was in the Detailed Development Phase. Pilot 2 was in the Concept Development Phase.

Pilot 1 – This project was the one selected and the tool description is included in the following sections.

Pilot 2 – A more detailed description of the product is given in the next chapter.

2.4. Tool Description

A brief, general description of the tools developed for Pilot Project 1 is provided in this section.

The respondents first receive instructions about what questions they will be getting and what will be expected from them in the duration of this exercise.

The respondents are then prompted to answer some simple questions ranking the importance of certain features in their decision making process. This will allow to weight correctly the importance of the feedback that will be received from this study. Also in the future, this ranking could be used to prompt the respondents to only the questions that are relevant to them.

The respondents in the next page use the drag and drop concept. Respondents can drag the elements they want to have on the finisher and they can observe the price changing. Also there are pop-up windows that explain each element.

The respondents then can play sliding the $10 bill up and down. This would give them a signal that depending on the accuracy they require they will be asked to pay more. Hopefully they will give us the maximum front to back registration that they are willing to comply with.

Last, the respondents go through a short version of a conjoint analysis that would determine the optimal combination of product options for them.

The specific goals for the research as communicated to Socratic, the firm that would collect the respondents were: (inconsistent list formatting)

- understand how trade-offs are made during the purchasing process;
- determine how the pricing of functional modules affects purchase decision;
- gather customer input through user design and feedback to the design process;
- ascertain differences between product decision makers in their receptiveness;
- assess how selected functionality and fully integrated multi-functional product requirements affect purchase decision;
- gauge the importance of specific product attributes;
- estimate market demand for specific product features; and
- collect demographic/firmographic information and analyze the results based on these data.
The recommended sample for this study would include respondents recruited specifically for this project as follows:
1. Environment 1
2. Environment 2

All potential respondents will be sole or primary decision-makers or have strong influence over the addition or replacement of these items.

2.5. Implementation

2.5.1. Customer Databases

Nampco was able to provide a list of possible participants in each case that included for each participant:
- Contact names
- Contact addresses
- Locations
- Size of company by employee number
- Size of company by revenue
- Industry types – SIC code
- Number of listings in each category

2.5.2. Socratic

A commercial market research firm, Socratic was chosen to administer the tests. Socratic is a full-service marketing research agency specializing in computer-based and interactive research techniques. Their client list includes companies such that 3Com, Andersen Consulting, AT&T, Cisco Systems, Compaq, Hewlett-Packard, IBM, Microsoft Corporation, Netscape, Oracle, and Texas Instruments. Socratic was employed to collect respondents that possess certain qualifying characteristics.

2.6. Lessons learned from the selection process and pilots:

This first pilot project offered some general lessons pertaining to the practicalities of creating a pilot project at Nampco. This section lists the lessons learned that proved to be very valuable in the second pilot project described in Part II, Chapter 3.

Product Development Phase: Although there is no ideal stage for implementing such a market research tool, we initiated the two pilot projects in the early stages of product development. It was more appropriate to choose projects earlier in the design process since market research at these stages has a larger and more immediate effect on design.

Team Commitment: To initiate a project of a large scope given the novelty of the tool, a strong commitment of the team is needed. The team needs to receive input from the engineering and planning sides, so it is important to involve players from these groups.

Translating Engineering Questions: It is inherently hard to translate questions pertaining to the design and development processes into questions that a customer can give input to.
There is thus an involved stage in the beginning of the tool development to determine what questions and issues are important in determining the product design direction. When these questions and issues are in place there is a translating step that takes place: what effect does a certain feature or particular technology have on the product performance and output? This is a very important step. The tool that the customers would see needs to be directly relevant to their needs. This way customer input would be accurate and would directly feed back into design.

**Technology Learning Curve:** There is a learning curve as the teams learn about the new tools and technologies before they can formulate questions that take advantage of the unique capabilities that an interactive tool can offer.

**Asking for Customer Needs, not Specs:** The engineering teams, in particular, are used to receiving specs for the design. Thus there is another learning curve as engineers learn to communicate the options that they are considering and what features, price and performance variances those options offer.

**Taking Advantage of the Web:** Building the tools so that they fully take advantage of the capabilities of the new medium they are created in requires a creative process where input is received from all the members of the development team. There is a pool of creative talent waiting to be tapped in the teams, not only necessarily in the marketing side. Understanding the tools and looking at examples triggers innovative ways of asking questions.

This chapter described the first pilot project run at Nampco. The following chapter is a description of a second pilot project run at Nampco, this time in a project that was in a much earlier product development phase.
Chapter 3: Design for a New Interactive Tool for Doing Conjoint Analysis

This chapter presents the outcome of a second pilot project done at Nampco, on how to use conjoint analysis as part of interactive tools for exploring and understanding product offering tradeoffs for a future product that Nampco will be releasing shortly.  

3.1 Methodology

The chart presented in figure 18 below describes the methodology used in this project. At the top of the chart lies the client’s core question: “What drives high-speed copier/printer purchase decisions?” To answer this core question, we determined multiple sub-questions that must first be answered in order to address it. In some cases, the sub-question itself needed to be further resolved into lower level questions (omitted from the figure for clarity) to gain an insight into factors that drive customer decisions. After defining the problem into critical questions, methods and tools that would be used to answer each question, tools were chosen, customized, and/or developed.

Figure 18: Strategy for Designing a Web-Based Solution for Core Question

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6 This chapter is the outcome of a project performed with Jared Clark, Milind Oak and Tony Gambito aimed at creating an interactive marketing study example
3.2 Goal Derived Objectives

Once the goal of the project design an effective web site strategy to determine what drives purchase decisions was firmly in place, three key objectives were established:

- Establish questions that critically impact the product design
- Develop analytical tools and methods to answer those questions
- Design a user interface that is simple and fun to engage

The specific questions, which are addressed here, include:

- What are the needs of the Target Segments in industries 1 and 2 in terms of attributes and functionality?
- Do participants approach these exercises differently depending on whether they view it from a functionality 1 or functionality 2 perspective?
- What is the validity of the combination of the various methods for collecting customer feedback?

A Panel of 200 US-based decision makers each from the two industries refered to here as Industry 1 and Industry 2

The objectives for this study were:

- Verify Service Option 1 and Service Option 2 particularly to gain understanding into which plan people want and who wants it.
- Is option 1 strategy acceptable?
- How many items are too many?
- Which items are acceptable to replace?
- Determine Configuration penetrations
- Validate solution/ option bundling strategy (Environments 1 and 2)

The following will be recruited for this study:

- Target Segment 1: The target segment 1 has the following characteristics: the participants are part of both industries, they are the sole or primary decision-maker or have strong influence in the acquisition of product, they own the product of Nampco, they own qualifying model competitive products.
- Target Segment 2: The target segment 1 has the following characteristics: the participants are part of both industries, they are the sole or primary decision-maker or have strong influence in the acquisition of product, they have employees with need for product, they own similar products.

3.3 Product Web Strategy Development

Developing a web site structure that will provide a means for the company to acquire significant, up-front customer input for their product involves:

- Strategizing the use of specific methods for extracting and ranking customer needs (what methods will be used and why?).
• Designing the questions and feedback/interface mechanisms (how customers will provide their data).
• Designing the flow of the site (how customers progress through it).
• Structuring the site to ensure that it provides unfiltered customer input in an unbiased manner.

A complete study has been designed utilizing a combination of three very powerful tools, Build Your Own, Conjoint Analysis and Kano analysis. These tools were described in Part I. These tools were chosen for their ability to effectively pull data regarding pricing, attribute importance, customer expectations, as well as for their adaptability to be implemented in ways that maximize participant interest. Table 7 summarizes the subsystems involved in this study and which tools were deployed to better understand the customer requirements as they relate individually and to each other.

**Table 7: Project Scope**

<table>
<thead>
<tr>
<th>Scope:</th>
<th>Build Your Own</th>
<th>Conjoint Analysis</th>
<th>Kano Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>System</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Subsystem 1</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Subsystem 2</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Subsystem 3</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Subsystem 4</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Subsystem 5</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**3.4 Overview of web site structure**

Figure 19 depicts the overarching strategy of our proposed study. At the highest level, the web site requires the participant to enter a user ID and password. This information will be distributed through e-mail to selected decision makers for both copiers and printers meeting the demographic requirements. Based on the user ID and password the participant will be sent to one of two web sites. These web sites mirror each other in every respect except one – the word “product 1” is switched with the word “product 2” and all relevant graphics are changed to correspond. The purpose of maintaining two almost identical test sites is simply to ascertain if there are differences in the levels of
importance for the same attributes depending on whether participants are designing a copier or a printer.

3.5 Overview of questions and explanations

The next screen should then introduce the web site with a high level overview which provides instructions regarding the various types of questions the participants will be asked and what will be expected from them during the course of the study. From here the respondents will move systematically through the remaining pages of the web site as they are guided from a subsystem focus up to a system level understanding. In one of the fundamental elements of the study, the respondents will go through a series of conjoint analyses that will determine accurate coefficients for their individual utility functions for each subsystem. These pages and their associated questions are detailed below:

3.5.1 Level 1: Subsystem and System Build Your Own

The Build Your Own tool, shown in figure 20, was chosen not only for its interactive interface, but also its usefulness for gathering data regarding price sensitivity. An added benefit of this tool when used in conjunction with Conjoint Analysis, is that it validates the top attribute levels that are derived from each conjoint exercise. The System Build Your Own page implements a refined version of the drag and drop concept and differs significantly from the test pages presented previously. This system allows the participant
to quickly find and fill out information important to them and make the necessary
changes at both a system and subsystem level using a file index card concept. As items
are selected on each subsystem index card, the subsystem total price is updated in real
time. Then as subsystems are added to the system, the total system price is also updated
to reflect these changes. Each time a subsystem is accepted, another subsystem index
card opens up until all five subsystems have been designed.

**Figure 20: Subsystem/System Build Your Own Interface**

As the participants navigate this screen, they can readily view the total price of the
system as they defined it and if it is acceptable they simply click on the system 'Accept'
button and move on to the next question of the survey. If however, they desire a
modification because the price is too high or they would prefer a different configuration,
they can double click on the item's icon in the copier/printer system workspace and the
subsystem's index card re-opens to be updated. Figure 21 is an example of an index card
for a subsystem.

**Level 2: Kano and Build-your-own for the Service Option 1 subsystem**

*Level 2 focuses entirely on the issue of service option 1 and various Service Models.*

*Much importance can be placed on a specific question. Specifically these questions were
to:*

- Verify Service Option 1 strategy
- Determine if the Service Option 1 strategy is acceptable.
- Understand how many items are too many for Service Option 1.
- Pinpoint which items are acceptable to replace and which items are not.

It is our understanding that gaining clear insights into the above questions may potentially have a dramatic impact on the design of the overall system as well as many of the independent components/modules of the system.

![Subsystem 1](image)

**Figure 21: Subsystem Build Your Own Index Cards**

### 3.5.2 Kano

The first question in this level is a Kano question. The Kano tool was chosen for both its simplicity and ability to determine where customer expectations actually are with respect to Service Options 1 and 2. This subsystem could lie within any one of the three satisfaction regions of Must Have, More the Better, or Delighter. The purpose of the question shown in figure 22 then, is to determine the user’s satisfaction and associated dissatisfaction of having to replace the system’s worn components.
In the Kano model, elements that lie in the Must Have region comprise the minimum customer requirements, elements that lie in the More the Better region need to be traded-off between price and performance and elements in the Delighter region are potential differentiators that provide strong motivation for purchase. This page, shown in figure 23, provides the participant with an interesting interface through which they may trade-off price with the bundling of replaceable components and service packages. Figure 23 indicates how this question might look and function. On the lower right hand side, there is a representation of a product. In it are elements representing various Service Option 1 components. These are also defined on the left hand side legend. Immediately above the product is a package, or bundle. The participants will use this workspace to construct their own service package. As they build this package, a price will appear as well as a package discount (savings). In order to place elements into the package, the users simply clicks on the element in the product. The selected items can be removed from the service bundle by clicking on the element within the package itself. Finally, the respondents can also indicate which items they does not want to service himself at any cost by double clicking on the elements in the copier/printer representation. This will cross out the element in much the same way as the filter is crossed out in the diagram above. Additionally, the user can get more detailed information regarding any particular element by performing a mouse-over on the element. An information balloon will appear listing the element’s name, replacement period as calculated using the sliding bar-- for usage level-- in the upper left hand corner, the time required to replace the element, the difficulty involved and the cost/unit.
3.5.4 **Level 3: Subsystem and System Conjoint**

In the third and final level of this survey, the user is asked to participate in six conjoints: one for each of the five subsystems and one for the overall system conjoint. Conjoint analysis was selected for its usefulness in determining the importance of a wide variety of attributes and their associated levels with a significantly reduced set of required experiments than would be needed otherwise. Another important feature of the conjoint method is its flexibility of form. Each of the five subsystem are defined, in turn, below with their attributes and levels. Samples of the conjoint experiment designs are detailed in Tables 8 and 9.
Table 8: System Conjoint Design

<table>
<thead>
<tr>
<th>Design #</th>
<th>Subsystem 1 (Top Attribute)</th>
<th>Subsystem 2 (Top Attribute)</th>
<th>Subsystem 3 (Top Attribute)</th>
<th>Subsystem 4 (Top Attribute)</th>
<th>System Reliability</th>
<th>System Price (Initial)</th>
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</thead>
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Table 9: Subsystem Conjoint Design

<table>
<thead>
<tr>
<th>Design #</th>
<th>Option 1.</th>
<th>Option 2</th>
<th>Option 3</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Level 1</td>
<td>Level 1</td>
<td>Level 1</td>
</tr>
<tr>
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<td>Level 1</td>
<td>Level 2</td>
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</tr>
<tr>
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<td>Level 1</td>
<td>Level 3</td>
<td>Level 2</td>
</tr>
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<td>Level 2</td>
<td>Level 1</td>
<td>Both</td>
</tr>
<tr>
<td>5</td>
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<tr>
<td>9</td>
<td>Level 3</td>
<td>Level 3</td>
<td>Both</td>
</tr>
</tbody>
</table>

Due to the number of conjoint analyses in this experiment, great effort went into reducing the total number of cards involved in each conjoint, as well as making the process as entertaining as possible. Focusing in on the questions asked by our client minimized cards. The next section describes in more detail how this process worked and provides illustrations to demonstrate efforts that were made to make this process interesting, interactive and valuable for both the company and the survey respondents.
3.5.5 *System Conjoint Analysis*

Each of the subsystem conjoints calculates the participant’s utility function in real time. The system conjoint is not predefined as the subsystem conjoints are. Instead it is created on the fly by selecting the top attribute from each of the five subsystems for each individual. The result is an individually customized conjoint for the overall system (Mass Customization of sorts). This, of course, creates some difficulty in processing the datum in a meaningful way. How do you develop a systemwide utility function with variable conjoints? The answer is to use a method which allows you to define separate market segments. (figure 24)

**Conjoint Analysis Design**

These market segments are not based on traditional demographic segments. They are based on needs segments. It is important to note that this method recognizes that customers from different demographic groups can (and probably do) have the exact same needs. This is not to imply that one should not care about the composition of the various need segments. Certainly understanding the likes and dislikes of traditional demographic groups will allow an organization to better understand its customers needs and target its advertising more efficiently.

Needs based segmentation divides the market into similar groups who are likely to have similar purchasing behavior by using an individual’s utility function from their conjoint analysis. A technique called Cluster Analysis is used to find segments whose members are similar on several attribute dimensions. Utility functions for all survey respondents are entered into a hierarchical-cluster analysis program (e.g. JMP). The cluster analysis program then groups people who have similar patterns of utility functions.
Figure 25: Needs Based Segmentation / Value Proposition

In summary, using market research techniques such as conjoint analysis and cluster analysis helps define/refine the product's value proposition (Figure 25). An example of a value proposition for a customer is "providing the broadest range of options and services, and fulfilling the needs of large companies through a single service and support contact."

Value means different things to different people. Some organizations are looking at the bottom line, others at flexibility and so on. By getting the users to identify their own value system we can more effectively cluster product attributes, options, and services.

A template for the system conjoint is shown in the Table 10. It shows the two predetermined attributes (Price and Reliability), but also the five variant attributes associated with the five independent subsystems.

<table>
<thead>
<tr>
<th>System Attribute</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Price (Initial)</td>
<td>$3000</td>
<td>$9000</td>
<td>$15000</td>
</tr>
<tr>
<td>System Reliability</td>
<td>1/6 mo.</td>
<td>1/12 mo.</td>
<td>1/18 mo.</td>
</tr>
<tr>
<td>Subsystem 1 - Top Attribute</td>
<td>Level 1</td>
<td>Level 2</td>
<td>Level 3</td>
</tr>
<tr>
<td>Subsystem 2 - Top Attribute</td>
<td>Level 1</td>
<td>Level 2</td>
<td>Level 3</td>
</tr>
<tr>
<td>Subsystem 3 - Top Attribute</td>
<td>Level 1</td>
<td>Level 2</td>
<td>Level 2</td>
</tr>
<tr>
<td>Subsystem 4 - Top Attribute</td>
<td>Level 1</td>
<td>Level 2</td>
<td>Level 2</td>
</tr>
<tr>
<td>Subsystem 5 - Top Attribute</td>
<td>Level 1</td>
<td>Level 2</td>
<td>Level 2</td>
</tr>
</tbody>
</table>

3.6 Conjoint Analysis

As stated previously, the market research design employed calls for several conjoints to be run in order to establish both a subsystem and system level of importance for the various attributes. In this way, the customer can not only make design trade-offs at the subsystem level but also at the system level between system attributes and subsystem attributes. In order to simplify this task, great effort went into developing an interface
that was flexible enough to incorporate a significant variation in the numbers of designs. A lot of attention was spent on minimizing the individual conjoint studies and the reader will notice that all five subsystem conjoints comprise no more than nine cards each. The system conjoint could not be simplified so easily. Clearly, promoting the top attribute from each subsystem in addition to the two established system attributes will result in a requirement for a greater number of profile cards. In the case of the system conjoint, this number is 18. A design that would significantly simplify the survey is illustrated in Figure 26.

![System Conjoint Pre-sort Page](image)

**Figure 26: System Conjoint Pre-sort Interface**

Through this interface the respondent will be able to sort the different product variations which are represented as unique cards. If the number of cards exceeds 12 as in the case of the system conjoint, the respondent will be asked to pre-sort the cards into 3 separate piles: “Like,” “SO-SO,” “Dislike.” Once all the cards have been presorted the participant is given the opportunity to sort each pile separately. While presorting allows the respondents to “break” the pool of cards into smaller groups, thereby taking into consideration the manageability of large data sets by those taking the survey, it also simplifies web implementation for large experiments where the number of available design cards could not be displayed easily on a standard computer monitor.

Once the cards are pre-sorted into the three groups, the participant then ranks the cards in each group as 1 through N (where N is the number of cards in that grouping). This
process is continued for each group until every card is sorted by preference as depicted in Figure 27.

Figure 27: Secondary Sort Interface for Pre-Sorted Groupings

A final step was added to verify the boundary conditions between the three pre-sort groups. This is done by selecting the first and last cards from each adjacent “pile” (Like, So-so, Dislike) and allowing the participant to confirm the ordering of each card in the pair. The participant can accept the order as it was originally sorted or swap the two cards around. This is done twice, once for the last card of the Like pile and the first card of the So-so pile and one other time for the last card in the So-so pile and the first card in the Dislike pile. Figure 28 depicts this screen’s configuration.

Figure 28: Boundary Validation Interface
Using the web as a marketing tool has many significant benefits. It can be interactive and engaging. It allows for customizing surveys and screens real time based upon customer information and prior responses. It is easy to understand with intuitive interfaces. It is very quick and can be utilized to feed the upstream Product Development Process more effectively. It is a relatively inexpensive customer interface tool. It provides for automatic data collection and entry. Building tools so that they take full advantage of the capabilities of this new medium requires a creative process where input is received from all the members of the development team. There is a pool of creative talent waiting to be tapped in any product development team, not only necessarily in the marketing side. Understanding the available tools and looking at examples are key enablers to developing new and innovative ways of asking questions and extracting data.

It is hoped that the tools and methods developed in this project will help reduce development time and cost by doing the following. Establishing questions that have a large impact on product design alternatives. Enabling the evaluation of Build Your Own and Conjoint tools when used in combination. Providing a path for in-depth questions that are dynamically created for each individual participants based on their calculated preferences. Allowing for the integration of these preferences with previously gathered data to reduce the size of the survey, thereby helping reduce participant fatigue. Exploring alternative methods for extracting customer data that are both meaningful and interesting for the participating customers.

The results were very encouraging since the pilot projects were deployed in 3 months with a much reduced budget and the results were used in the product development next phases. This work is only the beginning of what would constitute the development of new interactive market research tools. The marketing department at MIT is instrumental in the development of such new tools. The following chapter is a quick wrap-up of this thesis work by suggesting new areas of research to further the study done as this thesis project.
Chapter 4: Future Work

This thesis work was mostly concerned with design for marketing. The tools available for market research in new product development were studied in depth and some pilot projects were deployed in industry to study the applicability of such tools. There are some questions that were not answered through this thesis work and remain as open.

4.1 User Design

User design seems to be a promising tool but its applicability and usability is only limited. Consumers would have to be educated in the use of CAD models to be able to efficiently express what they feel and the model inherently assumes that visual signals are the most important in a product. Even though it is undeniable that the visual characteristics of a product are an integral part of product development functionality is not only limited to that. It would be also unreasonable to assume that user decisions are solely based on the visual aspects of any product. The tool has limited applicability to only these products where visualization is possible. CAD model representation will only work with certain number of products. What product characteristics would define them? (Very visual, geometric traits, little apparent complexity, have to have a way to represent features that would not necessarily translate into major design differences. Customer might need to be at least minimally familiar with the product. How would such a tool be used in a truly revolutionary design?)

These concerns set aside user design indeed provides with some benefits that are very valid. But what is the best interface that you can provide to get consumers comfortable with the use of the tool so that you do not impede the data gathering process? An interface needs to be very intuitive. The time that respondents are willing to invest in order to get accurate feedback, should not be the time they spend learning the tool instead. Moreover if a company is using accurate representations, it might be a very good way to inform its competition of internal sensitive product development information.

Another question that remains is how to define realism. How can a representation be realistic when it is not in the correct medium, form, surroundings, and usage situation? How can pictorial representation be assumed to be better? What types of attributes are best fitted in a pictorial representation? On the positive side, the web increases the possibility of respondents finding themselves in a natural setting of work/leisure where they can better picture the product usage. But how does realism in model relates to product selection accuracy? And what level of realism is necessary?

4.2 Automation of the Analysis

By automating the analysis of the results it is assumed that the tool or those using the tool are able to determine which are the questions that are the most relevant to the product development process. Result analysis automation seems to be most logically applicable to
the later stages of product development, where the questions only have a limited score and the answers can easily be bounded.

Another concern with such a tool is that making it available to the product development team assumes that the team will internally have the marketing expertise needed in asking the right questions in the right terms. It is a leap of faith to assume that marketing as a discipline can be replaced by an automated tool because a lot of marketing is about understanding people’s needs and wants which is as much as an exact science as psychology is.

Traditional tools can benefit from modernization but by limiting the scope of marketing research it is again assumed that all the answers can be predetermined. It is a step in the right direction to use technology to automate marketing tools but it should never be assumed that this would provide all the answers to replacing marketing expertise.

4.3 Natural language extensions

What is important in a market research setting? A suggestion would be taking a natural language approach to the problem. This would help go over the barrier of translating language into needs and wants. A tool suggestion would be to ask a customer really detailed questions based on syntax of a sentence.

For example:
How would you like your bicycle to be?
    Red
What would be red?
    The frame
What do you think about the frame?
    It could be tall, or specified at my height.
What is your height?
    ....

The reason there is a fault in this is that it would be extremely irritating to the customer and also it would be hard to establish for the computer a base of understanding in every product tested.

4.4 Conclusions

The problems are many but the fact remains that designing a product with a customer in mind can have a tremendous benefit over not involving customers in the design. Because of the complexity of humans, product design is inherently an exercise in capturing the satisfaction of some need into a product that the person will then be willing to buy. The need can be apparent, latent or otherwise unstated but there is a need that any product solves. The hard part is finding which need it solves, which needs it could solve and most importantly for economic benefits, it is important to find which needs many people share.
What marketing does is create an average person from the people surveyed that represents the target population and the product is designed to meet those needs.
References

[34] Dahan, E. and Srinivasan, V. “The Predictive Power of Internet based product testing using Visual Depiction and Animation”, 1998