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Mind Map and Demonstration of the Quicklook Methodology for Technology Commercialization

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Mind Map and Demonstration of the Quicklook Methodology for Technology Commercialization

by

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Dedication

I would like to dedicate this work to my grandpa, Paul Harbert. Thank you for being an exceptional influence in both my academic and personal life. You have helped shape me into the person I am today, and for that, I will always be grateful.

Acknowledgements

First and foremost, I would like to thank Dr. Steven Nichols for his guidance, contribution, and support. This work would not have been possible without his help. Many thanks to Hugo Celio for allowing me to work with his technology and for the countless hours he spent sharing all that he knows on the topic. Much gratitude to Jakub Felkl for assisting in the development and evolution of this document, and especially for his help developing the function analysis found in the Appendix. Thanks to Gary Cadenhead for serving as my second reader and to Texas Materials Institute for funding the research that led to the creation of the ROx interface. To the Center of Nano-Materials, many thanks for funding my trip to the American Vacuum Society's annual conference where I was able to perform the majority of the interviews for the Quicklook report. I would also like to acknowledge Nicole Tan and Nicole Harbert for assisting in the final editing of the document. And last, but certainly not least, I would like to thank my parents, Paul and Jo Ellen Harbert, for their unwavering support as I pursue my goals.

Abstract

Mind Map and Demonstration of the Quicklook Methodology for Technology Commercialization

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Quicklooks provide an initial examination of commercialization potential of a technology. This thesis examines the Quicklook methodology in support of technology commercialization. The paper uses a Mind Map to create a visual representation of the methodology in a single image. Each component of the Mind Map is constructed individually and described in detail. The Mind Map allows the relationship between the many components of the Quicklook to be understood more rapidly. An example of a Quicklook report follows. The results of a Quicklook analysis support improved decisions regarding continued commercialization efforts while outlining the steps needed to get the product or service to market. The technology, its intellectual property, the market, and the competition are included in the analysis. Commercialization specific aspects, such as economic sustainability and business models, are then considered along with the value proposition. The final step in the Quicklook methodology is to recommend whether or not commercialization efforts should continue.

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Chapter 1: Quicklook Background and Methodology

1.1 Overview

Quicklooks assist in assessing the commercial potential of a technology and help decide if further steps should be taken in the commercialization process (Cornwell 1998). They specialize in evaluating technologies from universities and research laboratories, providing an assessment of the market, competition, potential partners, and interest in the technology. Quicklooks also indicate where problems may be encountered and areas where more research may be needed.

1.2 The Need

The Quicklook methodology helps bridge the gap from technology[1] creation to the development of business plans and early-stage venture opportunities. This gap exists because research is often performed with no specific product or service (hereinafter referred to as "product") in mind (Evans, Parks, & Nichols 2007). Boer asserts that technology alone has no inherent value (1999) and Nichols argues that technology has no inherent application. As a result, in most cases "technology push" is required to start the commercialization process. Evidence suggests "basic research may even have a greater likelihood for commercialization than applied R&D" (Powers 2004, p18). Thus, there is a

[1] For the purpose of this discussion, technology is defined as the fundamental scientific understanding of the problem. Product or service is defined as the application of the technology in a market-ready form.

need for a methodology that assists in identifying and validating application in the market. This creates the opportunity for market pull to become the dominating factor.

Figure 1 illustrates Jolly's commercialization model (1997). The model outlines the value-adding steps along the path to commercialization. It begins with the point where a relationship between technology and market is first imagined. The technology then goes through an incubation stage to allow a better understanding of its place in the market, which leads to the demonstration and promotion stages. The model ends with a sustained product in the marketplace (see p. 3-12 Jolly 1997). The Quicklook aids every aspect of the commercialization process, but is most useful in assisting and bridging the "Imagine" and "Incubate" stages.

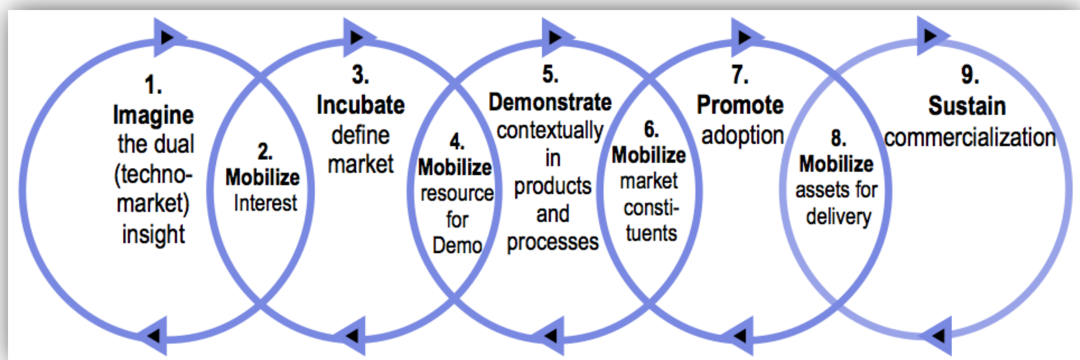

Figure 1: Jolly's technology commercialization model (Information from Jolly 1997).

1.3 History

In the 1990s, the NASA Mid-Continent Technology Transfer Center at Texas A&M University charged one of their Program Coordinators, Brett Cornwell, with commercializing a group of technologies represented by a large collection of patents (Cornwell 2011). After initial analysis, Cornwell concluded there was no market opportunity for many of the technologies, but NASA had no documented methodology to support these assertions, and no way to document market demand (or lack of demand). As a result, Cornwell developed a methodology (Cornwell 1997) to capture the voice of the market in a "Quicklook report." This development served as the genesis of the Quicklook.

As he developed the Quicklook methodology, Cornwell realized the same format could be used to support continued commercialization efforts. Once NASA addressed the original set of patents, the approach was used to determine if intellectual property protection should be pursued for new NASA technologies in support of commercialization. Reexamining Jolly's model, this represents a shift in both how and when Quicklook methodology was applied in the commercialization process. While originally applied closer to the "Demonstrate" stage, it also proved to be valuable in the "Imagine" and "Incubate" stages. Quicklook methodology allowed NASA to make informed decisions in a timely manner regarding the potential commercialization of their technologies. Cornwell formalized the approach in his "'Quicklook' commercialization assessments" publication (1998).

1.4 Expansion

Research at the University of Texas at Austin continues to develop and extend the Quicklook methodology, and faculty have organized classes that use the method to determine the commercial viability of new products. The approach builds upon the foundation created by Cornwell, and expands on the ideas of intellectual property while also providing broader assessments. As used in class, rather than arriving at a simple “go” or “no-go” decision, the final recommendations indicate under what conditions the technology should proceed to immediate commercialization. Quicklooks have led to improved decisions and have allowed the market to better drive the commercialization process by shaping technology development.

In addition to the classes, the Idea to Product® Program (I2P®) assists in broadening the application of Quicklook methodology (Evans & Nichols 2007). Originally hosted exclusively at the University of Texas at Austin, this technology commercialization education program has rapidly expanded to a global scale. There are now approximately a dozen annual I2P® competitions held worldwide and over 80 universities have participated since the program’s inception. The core of the I2P® Program is an expanded Quicklook analysis. The focus of the program is to provide an educational experience by encouraging students to span the gap between research and market (Evans *et al.* 2007)

1.5 THESIS ORGANIZATION

This thesis contains five chapters. The remainder of Chapter 1 explains the methods used to acquire the information needed to complete a Quicklook analysis. Mind Mapping is introduced in Chapter 2. Chapter 3 thoroughly explains each component of the Quicklook by constructing the Mind Map section by section. Chapter 4 contains an example Quicklook report, and the conclusions are included in Chapter 5.

1.6 QUICKLOOK METHODOLOGY

Quicklook methodology requires both primary and secondary market research. Secondary research uses existing literature (publication, databases, etc.) to gain insight into potential markets. Primary research targets experts in the field, which consist of potential customers, licensees, and those who are very familiar with the market and/or technical landscape. The main objectives are to gauge the trends, interest, and size of the market. An intimate knowledge of the technology may be helpful, but one applying Quicklook methodology only requires a basic understanding of the technology in the context of a potential market (Cornwell 1998) For a more complete description, see Cornwell in *Marketing scientific results and services: a toolkit* (2004).

Step 1: Familiarization

The first step in the Quicklook process is to become familiar with the technology and recognize potential areas of application. The best way to get information about the technology in this stage is direct interaction with the inventor and researchers. Open discussion contributes to identifying potential uses for the technology that the inventor may not have originally considered. From here, secondary research is used to gain a top-level understanding of potential markets.

Step 2: Primary Research

The second step focuses on identifying potential licensees and/or the end users of the technology and products that may be based in the technology. The objective is to talk to experts in the field who serve as a good representation of manufacturers, users, and any other group who will be involved in getting the technology to the market. Databases can be a valuable source of information since many contain names, telephone numbers, and position descriptions.

The interviewer should seek to determine if the performance characteristics of the technology are deemed important. The market size should be probed and an appropriate price point should be estimated. Inquiries should be made about similar products. The general strategy is to ask broad, open-ended questions. This allows each conversation to take a unique path, which can lead to increased information gain. It is important to avoid going into an interview with a rigid set of questions. The conversation should be allowed to meander, and questions should be tailored accordingly. It is recommended that two follow up questions are asked at the end of each interview—"Is there anyone else you recommend I contact?" and "Are there any questions I should have asked?" While the first question expands potential sources of information, the second question helps identify topics or issues that may not have been previously considered, but may be of great importance in the market. Only eight to ten productive interviews with converging information are needed in most cases.

Step 3: Preparing the Deliverable

The next step is to compile the results in a report or presentation. To reiterate, the end goal is to make a recommendation as to the conditions under which further effort should be invested in the technology. The deliverable should be a summary of the information acquired and efforts should be made to avoid any bias in the presentation of the findings. Negative findings should not be overlooked or omitted. Deliverables should be presented in a concise and efficient manner. Figures, tables, and matrices can be utilized to display a large amount of information in a small space.

Chapter 2: Mind Mapping

2.1 Overview Of Mind Maps

Tony Buzan states that Mind Maps help develop the "operations manual to [your] own brain" (Crainer 2008, p15). Buzan created the method based on research indicating that the brain processes a concept or idea by moving outward in a "random yet organized fashion" (Zampetakis, Tsironis, & Moustakis 2007, p372). The brain begins with a single point of focus (Crainer 2008, p16). From here, the brain populates what becomes the first level of the Mind Map by creating connections to the subtopics that derive from the main focal point. These connections become the branches of the Mind Map. The process can be repeated for each of the subtopics, which allows the map to expand as necessary. Mind Mapping is commonly used to aid brainstorming sessions (Otto & Wood 2001), but it is also an effective learning tool. Mind Mapping can accelerate learning and retention since it captures the brain's natural thinking pattern (Zampetakis *et al.* 2007).

2.2 Construction and Applications

A Mind Map starts by capturing a central idea, or "main topic," with just a few words. From here, the key components, or focal points, of the "main topic" are recorded, reflecting the connection back to the "main topic." Additional branches are added in order to expand the concepts. New concepts generate additional branches from the "main topic" (Otto & Wood 2001). Color can enhance the visual clarity of the Mind Map (Zampetakis *et al.* 2007).

Mind Maps have a wide range of applications. As seen in the following examples, Mind Maps have been used to support business negotiations (Rosenbaum 2010) and as a tool to support and document industrial innovation (Swan & Pitta 2006). They can also be used for note taking, problem solving, summarizing, project planning, and a variety of other applications (see Zampetakis *et al.* 2007). Another area of proven success is in concept generation. It has been shown that Mind Mapping consistently enhances the results of a brainstorming session (Wood & Linsey 2006).

2.3 Examples

Example 1.

Clive Lewis has worked extensively with Mind Maps as the managing director of a Mind Map training company in the United Kingdom. He states that one area in which Mind Maps excel is as a negotiation tool because they present the information in a way that is similar to how it is processed by the brain (Rosenbaum 2010, p4). Figure 2 provides an example of a Mind Map used for negotiation (Rosenbaum 2010, p4). The map presents the entirety of the "Proposed Marketing Plan" within a single image. The relative importance of each point is quickly indicated to the viewer by the use of varied font sizes, line thicknesses, and its placement within the Mind Map's layered construction. Related points from different branches are connected with arrows to further strengthen the viewer's understanding of cross relationships within the map. This approach increases the ease with which "holes" or underdeveloped areas can be spotted and allows the information to be more easily remembered.

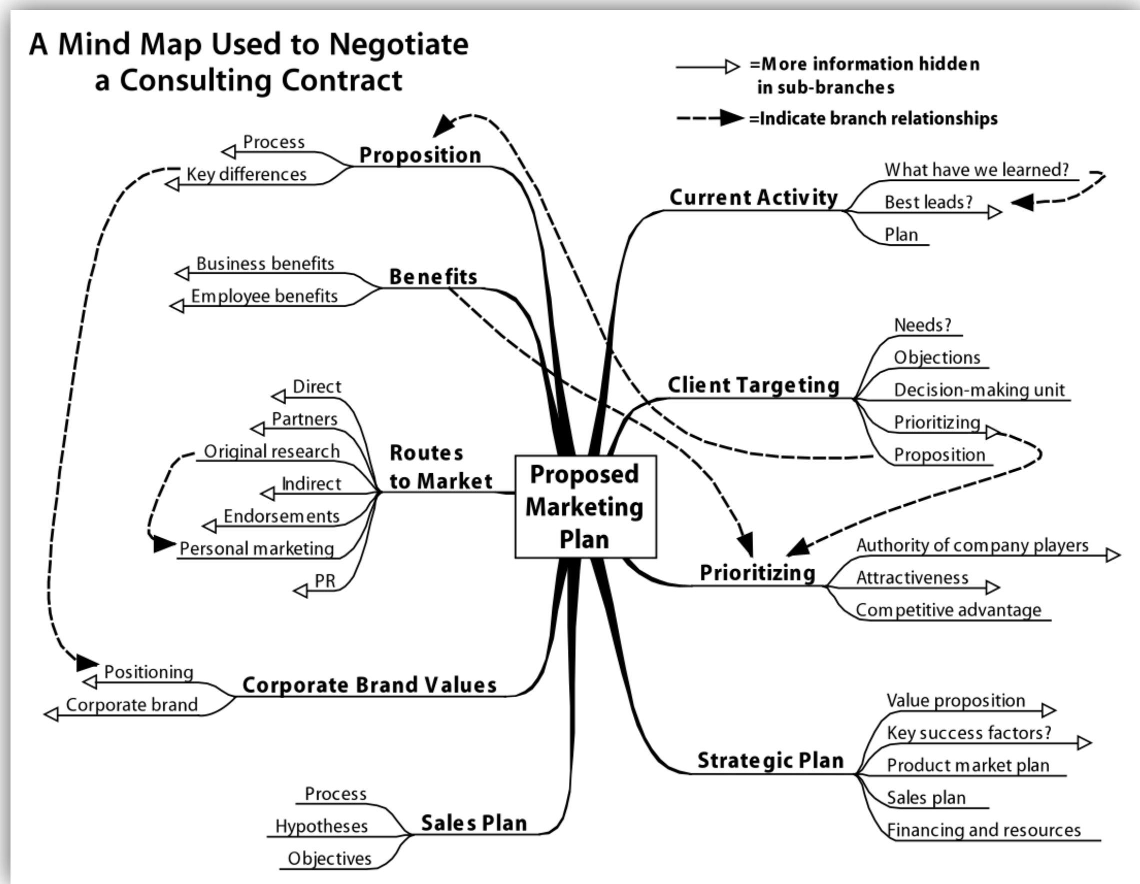

Figure 2: Mind Map Example 1 (Mind Map courtesy of Mindjet).

Example 2.

A pipe coating company in a highly competitive market depends on innovation for survival. The company uses Mind Maps because they allow all of the information for a particular project to be displayed in one place. Beyond convenience, they found this allows the brain to start piecing the information together in ways not allowed by other methods of presentation. The company incorporated 30 customized symbols in their map to help indicate the results of their formulation testing. Figure 3 displays a sample Mind Map used by the company. Mind Maps have increased the speed and quality of their decision making (Swan & Pitta 2006, p152).

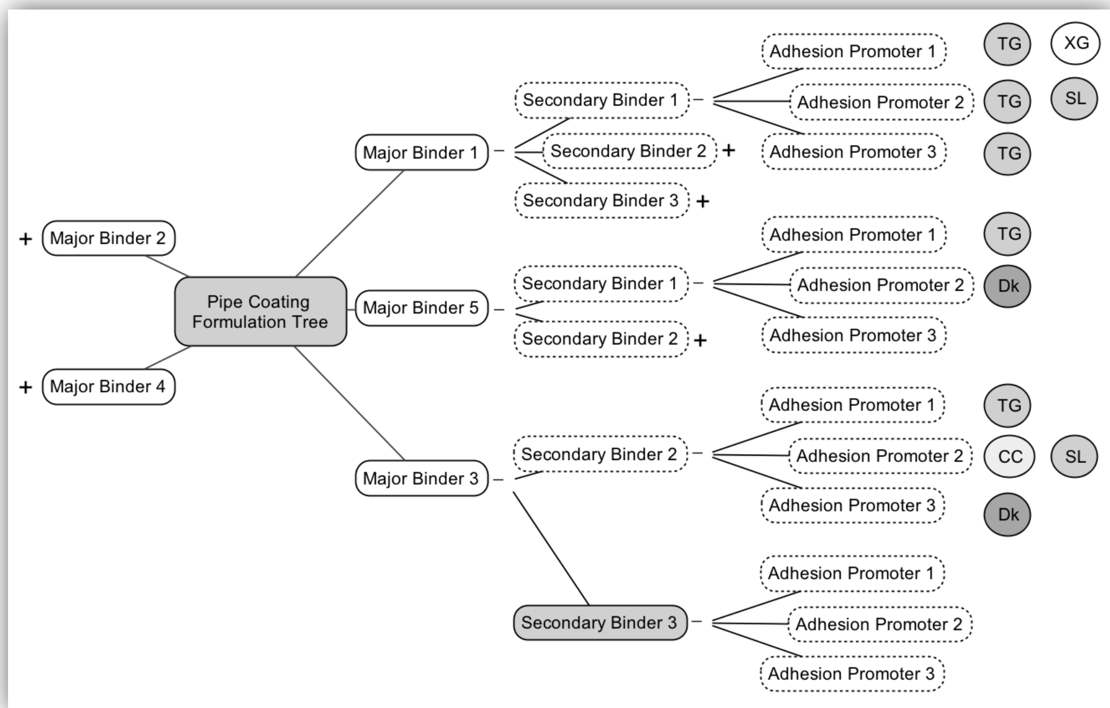

Figure 3: Mind Map Example 2 (Information from Swan & Pitta, 2006).

2.4 Benefits

Mind Maps excel at bringing order to nonlinear applications, such as the Quicklook. The main advantage of Mind Mapping over a traditional row and column approach is the *addition of a visual representation with ties between linked concepts*. This makes it easier for the user to absorb the material given that a large portion of learning consists of making ties between various concepts. With a Mind Map, this is already done (Rosenbaum 2010).

2.5 Mind Mapping the Quicklook

The Mind Map shown in Figure 4 provides an overview of the topics included in a Quicklook. It begins with the "main topic" (the Quicklook), and branches off to seven focal points. Although a Mind Map does not need to be read in any particular direction, the natural tendency to read from left to right was kept in mind (Zivotofsky 2004). This suggests the order in which the analysis will be performed. Each of the map's main focal points are examined and expanded below. Points of consideration specifically for reports or presentations will be included in the footnotes.

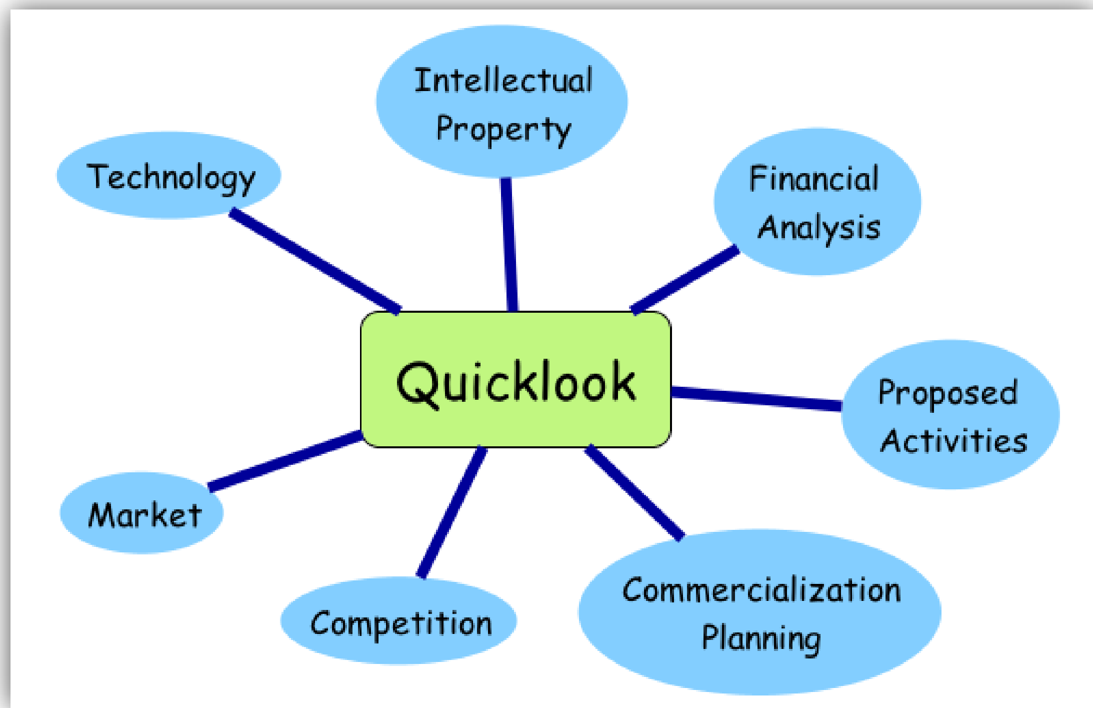

Figure 4: First layer of the Quicklook Mind Map.

One can begin applying Quicklook methodology simultaneously from the 'Technology' and 'Market' focal points. From here, Figure 5 illustrates the suggested path. An understanding of the intellectual property flows from an understanding of the technology. Likewise, an examination of the market allows a more thorough understanding of the competition. Financial analysis and commercialization planning may then take place simultaneously. The best course of action for the technology can then be examined. The Quicklook is an iterative process and, as previously stated, is not linear in nature. It will often span multiple focal areas and efforts may shift back and forth as new information is discovered.

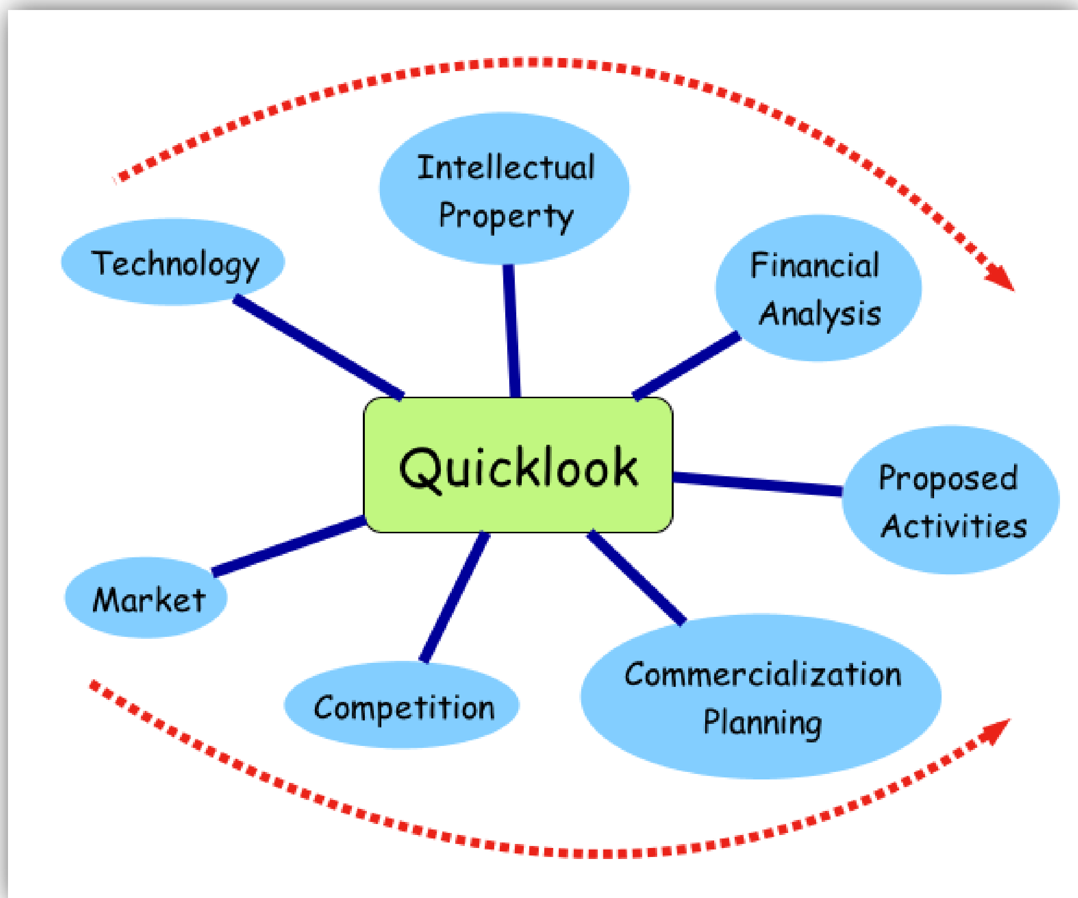

Figure 5: Suggested Quicklook sequence.

Chapter 3: Building up the Quicklook

3.1 TECHNOLOGY

As mentioned, Cornwell developed Quicklook methodology to support technology commercialization from the perspective of a technology developer (NASA) and has been further developed at universities. It is not surprising then that its application generally begins with a thorough understanding of the 'Technology' and typically starts from the perspective of "technology push." While one can commercialize a product with "technology push," successful commercialization eventually requires development of "market pull." The Quicklook supports the identification of the eventual market. Starting with a focus on the technology requires appreciation of the features of the technology. These features will later be compared to perceived market needs. Figure 6 displays the initial expansion of the technology focal point.

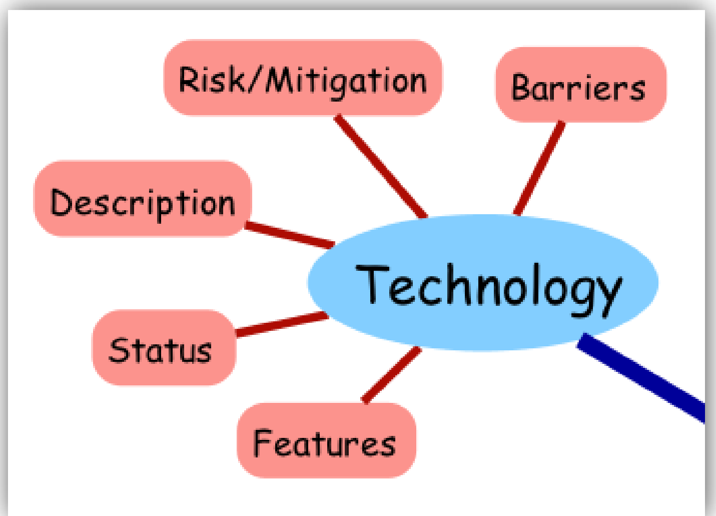

Figure 6: Expanding the Technology focal point.

The technology and its features should be clearly understood with emphasis placed on recognizing unique features of the technology. Understanding the technology landscape, or context, is also useful. As Quicklook methodology relies heavily on primary research, it is important that the technology can be described in a clear and concise manner. Analogies and comparisons can aid in describing the technology without revealing proprietary information[2]. It is necessary to show what distinguishes the technology from existing solutions.

An understanding of the technology's features allows an initial assessment of potential applications. Any features that offer a competitive advantage to existing solutions should be identified. These unique features will later be mapped into customer

[2] The goal is to explain the technology such that an average person can gain a "big picture" understanding. It should also be made clear that it comes from a credible source.

needs in order to clearly identify unique benefits provided by the technology that flow from technological features. Competitive advantages do not necessarily equal benefits[3].

The technology's status indicates where the technology is in the development process. An understanding of required future development will be important in several aspects of the Quicklook methodology. The status is assessed by determining if the technology has been simulated, if the concept has been proven, if a prototype exists, if regulatory approval is necessary, and if the technology can be easily scaled.

Any risks within the development of the technology should be identified. These include concerns that the expected level of performance may not be reached or that certain developmental milestones may not be realized. Plans for alternate approaches or modifications should be formulated to counter any potential issues.

Technology barriers may come in the form of unavoidable side effects and fundamental physical limitations. With barriers the problem may be insurmountable, and the technology may have to be abandoned until further technological advances are made. Figure 7 displays the fully expanded 'Technology' focal point.

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[3] If a new technology is able to make parts with much smaller tolerances, but the target market lacks the need for such precision, it is unlikely current customers will see the technology as a benefit. For example, if nuts and bolts are being made, but current nuts and bolts already meet customer's needs, the increased precision would not be a benefit.

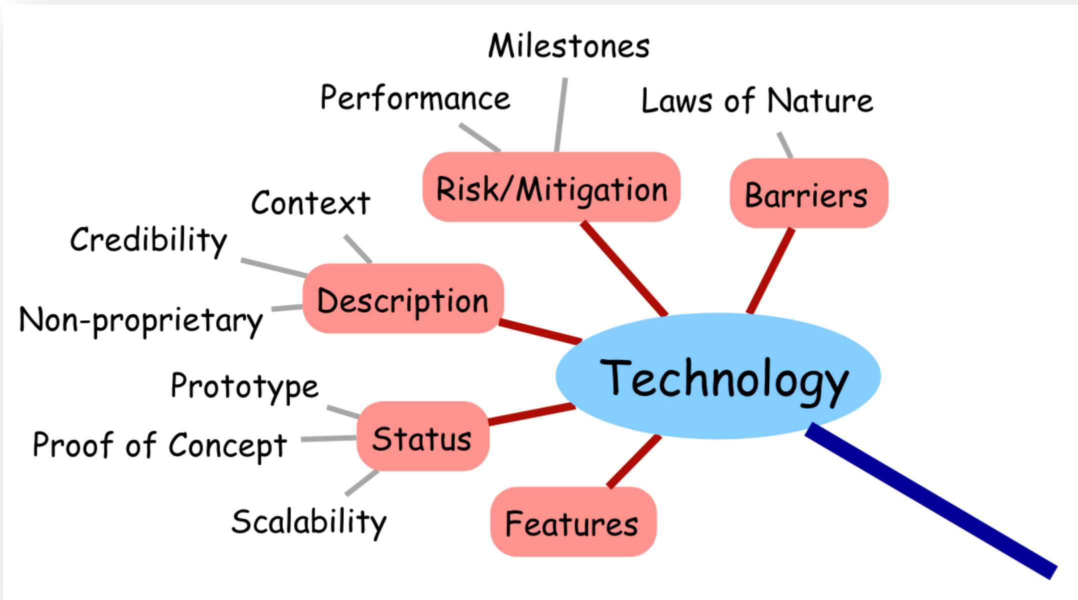

Figure 7: Fully expanded Technology focal point.

3.2 Market

A fundamental understanding of the 'Market' allows the focus to shift from "technology push" to "market pull." Moore defines a market as "a set of actual or potential customers for a given set of products or services who have a common set of needs or wants, and who reference each other when making a buying decision" (2002, p28). For the market focal point, shown in Figure 8, the objective is to understand the market landscape. This is accomplished by describing the market selection, its pain and characteristics, and the benefits of the technology's features for the chosen market.

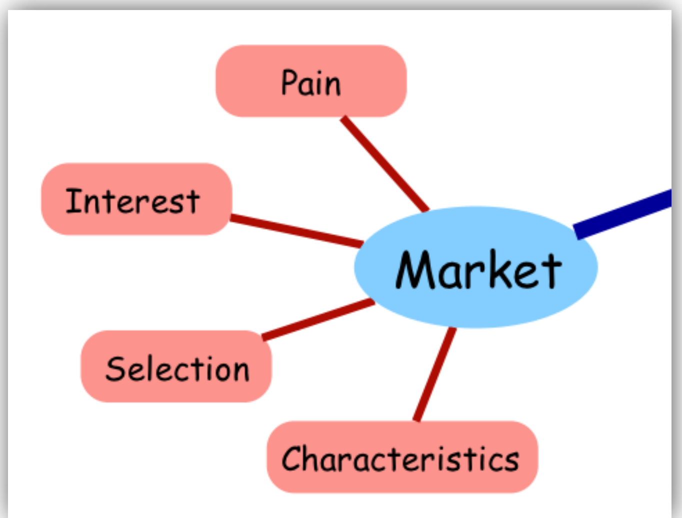

Figure 8: Expanding the Market focal point.

One may identify several markets for the technology (See Moore 2002). This should be narrowed to a single, or beachhead market[4]. The selection should be made primarily based on the results of secondary research and consideration of the points that follow.

Identifying a *real* market need is a critical part of Quicklook methodology. It is important to remember that technology alone has no inherent value or application. Therefore, one must start with a *perceived* market need. The validity of this perceived need must then be tested.

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[4] A detailed description of the rationale for the chosen market should be avoided. The choice should be obvious based upon the match or discussed only briefly. If additional description is necessary, it should be placed in an appendix.

The customer "pain" should be defined and verified. One asks, "What is the exact problem that is being solved and how much are people willing to pay for a solution?" This information is derived through both primary and secondary research. It is helpful to become proficient at describing the market pain and the technology simultaneously in the form of a "hook"[5]. The technology's potential for profitability will be examined in the 'Financial Analysis' section based, in part, upon the answer to this question.

Developing a Product with Unique Benefits to the Market Based on the Subject Technology

The match between the features the technology offers and the pain felt in the market, Figure 9, allows the commercialization team to define a "Product" based on the "Technology," that is, the team maps the unique features of the technology into a product that addresses the customer needs. The product's fit in the chosen market should be well understood through the use of primary research. Primary research is the best way to capture the market's interest in the technology[6].

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[5] The market pain should be incorporated into the description of the technology and presented upfront in a way that will capture the listener's attention.
[6] Direct quotes from experts in the field go a long way in making a case for or against continued commercialization efforts.

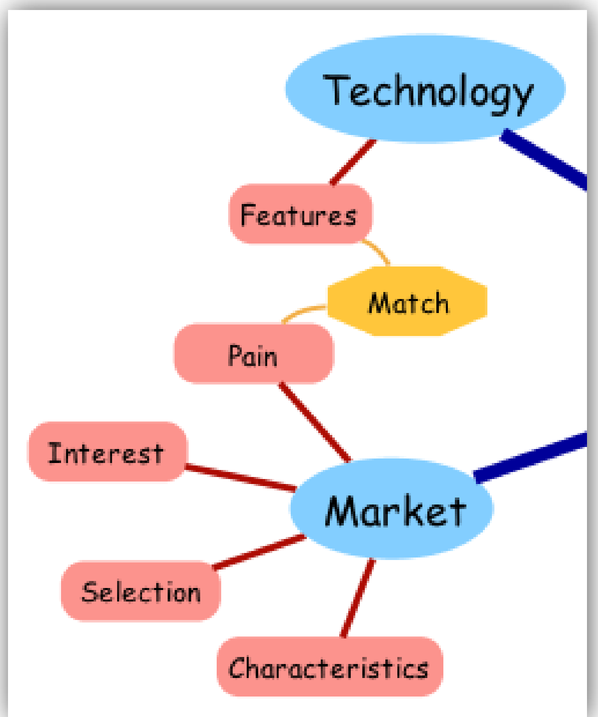


Figure 9: Matching the technology's features to the market pain.

The characteristics of the "beachhead market," such as the customer, size, and trends, (Moore 2002) should be understood. In addition to increasing the understanding of the market, this information will be used in the 'Financial Analysis' section. The market size will likely have to be constructed from information gathered during primary and secondary research. The goal is to understand the size of the exact market that will be entered. For example, if the technology is for a specific computer component, the market size of the entire computer industry is not terribly helpful. Beyond size, it is useful to know how the market is trending. A small market may be a sound choice if it is showing a large growth rate. The needs of the customer can be better understood by asking, “Who cares?” Who really cares and who will actually pay for the product? In many cases, the needs of the customer’s customer will also have to be understood. Figure 10 displays the fully expanded ‘Market’ focal point. Past focal areas will only be displayed if they are directly relevant to the current topic.

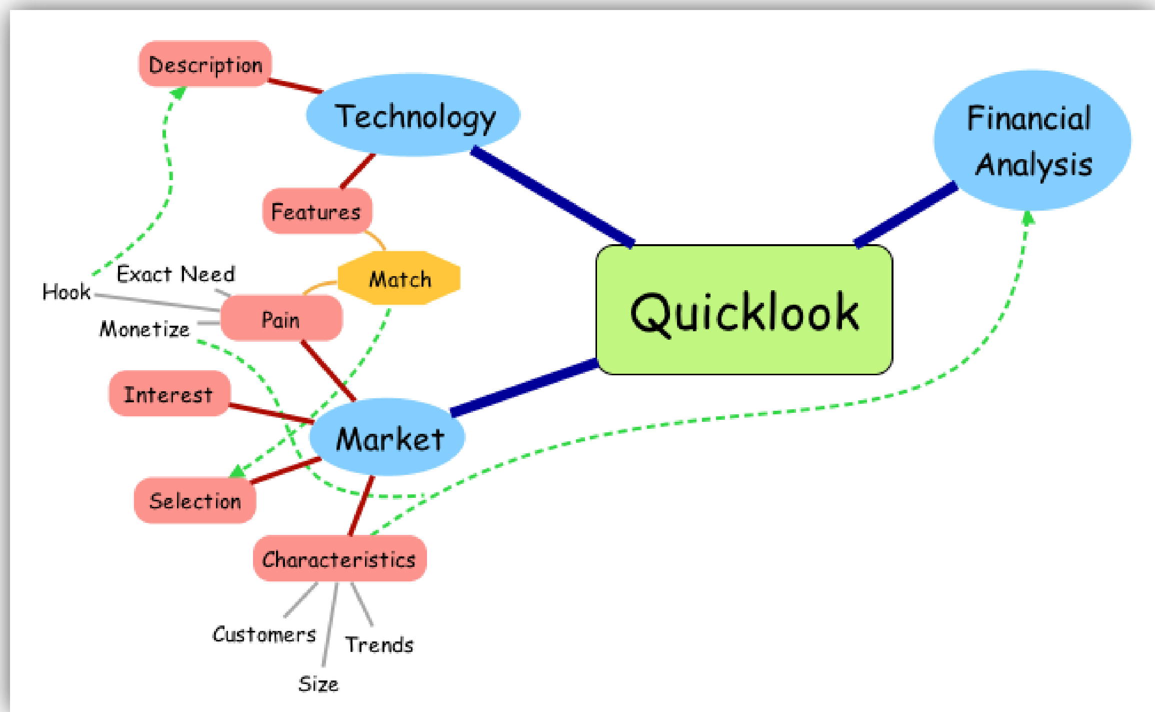


Figure 10: Fully expanded Market focal point.

3.3 Competition

All products face ‘Competition.’ Informed decision-making can only take place after all the options available to the customer (including status quo and non-action options) are thoroughly understood. Figure 11 displays the initial expansion of the competition focal point.

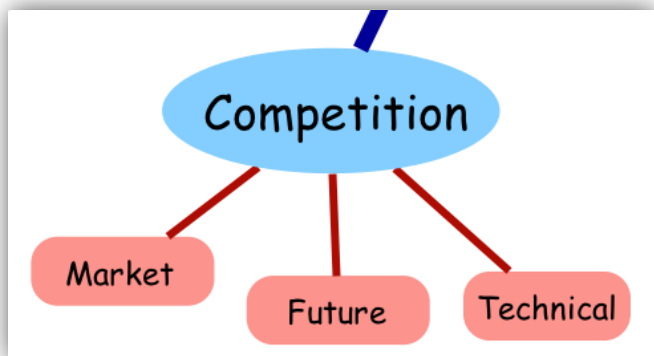


Figure 11: Expanding the Competition focal point.

Competition assumes two major forms—technical and market. Technical competition solves the problem with a similar technology. Market competition can be direct or indirect. Direct competition solves the same problem with a different technology. Indirect competition encompasses all other options available to the customer, including non-action options. This can be illustrated in the computer market. A company that makes laptops faces technical competition from other companies that make laptops. Ten years ago, the primary source of market competition was desktop computers, but technology advances have changed this. For this reason, future competition should also be analyzed. Others will certainly attempt to create their own solution if the emerging technology is able to successfully control a portion of the market. This could be in the form of technical or market competition. Future technical competition can be limited with strong intellectual property protection. Patents, however, do little to address emerging market competition. Returning to the laptop example, in recent years, an increasing amount of market competition is being realized in the form of tablet computers and smart phones. With some foresight, those in the laptop industry could have predicted this change in the market. Such foresight can be critical to an emerging technology or a possible startup. Academic journals can be a valuable resource for seeing what others have "in the pipeline."

Commercialization efforts should not be abandoned simply due to strong competition. The commercialization team should analyze competitive products and understand the strengths and weakness of each. As stated, understanding competitive advantages is the first step toward understanding what the customer views as a benefit. Does anyone care if the new product can perform a task ten minutes faster than the competition? The customer does not benefit if time is not a pain point. It is equally important to recognize areas where the new technology is outperformed and determine if it is of concern to the customer.

The habitual nature of people and capital investment within companies must also be considered. Even if a new product outperforms the competition in every aspect, it still may have trouble in the market place. A superior product does not guarantee success (Jolly 1997). Human beings are creatures of habit (Hodgson 2009). It can often be difficult to convince someone to move away from something that has become a part of his or her routine even if it is no longer state of the art. Within industry, companies may be unwilling to replace their equipment for some time if they have recently invested in new equipment. Figure 12 displays the fully expanded 'Competition' focal point.

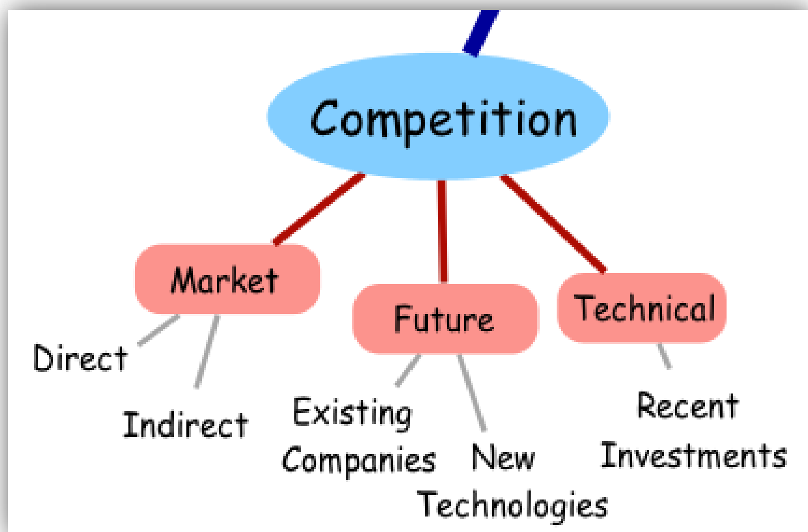


Figure 12: Fully expanded Competition focal point.

3.4 Intellectual Property

It is essential that the 'Intellectual Property' (IP) surrounding the technology is understood and protected. Protection of IP, Figure 13, helps create a sustainable economic advantage by preventing others from duplicating the protected material. Protection can come in the form of patents, trade secrets, trademarks, and copyrights. This paper will briefly discuss an analysis of patents, trade secrets and copyrights; it will not include a discussion of trademarks.

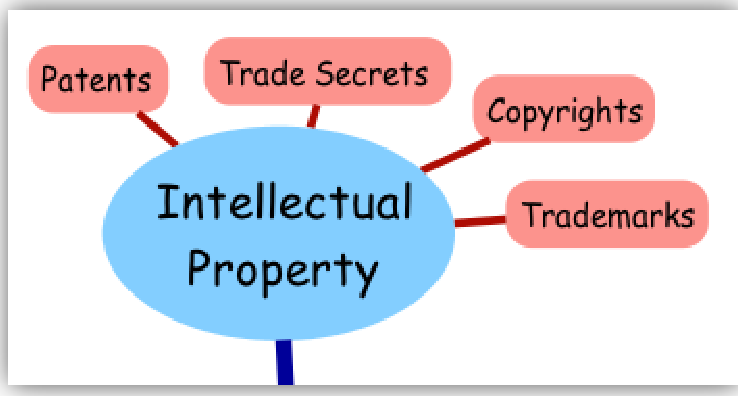


Figure 13: Expanding the Intellectual Property focal point.

Patents

Patent protection grants to the owner an exclusive use of the claims. This provides the right to exclude others from making, using, selling, or importing items protected within the claims of the patent (See Leahy-Smith America Invents Act, 2011). An invention must be novel, useful, and nonobvious when compared to prior art (previous knowledge in the field) to be eligible for protection. Prior art consists of information covered in existing patents, in public documents, or otherwise known or used before[7].

This does not mean, however, that the patent owner can limit others from providing solutions to the problem that the patent addresses, but only that others are prevented from duplicating the specific claims used to solve the problem in the patent. As

[7] Note that in "first-to-invent" nations (such as the United States), the time to measure prior art is at the time of the invention. For "first to file" nations, it is measured at the time of filing. Also note that recent changes in Patent law in the United States will result in the U.S. joining the "first-to-file" nations. See the Leahy-Smith America Invents Act, 2011.

a result, the prior art, patents for similar technologies, and patents for other approaches to solve the same problem need to be appreciated. Published patent applications that have not yet been examined should also be considered.

Owning a patent does not necessarily provide the patent owner the right to practice the claims. That is, if practicing the claims would infringe another valid patent, one cannot legally infringe simply because one has a patent. This addresses "freedom to operate," or the ability to practice one's own patent. For example, if the patent protects improvements to a previously patented item, the new patent does not grant a right to produce and sell the improved product. Licensing agreements would likely be required. Broader patents owned by others may also prove to be restricting.

Trade Secrets

Under certain circumstances, governments will assist an inventor in the protection of commercially valuable "trade secrets" if the inventor has taken reasonable precautions to protect that secret. Trade secret potentially provides a sustainable competitive advantage. Unlike patents, trade secrets do not involve a filing or application process. As the name implies, trade secret means that the company will take reasonable precautions to prevent proprietary information from being accessible to those who do not agree to maintain its secrecy. Trade secret laws do not protect against reverse engineering or independent discovery. If this is a concern, patent protection is a preferred choice.

Copyrights

Copyrights protect original works of authorship from copying. The works needs only to be minimally creative and must be fixed in a tangible medium. There is no filing or application process. Copyright grants the author exclusive rights to use the material as desired, and exclusive rights to create derivative works. Copyright does not protect processes. For example, the coding for a computer program would be protected, but the processes within the program could legally be duplicated so long as the code itself was not copied.

Status, Ownership, Risks, and Barriers

The commercialization team must understand the IP ownership, determine the IP protection strategy, identify associated risks, and develop a risk mitigation plan. The Quicklook should also identify and address potential barriers such as existing patents (freedom to operate), and prior art. Figure 14 illustrates the expanded 'Intellectual Property' focal point.

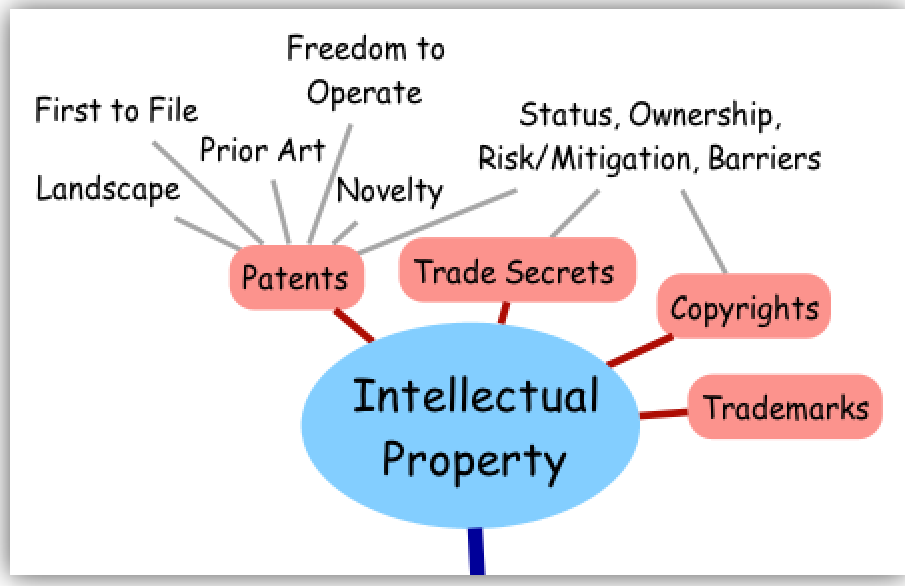


Figure 14: Fully expanded Intellectual Property focal point.

3.5 Commercialization Planning

The 'Commercialization Planning' focal point examines several important points relating to the technology's place in the market. As seen in Figure 15, these include the chosen business model, the sustainability of business opportunities, the core activities on which focus needs to be placed, and potential risks and barriers along the path to the market.

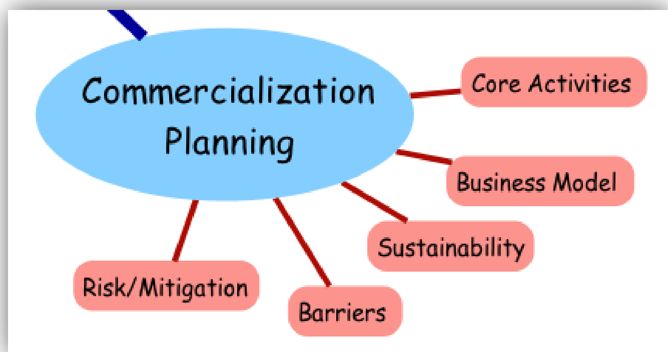


Figure 15: Expanding the Commercialization Planning focal point.

The business model describes how the product will be brought to the market and the role that the commercialization team will undertake. Licensing agreements, startups, and partnerships are common options. A price point should be set based on information acquired during primary research and the cost distribution should be broken down such that it is clearly understood how much money each party will spend and make in return. All numbers should stem from and be verified through primary research as much as possible.

Quicklooks must address the sustainable economic benefit that the product provides both the customer(s) and the commercialization team. Will the technology and the proposed business model allow the product to be profitable for an extended period of time, or will a level of saturation be reached? How will the competition respond to the new presence in the market? Will the chosen method of intellectual property protection be able to adequately protect the product?

The core activities that need to take place for commercialization to be realized must be identified. In essence, this is a “road map” to the market. Future steps may include activities such as further research in a specific area, laboratory testing, pilot testing, and market entry. This is referred to as the value adding chain as the completion of each step increases the product’s worth. The capital and time required for each step should be estimated.

Potential barriers could include required legal or regulatory approvals. If the product will be used in the medical field, FDA approval will almost certainly be a factor. A risk would be a concern of poor market acceptance due to a lack of familiarity with the technology. If the product is not understood, potential users may be skeptical that it can perform “as advertised.” A strategy should be developed to minimize any risks. Figure 16 displays the fully expanded ‘Commercialization Planning’ focal point.

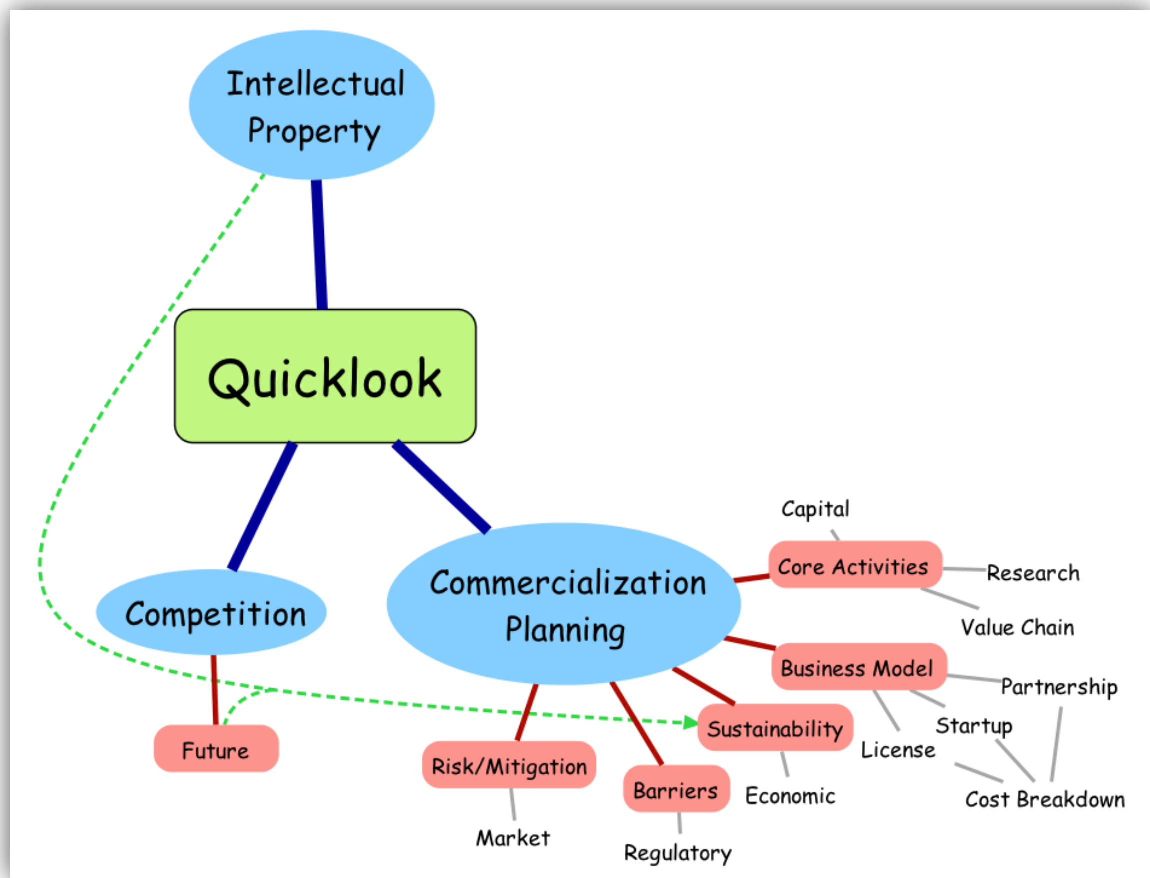


Figure 16: Fully expanded Commercialization Planning focal point.

3.6 Financial Analysis

As shown in Figure 17, 'Financial Analysis' requires a quantitative analysis of the potential profitability of the product. The analysis includes the value proposition for the customer, the value proposition for the seller, and revenue projections.

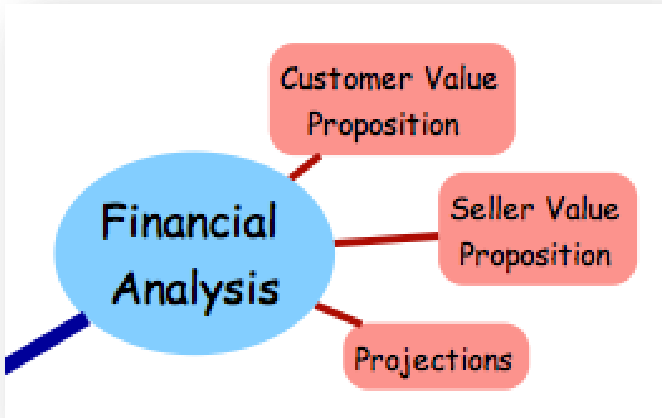


Figure 17: Expanding the Commercialization Aspects focal point.

Figure 18 illustrates the value proposition for the customer as well as the value proposition of the commercialization team. These values are determined from the perspectives of both the customer and the seller. Meaningful results can be obtained through primary and secondary research, but the quantities represent approximations. The customer value proposition is the difference between the value the customer places on the product and the customer's purchase cost. The value proposition for the seller is the difference between the cost at which it is sold to the customer and the cost of parts and services required to make the sale. The value proposition must be reasonably positive for both customer and seller to justify continued commercialization efforts.

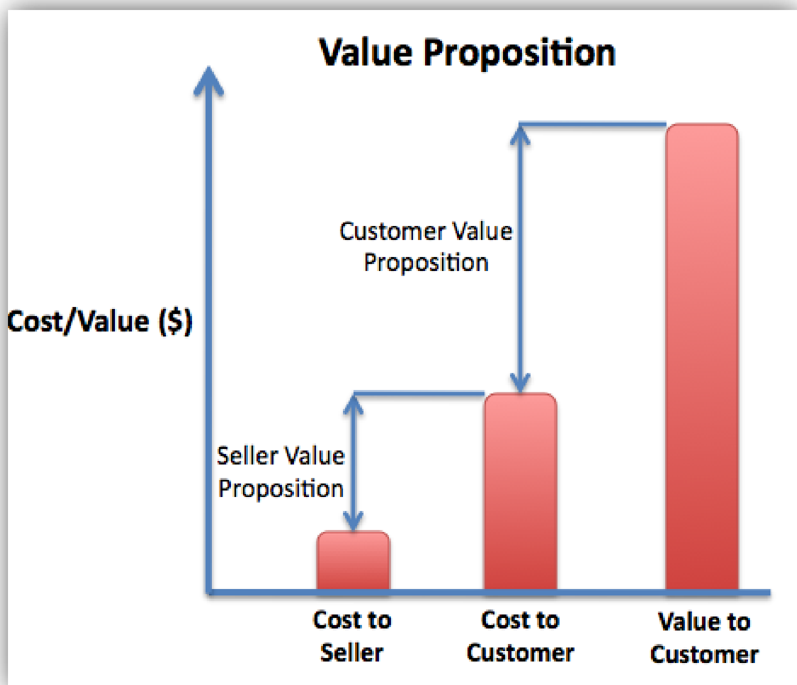


Figure 18: Customer and seller value proposition.

The value proposition and the chosen business model can now be analyzed to create revenue projections. This will not be an in-depth analysis, but rather an educated guess based on the entirety of the analysis up to this point. Projections should be performed for the expected market share. It is often helpful to analyze a best, likely and worst case scenario over a period of several years. The breakeven point for each should be noted. Figure 19 displays the fully expanded 'Financial Analysis' focal point.

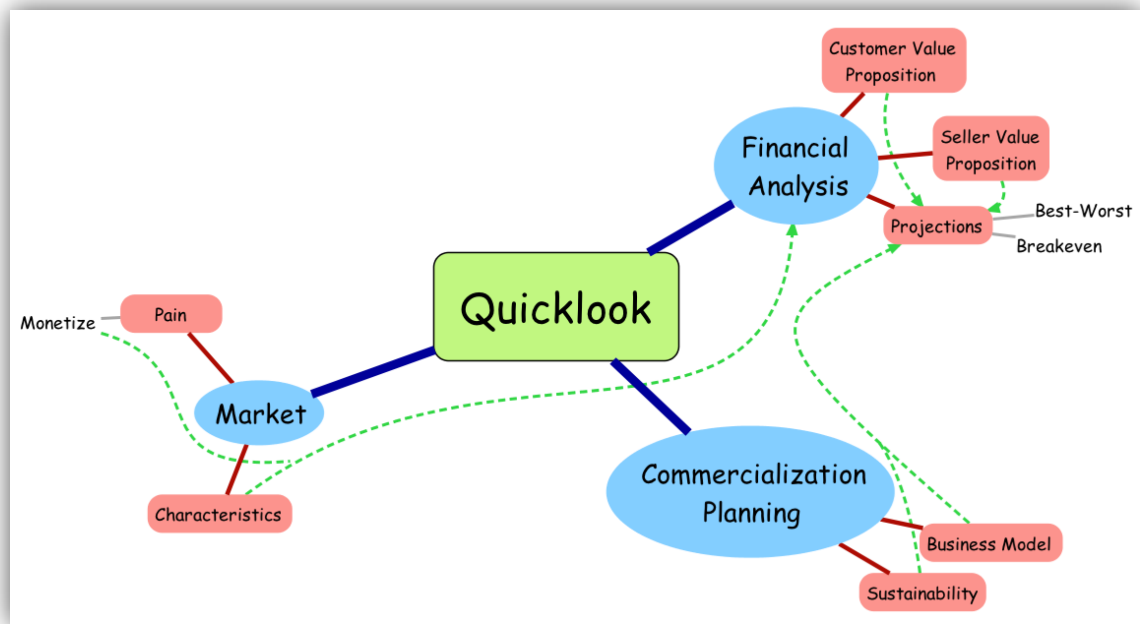


Figure 19: Fully expanded Financial Analysis focal point.

3.7 Proposed Activities / Recommendation

'Proposed Activities', Figure 20, is the final stage of the Quicklook analysis. This stage evaluates the overall opportunity and results in a recommendation as to whether or not one should proceed in the commercialization process based on the analysis described in the preceding sections. This recommendation may be in the form of a "go no-go" decision, but the results are frequently more nuanced (i.e. conditioned on factors not yet known or knowable—outcomes of technology risks, changing market conditions, technical break-throughs, or barrier removal.). A number of future factors can heavily influence the appropriate course of action. In these cases, the recommendation will be based on the outcome of these future events.

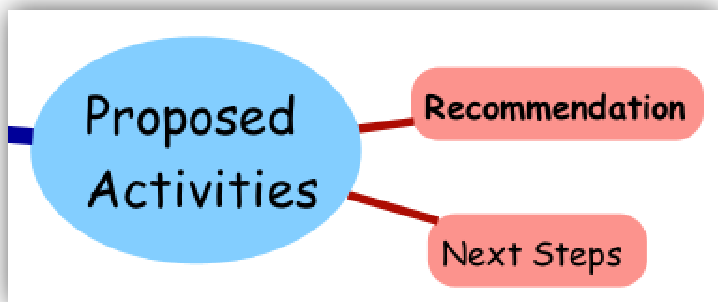


Figure 20: Expanding the Proposed Activities focal point.

The next steps along the path to market should be determined if the decision is to proceed with commercialization. The core activities should be clearly understood. This will likely include areas where refinement is needed to allow the product to better match the needs of the market. A timeline noting significant expenditures and events should be created.

The Quicklook is not a sales document. Rather the Quicklook aims to examine, in an unbiased environment, the commercialization potential of a technology/product mix aimed at a specific market need. As mentioned, negative points should not be left out or down played. Having a "good" technology should not play a part in the decision making process. Many "good" technologies have failed in the marketplace (Jolly 1997). The recommendation should be made solely based on the analysis. Figure 21 displays the fully expanded 'Proposed Activities' focal point.

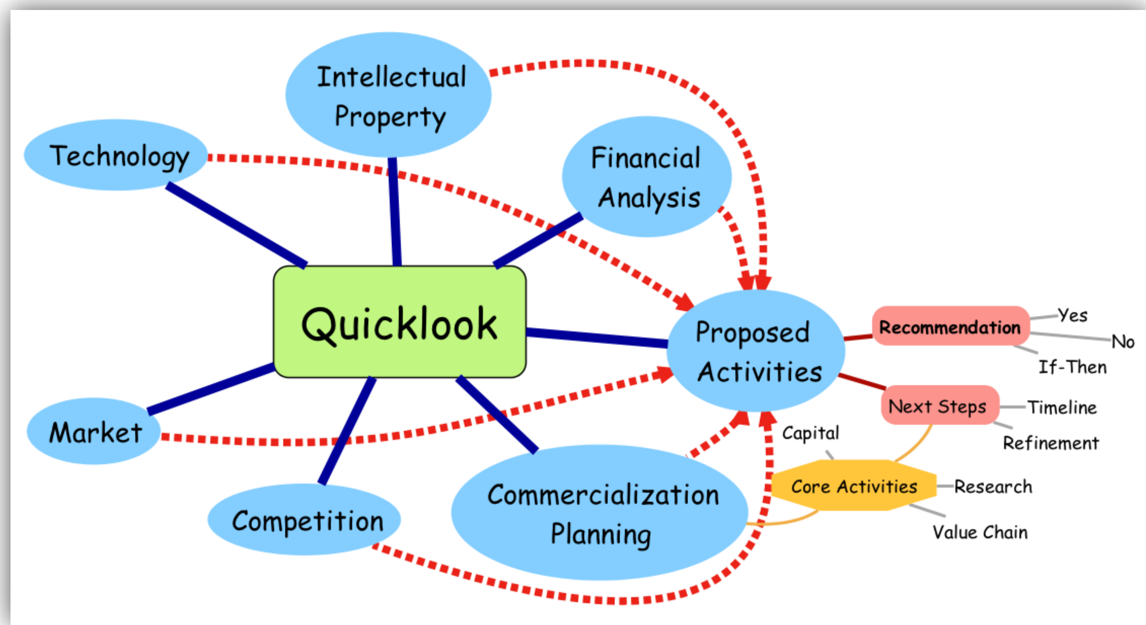


Figure 21: Fully expanded Proposed Activities focal point.

3.8 The Completed Mind Map

The completed Mind Map, Figure 22, displays the methodology in its entirety. It will be used as an outline for the example Quicklook report that follows. The Mind Map does not command a specific sequence, since each report will need to be tailored to the technology at hand. Numbers have been added to the first two layers of the map based on the order of the preceding discussion. These numbers will be used to match the corresponding sections in the example Quicklook report via parenthetical references. Most, but not all of the points on the Quicklook Mind Map will be discussed directly. Points that are implied or follow naturally will not be explicitly stated, and will therefore remain unnumbered. The next chapter provides an example of a Quicklook.

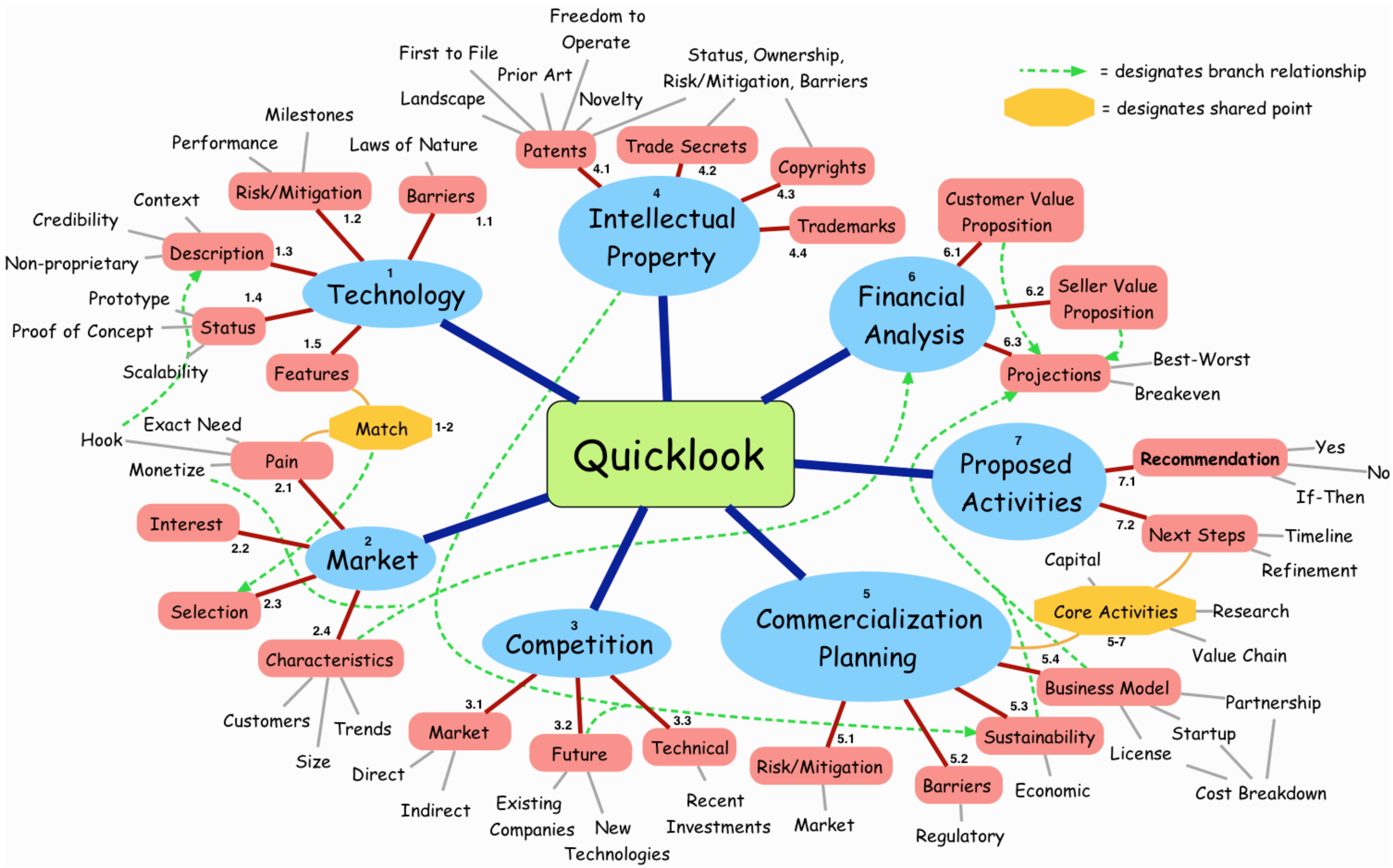


Figure 22: The completed Quicklook Mind Map.

Chapter 4: Example Quicklook - Interface for the Transport of Air Sensitive Samples

This technology helps researchers in the field of surface analysis by reducing sample oxidation and contamination, thereby leading to expanded research capabilities. While many designs for transferring environmentally sensitive samples from atmospheric pressure to ultra-high vacuum (UHV) exist, they all suffer from limitations and a standard design has yet to emerge. The surface analysis community has been reinventing the wheel for the last 30 years when it comes to transferring such samples. Currently, the integrity of samples cannot be known with certainty after the transfer process and the usual pump down methods may inadvertently add to the molecular contamination and oxidation (2.1)[8]. For a 7% increase on the instrument's original price, the ROx™ (**R**educed **Ox**idation) Interface mitigates these problems with a new and semi-automated pump down process (1.5). It also yields a Figure of Merit (FOM) that displays the success rate of the transfer and it has the potential to double the throughput of the instrument on which it is installed leading to annual revenue increases of several hundred thousand dollars.

[8] Parenthetical references in this chapter refer to the corresponding points on the Quicklook Mind Map in Figure 22.

4.1 Description of Technology

The ROx™ Interface is a loading dock for an airtight transfer capsule (1.3). It specializes in transfering samples from glove boxes to ultra high vacuum chambers (base pressure of 2x10^-9 Torr) where surface analysis instruments—such as X-ray Photoelectron Spectroscopy (XPS), Figure 23, and Time of Flight Secondary Ion Mass Spectroscopy (TOF-SIMS)—allow the user to determine the elemental and molecular composition of a material, respectively. Surface analysis with these instruments takes place within the first 2-10 nanometers of a material; therefore, it is important that the samples be as free of oxidation and contamination as possible in order for meaningful interpretation of spectroscopic data. ROx™ contains both hardware and software components and can be installed as a replacement to the instrument's existing transfer interface.

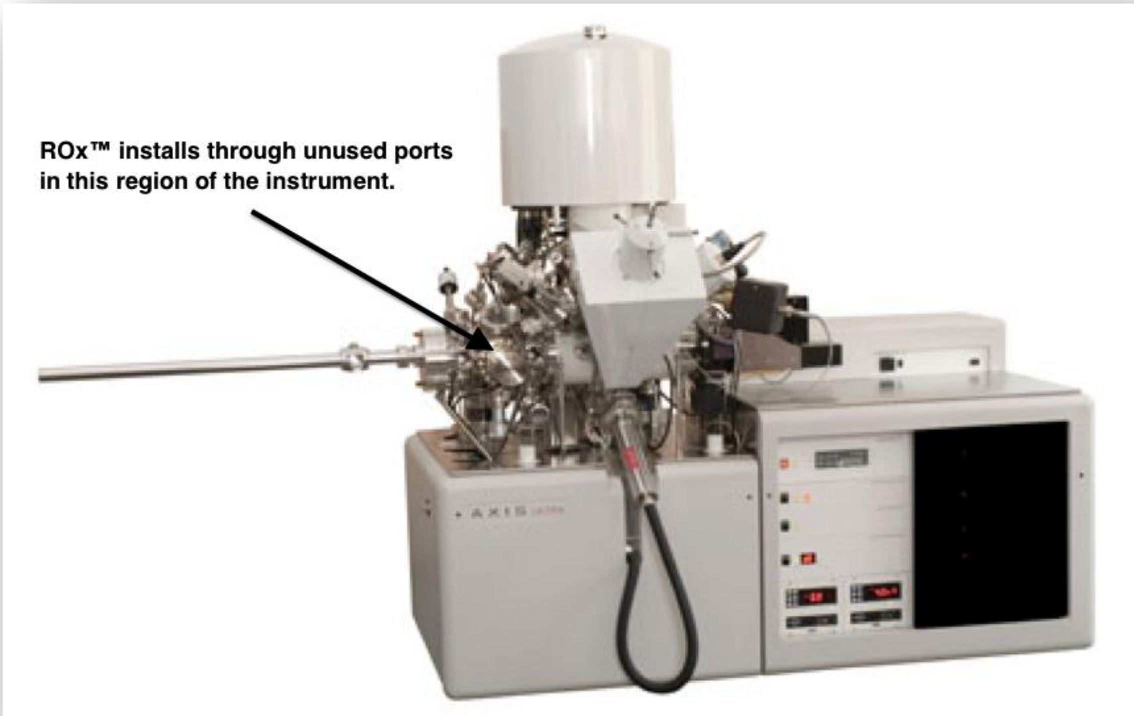


Figure 23: An XPS from Kratos Analytical.

ROx™ specializes not only in the transfer of air sensitive samples, such as Li-based battery materials, but also in cases where molecular contamination is a point of concern (1.5). The semi-automated pump down process is unique in that it avoids subjecting the samples to backstreaming from a mechanical pump (a source of hydrocarbon and oxydant contamination). ROx™ is also beneficial when working with outgassing samples. As implied by the name, samples that are outgassing continue to emit gasses as a result of their synthesis for some time (often hours). These samples cannot be introduced to the instrument's analysis chamber until the outgassing stops. ROx™ is able to moniter and accelerate this process.

A novel component of ROx™ is the built-in FOM (1.5). FOM allows the user to validate the successful transfer of their sample while permitting any problems to be tracked to the sample's previous place of storage (usually a glove box), the transport capsule, or the pumpdown process of the interface. FOM also allows the cleanliness of glove boxes to be compared. One can easily see top performers and the "underachievers" in a setting where multiple glove boxes are in use. This allows the sample's exposure to contaminants to be further understood. This can be taken one step further if the user has a Residual Gas Analyzer (RGA) installed on the analysis instrument. ROx™ can interface with the RGA to allow an analysis of the molecular content of the glove box. Current interfaces are less reliable when it comes to sample transfer and give no indication of how well it was performed. The high reliability of the ROx™ Interface increases the usability of materials analysis instruments.

Another feature of the ROx™ Interface is its ability to accept "bar" sample holders (Figure 24, top). This allows multiple samples to be placed in the analysis chamber simultaneously (1.5). Other capsules/interfaces for air sensitive samples are limited to "pucks" only (Figure 24, bottom). "Pucks" limit the throughput of the instrument as the loading and unloading of samples is a timely process. ROx™ has doubled the throughput of the XPS on which it is currently installed and allows the use of other capabilities such as sample sputtering for depth analysis. A map of the technology can be seen in the Appendix.

Figure 24: "Bar" and "Puck" sample holders.

4.2 Market Analysis

Surface analysis is a relatively small and specialized field. The total number of instruments in the market is on the order of hundreds, each with a price tag of approximately $1,000,000 (2.4). The leading companies in the XPS field are Kratos Analytical, Thermo Scientific, and Physical Electronics. Combined global annual sales are estimated to be between 50 and 90 units creating a market ranging from $50,000,000 to $90,000,000[9]. The ROx™ Interface could be added to the majority of previously purchased instruments.

[9] Author's estimate based on primary research.

One company stated that they typically sell 25 to 30 instruments annually (2.4). Of these, approximately 10% buy a transfer vessel that allows the analysis of air sensitive samples. The company's President said that after buying and using their transfer capsule, some customers do seek a better solution. One of the leading options is to attach a glove box directly to the XPS and interest is said to be slow, but steady. Representatives from another company stated that approximately 30% of their customers use an airtight transfer vessel. A representative from a third company said that he was surprised transfer vessel sales at his company were not higher. He speculated that it might be due to a lack of satisfaction with current solutions or due to the cost given that it is a limited use item.

ROx™ can also be installed on a TOF-SIMS instrument. While the TOF-SIMS market is not as large, the technique is up to six orders of magnitude more sensitive to oxidation than XPS, as just the first two nanometers of the sample are analyzed. Targeting users with a TOF-SIMS is also wise because a customer with a TOF-SIMS will likely have an XPS as well. This creates the opportunity to sell two interfaces. The TOF-SIMS complements the analysis provided by the XPS. The combination of the two techniques is very powerful and for this reason there is a slight push to link the instruments in an effort to avoid air exposure during transport (2.4). However, this is a cost prohibitive approach to the problem as these cluster chambers cost between \$250,000 and \$300,000. Research Associate Stephen McDonnell from The University of Texas at Dallas says that ROx™ could potentially reverse this trend by offering a cost effective solution for those who work with environmentally sensitive samples.

4.3 Market Interest/Barriers

"There is definitely a need for figures of merit."

-Mark Engelhard, Sr. Research Scientist at Pacific Northwest National Laboratory

Primary research indicates there is undoubtedly a need for a better solution when it comes to transporting air sensitive samples. The handful of researchers interviewed all expressed interest in the features offered by the ROx™ Interface (2.2). Even if the technology was not directly applicable to their research, they were quick to think of others who would surely benefit from such features. The need, however, will have to be created to some extent (5.1). The field has adapted to what is currently available. People have either created their own solution to the problem, decided to tolerate a certain level of oxidation, or limited their research to areas supported by the current methods of transferring samples (2.1). ROx™ solves the problem to the extent that it even creates new research opportunities, particularly in studies where oxidation kinetics occur very rapidly (1-2). The challenge will be making researchers realize there is now a better way to transfer environmentally sensitive samples.

End user Paul Abel from the Chemical Engineering Department at University of Texas at Austin would not have been able to perform his research without ROx™. The previous transfer capsule and interface (from Kratos Analytical) allowed too much air exposure despite being marketed specifically for air sensitive samples (2.1). ROx™ "made the paper" in his case. End user Justin Hall from the Chemistry Department at the University of Texas at Austin said the interface makes it possible for his group to take advantage of XPS since it is capable of safely transferring highly reactive pyrolytic materials and has reduced sample transfer time from overnight to an hour.

Representatives from Kratos Analytical, Thermo Scientific, Physical Electronics, and ION-TOF expressed interest in learning more about the technology and potentially entering licensing agreements once a patent application has been filed (2.2). It was also unanimous that they would be willing to recommend ROx™ if the customer's needs exceeded the ability of their own solutions. It was made clear, however, that they would try to sell their products first.

David Surman from Kratos Analytical was impressed by the ROx™ Interface's ability to accept the "bar" sample holder (2.2). He felt this alone was a major selling point. As previously mentioned, nearly all other methods of transferring air sensitive sample are limited to the "puck" sample holder. There is one glove box attachment option that can accept the "bar."

Feedback for FOM was mixed. No one thought it was a bad idea, but several questioned how useful it would be once the user saw that ROx™ was capable of performing "as advertised" (2.2). Others were excited by the prospect of knowing, with certainty, that the samples were transferred safely and by the ability to pinpoint the area of contamination in the event something goes wrong. Mark Engelhard of Pacific Northwest National Laboratory was especially interested in FOM. He believes there is a void in this area and is more than willing to help get a product like this to market. His input is particularly encouraging considering his experience in the area of air sensitive sample transfer (his research group tests XPS attached glove boxes). While skeptical that demand will come in high volumes, he does expect that it will be long term (5.3). He warns that he expects funding at universities and national laboratories limited the next few years due to the recession (5.1). He says the demand within the entire field is on a slight downward slope due to this (2.4). David Surman echoed this by stating that sales for ROx™ may vary from zero to upwards of five per year depending on available funding. A map of the customer buy decision can be seen in the Appendix.

4.4 Development Status & Technology Barriers

A prototype of the ROx™ Interface has been in use for almost a year at the University of Texas at Austin on a Kratos XPS (1.4). Refinement continues, but the current version is fully functional and has proven that it can successfully transfer air sensitive samples. It has allowed research to take place that would not have been possible otherwise. As a result, two papers have been accepted in highly regarded journals and two additional drafts are in preparations. It has also increased the throughput of the instrument from two users per day to four and has allowed users to apply other capabilities of the XPS such a sample sputtering for depth analysis within the same day.

Construction of a second prototype is set to begin in the summer of 2012. The second prototype will be installed on a TOF-SIMS instrument. The ability to successfully transfer samples between the two analysis instruments will be verified upon the completion of the second prototype. This is expected to expand the market for the interface by combating the slight push to couple XPS and TOF-SIMS with cluster chambers.

There are no developmental barriers at this time (1.1). There is, however, an issue that will pose a problem for some customers wishing to install the interface as an add-on (1.2). The current design requires opposing ports on the analysis instrument. Some instruments will not have this and will therefore not be compatible with the interface. This is not expected to be a critical problem as add-on sales will be a secondary market and the majority of previously purchased instruments are expected to be compatible.

4.5 Intellectual Property

A patent application has not been submitted (4.1). The technology was disclosed to the Office of Technology Commercialization (OTC) at the University of Texas at Austin in the fall of 2011. OTC has released the technology to inventors Hugo Celio and Justin Johnson. A search revealed several patents for airtight transfer vessels and glove boxes, but nothing relating to the novel aspects of ROx™ was discovered (4.1). Furthermore, while conducting interviews, no one had heard of anything similar. Therefore, freedom-to-operate issues are not expected. The next step will involve a more detailed search by a patent lawyer. The claims of the patent can then be drafted. ROx™ will be difficult to commercialize if a patent cannot be acquired. Trade secret is not a viable option as ROx™ hardware could be reverse engineered without great difficulty (4.2).

ROx™ has the potential to be sold in many countries. International patent protection will need to be considered, but this will take place at a later time due to the high cost associated with pursuing such protection. Trademark protection will also need to be considered (4.4). A trademark search revealed the term "ROx™" is already registered and in use by multiple parties. However, problems are not expected given that other uses of the name are not related to surface analysis or vacuum equipment. The capitalization pattern also appears to be unique. The mark will be registered in the early days of the business. The software, coded in LabView®, will be protected by copyright (4.3).

4.6 Competing Technologies

The market offers several options for the transfer of air sensitive samples. These primarily consist of glove boxes attached directly to the instrument and a variety of "airtight" transfer capsules. Each of these approaches has its share of shortcomings. ROx™ does involve the use of an airtight transfer capsule, but it is set apart by the method in which the sample is transferred from the capsule to the instrument's analysis chamber. This carefully controlled process results in far less contamination than the simplistic transfer methods associated with traditional capsules. The transfer capsule utilized by ROx™ also boasts a lower leak rate than other airtight capsules. Figure 25 shows a competing transfer capsule (3.3). Notice that it is limited to "puck" sample holders and that it relies on O-rings to provide a seal. The approximate cost for this transfer capsule and the associated dock (very minimal) is $15,000.

Figure 25: "Airtight" transfer capsule.

The XPS attached glove box, Figure 26, results in less contamination than the transfer capsule approach, but it still cannot be used for certain catalysts and nanomaterials (3.1). It should be noted that attached glove boxes are designed to minimize oxidants and molecular contaminants—not to synthesize samples. An airtight capsule is still needed to transfer the sample from the glove box where the sample was synthesized. Problems may arise from the space required for an attached glove box and their maintenance intensive nature leads to extra costs. The attached glove box can also suffer from hydrocarbon back streaming, a source of contamination and oxidation. Prices range from $30,000 to $50,000 (transfer capsule not included in cost). Table 1 examines some key differences between transfer capsules, attached glove boxes, and the ROx™ Interface.

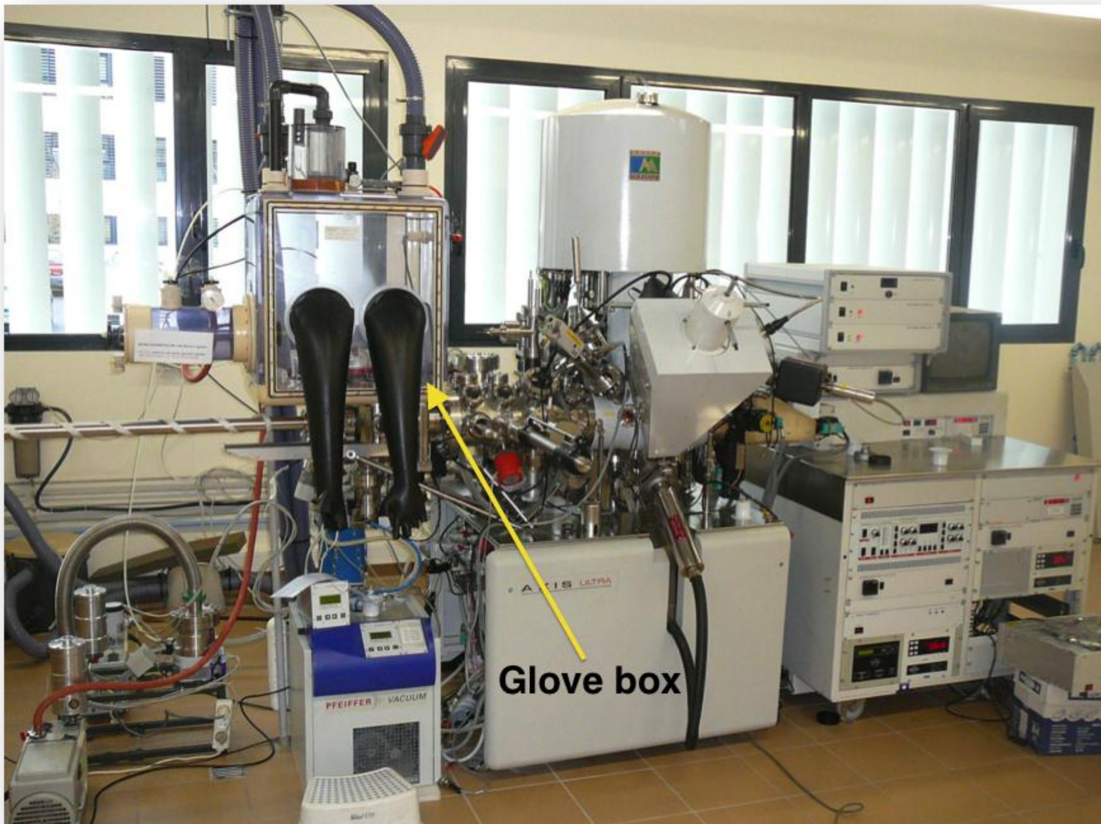


Figure 18: Glove box transfer option.

The third form of competition, and perhaps the most threatening, is non-action or complacency with the partial solutions that are currently available (3.1). Most researchers are conditioned to working within the confines offered of the current options. Some may attempt to mitigate oxidation related issues on their own while others accept that some contamination is inevitable. This mindset will have to be overcome.

Table 1: Competitor Analysis

	Transfer Capsules	**Glove Boxes**	**ROx™**
Transfer Time*	~90 MINUTES	~30 MINUTES	~60 MINUTES
Contamination	MOST	LESS	LEAST
Provides Feedback	NO	NO	YES
Avoids Back Streaming	NO	NO	YES
Semi-Automated	NO	NO	YES
Residual Gas Analysis	NO	SOME MODELS	OPTIONAL
Sample Holder	PUCK ONLY	PUCK, BAR (One model)	BAR OR PUCK
Cost	$5,000-$20,000	$30,000-$50,000	$70,000
Potential to Increase Throughput	NO	YES	YES
Notes	Inadequate for many applications. Limited throughput.	Bulky. Maintenance intensive. Inadequate for some applications.	Comprehensive solution.

**Assumes the sample is not outgassing.*

Future competition is not deemed to be a significant threat at this time provided that patent protection can be acquired (3.2). Neither primary nor secondary research give any reason to believe a similar invention exists or that others are actively working on commercializing a solution to the problem. It is hoped the claims within the to-be-written patent will be broad enough to prevent those in a position to act (primarily the instrument manufacturers) from doing so.

4.7 Commercialization Model

A licensing agreement appears favorable given its low risk nature, but the limited market would lead to a minimal revenue stream. Therefore, a small startup operation is likely the most profitable option (5.4). Ninety-five percent of the hardware consists of "off the shelf" parts. This is an enabling factor because it simplifies the supply chain and reduces the amount of capital needed upfront. The startup will license the technology from the primary inventor. The terms of this agreement will be decided at a later time. The primary inventor will be working closely with the startup operation in an effort to ensure its success; therefore, the current uncertainty of the licensing arrangement is not perceived as a risk. OTC will receive 5% of any consideration received by the inventors as a result of patent licensing.

The goal is to sell ROx™ as a purchase option for new instruments and as an add-on for instruments already in the field. The major companies all expressed a willingness to make the interface available for their instruments. Kratos Analytical and ION-TOF seemed to prefer a licensing agreement that would allow them to make ROx™ themselves. Thermo Scientific said they would likely buy the interface and resell it as their own. All agreed that they would be happy to point customers toward ROx™ (no licensing agreement) in cases where the customers' needs cannot be met by the options offered by their company. Further discussions will be required if ROx™ is to be offered alongside new instruments without licensing agreements. The commercialization model will have to be reevaluated in the event that companies are not open to a partnership

(5.1). A small number of add-on sales will be targeted initially in an effort to further validate the product and develop a favorable reputation before partnerships are negotiated.

The opportunity is believed to be sustainable for the foreseeable future (5.3). As long as new instruments are being sold, there will be an opportunity to sell ROx™. Some level of saturation will eventually be reached in the add-on market, but this will likely take many years given the nature of the market, namely, the expectation that the volume of sales will be low.

4.8 Financial Analysis

The targeted selling price for ROx™ is $70,000. While no firm price points were discussed during primary research (largely due the inability to fully describe the technology), this is based on the entirety of the research and a "feel" for the market. Currently, part costs are between $35,000 and $40,000. It is hoped that further optimization and negotiations with part suppliers can reduce this by at least 30%. The selling price will include all installation costs.

Table 2 displays revenue and profit projections (6.3). This table assumes a sales price of $70,000, a parts cost of $40,000 (worst case), and $2,500 in installation costs (shipping and travel). For this scenario, each sale yields $27,500 in profit. This assumes there are no employee, licensing, or overhead costs. This is a fair assumption for the early days of the business. The "employees" will initially be donating their time, and overhead costs will be avoided by running the company from existing (non university owned) facilities. If an employee were hired to assist in ordering and assembling the many components of the interface, the added cost is estimated to be $480 (32 hours at $15 per hour). In this case, each sale would yield approximately $27,000 in profit.

Table 2: Expected Value of ROx™

Units sold annually	**Revenue**	**Profit**
3 units	$210,000	$82,500
6 units	$420,000	$165,000
9 units	$630,000	$247,500

The value proposition for the seller is $27,500 per unit sold (6.2). The value proposition for the customer, although difficult to estimate, is expected to be upwards of $100,000 (6.1). This is based on two factors. First, ROx™ has the potential to double the throughput of the instrument. Rates for the Kratos XPS on which ROx™ is currently installed are $48 and $489 per hour for UT users and external users, respectively[10]. Assuming that doubling throughput will double revenue and that the instrument is in constant demand, ROx™ will generate an additional $50,000 per year given an hourly rate of $48. If external users make up 50% of the instrument's customers, the yearly revenue increase jumps to over $500,000. ROx™ also expands research opportunities.

[10] http://www.tmi.utexas.edu/equipment/small-angle-x-ray-scattering-saxs-facility-2/

New areas of research have the potential to create untold amounts of value for the customer.

4.9 Next Steps

Short-term goals for ROx™ include pursuing intellectual property protection and beginning construction of a second ROx™. The current prototype will also be further refined and modified during this time. The only expense in this step will come from applying for a patent. This cost is estimated to be $15,000. Texas Materials Institute (TMI) will cover development costs as further refinement of the existing interface and construction of a second interface align with their plans regardless of whether or not ROx™ is commercialized.

It is expected that sales can begin as early as the fall of 2012. In order for this to be possible, the final form of the product must be determined and the logistics of selling, building, and installing the interface must be considered (7.2). One benefit of a market with low sales volume is that each sale will be "personal" in a sense. Initially, it is likely that relationships will have to be built with prospective customers in order for them to better understand the need for ROx™. The various options and extras (the product's final form) can therefore easily be customized to meet the user's needs on a case-by-case basis. Minimal cost to the company is expected during this phase.

There are a few long-term goals to consider (5.3). As mentioned, ROx™ is currently installed through ports already present on the instrument. By working with the instrument manufacturers, it would be possible to integrate ROx™ directly into the instrument. This would reduce the number of parts and simplify the transfer process, thereby creating more value for the customer while reducing part costs for ROx™ by approximately 50%. It is also possible that ROx™ could become a standard in the field (5.3). This would require testing and approval from The National Institute of Standards and Technology (NIST). The development strategy for ROx™ can be seen in Figure 27 (5-7) and a map of the value adding activities can be seen in the Appendix.

Figure 19: Development strategy.

4.10 Recommendation

It is recommended that commercialization activities for ROx™ proceed (7.1). A startup company should be established. The market is small, but little capital is required upfront due to a lack of developmental costs and minimal overhead. The breakeven point will be reached after a single sale. Successful negotiations with part suppliers to reduce costs will make the opportunity even more appealing. Intellectual property protection is the biggest risk. Commercialization of ROx™ will be difficult if patent protection cannot be acquired. Also, partnerships with instrument manufactures must be carefully negotiated if ROx™ is to be offered alongside new instruments. This is a critical and uncertain portion of the business model. Primary research clearly displays the need for a better method to transfer air sensitive samples. ROx™ goes beyond meeting these needs – it increases the usability of the instruments on which it in installed and creates new research opportunities. The ROx™ Interface is the answer many researchers do not yet know they need.

Chapter 5: Conclusions

5.1 The Quicklook

A completed Quicklook incorporates a wide range of information that allows commercialization decisions to be made in an educated manner. The methodology enables a product to be tailored to a market with validated interest. Quicklook provides an improved understanding of the economic viability and sustainability and of the steps required to get the product to market. In the event of a no-go decision, hours of work and large sums of money can be saved for more promising opportunities.

Quicklook methodology uses a rational, step-by-step approach that allows helps avoid common pitfalls in commercialization. A new technology may seem promising from the perspective of the inventor or those involved with development. This belief can often be backed with secondary research, but it fails to take the reality of the end user into consideration. Talking to those with intimate knowledge of the market is the only way to be assured that interest truly exists. This allows the exact customer need to be discovered as opposed to an interpretation of the problem from an outside view. It also creates an opportunity to identify interested parties, such as potential licensees or partners, and allows the voice of the customer to shape the development of the product. Previous methods of assessing the market relied primarily on secondary research. Such methods fail to provide adequate depth when assessing a new technology, as relevant published information is typically limited.

Recognizing a solution for a real need in the market is only part of the equation. One must examine the potential for economic viability. This is the focus of the remainder of the Quicklook. Studying the intellectual property surrounding the technology, the competition, the business model, the value proposition, and the risks along the way gives an indication of the product's ability to be successful in the market.

5.2 Applying Quicklook Methodology to ROx™

Little was known about the place of ROx™ in the market prior the application of Quicklook methodology. One could only hazard guesses for the many unknowns after the initial round of secondary research. Nothing of great substance was discovered until the primary research phase of the methodology. There was demonstrated interest in the technology, an understanding of the competition, knowledge of the size of the market and potential sales volume, and a rough business model by the conclusion of this phase. The entirety of the collected data was then analyzed. Calculations were performed to assess the financial feasibility of moving forward with the technology under several business models.

While the results of the Quicklook analysis for the ROx™ Interface cannot be tested for quality and absolute truth without either extensive market research or years of hindsight, it is believed that decisions about moving forward can be made in a confident manner. Primary research sets the Quicklook methodology apart from other technology/market assessment methods. There is no substitute for speaking to those with direct knowledge of the market. The vast majority of the information contained in the report came directly from the mouths of those who know the market best. This allows a strong case to be made for the report's conclusions. Applying Quicklook methodology to the ROx™ Interface has successfully bridged the gap between the creation of a technology and the start of a business opportunity.

5.3 Using the Quicklook Mind Map as a Point of Reference

The methodology and report sections of this document were written at different times. The completed Mind Map was kept in mind, but not directly referenced, during the writing of the report. This provided an opportunity to analyze the Mind Map's usefulness. The focal points presented in the Mind Map were compared to the topics found in the draft report. It was quickly realized that the draft was underdeveloped in multiple areas.

Mind Mapping encourages a topic to be thought out in a detail-oriented manner that results in a thorough development of the area of interest. It is not surprising then that it would provide a more complete analysis than the "feel" based approach used when writing the first draft of the report. This reinforces the use of a Mind Map to display and teach the Quicklook methodology. It also demonstrates the usefulness of the Quicklook Mind Map as an outline for a Quicklook report. It presents the information in a logical and comprehensive manner that allows the author to easily see what is required of each section while allowing the freedom to organize the document as desired.

5.4 The Use of a Mind Map to Describe Quicklook Methodology

This thesis demonstrates the advantages offered by Mind Maps for examining the various components of Quicklook methodology. Mind Mapping allows the wealth of information encompassed by the Quicklook to be presented in a way that much more closely resembles the natural thinking pattern of the brain. The Quicklook Mind Map allows the viewer to quickly see the focal points and their subtopics in a way that provides a big picture view while depicting the relative importance of each item as a result of the layered approach. The use of color, varied font sizes, and strategic placement increase the readability and make the Mind Map more memorable and easy to comprehend. The step-by-step construction of this map brings order and simplification to an otherwise complicated process.

Appendices

APPENDIX 1: INTERVIEW SUMMARIES

Interviewees: Kevin Fairfax, Andy Weight

Positions: Managers at Thermo Scientific

- The K-Alpha XPS is the easiest to use (End user, Harry Meyer, agreed, but stated that it's not an R&D tool. Also said the company was great to work with)
- A glove box can be added directly to the instrument for air sensitive samples. That comes with a pump that has to be serviced every year.
- They don't receive many inquiries for the glove box.
- Have sold 100 K-Alphas and 100s of ESCALAB 250Xi.
- Our product would be niche.
- "People who do such work are used to the limitation of what is currently available, but they would be a market."
- There are a "decent" number of such people.
- May be interested in having it as a buy option for their instrument (want to hear from us after its patented).
- Would likely buy from us and resell.
- Estimated yearly sales in single, possible double digits
- Didn't express concern about us adding it to existing instruments (warranty likely expired anyway).

Interviewee: David Surman

Position: President of Kratos Analytical

- Use glove boxes on some instruments now. Says they're bulky and he doesn't sound thrilled with the solution.
- Cost about $50000 each – slow but steady interest in going down that route
- Kratos sells three transfer devices of their own priced at $5000 (small) and $10000 (medium) (the inadequacy of these devices ultimately led to the creation of the new interface).
- Some customers do come back looking for a better solution. He would be happy to send them our way.
- Really liked that our solution allowed an entire bar to be used (as opposed to only a puck). Thought this was a major selling point.
- Didn't know what to think about FOM. End users are concerned with leak rate.
- He would want to buy or license from us.
- Estimated sales from 0 to 3 or 4 per year for our interface.
- Estimated 0 to 2-3 add-on sales annually.
- Sell 25 to 30 XPS instruments annually. About 10% of those buy a transfer vessel.
- 250 Ultras in the field.
- Total of 300 instruments in the world.
- Expects a 5-year window for this technology (maybe 10).
- Says it won't be a huge moneymaker, but it may do alright.
- Says ours probably needs to cost $3000 or less in parts.
- Not much chance to sell around $20,000.
- Potentially interested in licensing (wants more details).

- If not licensing, would try to sell theirs first, but would then happily point customers our way.
- Post interview thoughts - he didn't seem to have the best understanding of what exactly our technology is and we couldn't describe it further due to the NDAs. Didn't explain the different pump down process so no credit was given to the fact that this tech keeps samples cleaner. Comment about parts cost of less than $3000 further demonstrated a lack of understanding.

Interviewee: Bill Gerace

Position: Manager at Omicron

- Omicron doesn't really compete with Kratos. Their focus is different.
- They have a load lock for inputting air sensitive samples. It has a unique shape and dimensions of 18*15mm. (Sounds rather crude, carries a price tag of $20,000)
- Believes it's next to impossible to have a universal system due to different standards. Says this could be worked around will only minor changes though.
- The option to transport air sensitive sample is not highly demanded by their customers.
- FOM sounds great, but it's not a big demand item.
- Omicron is not likely to offer our interface as an option because they are very custom.
- He does thinks others would likely be interested.

Interviewee: Nathan Havercroft

Position: ION-TOF Sales Manager

- Customers would like the FOMs the first time the first time they use it, but may not care once they know it works.
- Hasn't heard of anything close to our system.
- Have a couple partial solutions of their own.
- Vacuum transfer sales very low- surprised it's not higher - speculated that it may be from a lack of satisfaction with current solutions or the cost involved for a limited use item.
- They would try to sell their option first, but would be more than happy to point customers our way if customers wanted a better solution.
- They would need clear demand to be interesting in joint licensing.
- 235 TOF SIMS out in the market currently - would want a demand of 50.
- Customers are very likely to have an XPS if they have TOF SIMS (potential to sell two).

Interviewee: Michael Burns

Position: Researcher at Karlsruhe Institute of Technology

- His research involves batteries.
- Very interested in the possibility of being able to dig further into R&D as a result of the interface.
- Would be very helpful to have a system that allows problems to be excluded and provides more certainty.
- Overall, he was thoroughly excited by the prospect of the new interface.

Interviewee: Cliff Henderson

Position: Researcher at Georgia Tech – Graphine Films

- "That's interesting."
- Said it may be useful for him, and that it would certainly be useful for coworkers
- "It would be hard for there to be a case where no one would want it."

Interviewee: Stephen McDonnell

Position: Research Associate at The University of Texas at Dallas

- "It's always good to know if something's gone wrong."
- The ability to compare glove boxes would be very useful.
- His group tries to do all their work within the instrument to ensure it is never exposed to air.
- There is a bit of a push to link instruments to avoid air exposure, but something like this could reverse that.
- SIMS and XPS together are very powerful so the ability to safely transfer between the two would be great.
- He would want FOMs it he couldn't do all of his work within the instrument.
- "There is much potential for figures of merit and how interesting they could be."

Interviewees: Saad Alnabulsi, Chris Von Ruden

Positions: Applications Engineer and Central Region Sales Director at Physical Electronics

- They've sold transfer vessels, but no glove boxes.
- Our interface "could be interesting."
- Specific people may be interested, but the volume would probably be low.
- They have not received requests for such a device. The end users take care of it on their end.
- People currently have a work around for the problem meaning the need would have to be developed.
- "Applications definitely exist."
- Could use for film growth in growth chamber.
- DOD and DOE laboratories may be interested for explosive samples and maybe the FDA for cases where everything needs verified.
- Got the sense that they were more interested in licensing.
- They are certainly interested in further discussions if there proves to be demand.
- Said to expect a fairly low number of sales.
- Will have to make people care/realize they need it.
- Customers typically ask, "Do you have a transfer vessel?" as opposed to "How good is your transfer vessel."
- Approximately 30% of their customers use a transfer vessel.
- Have sold 100 Versa Probe in four years.
- Over 300 Quantera in the market.
- They would be happy to listen to more details.

Interviewee: Mark Engelhard

Position: Sr. Research Scientist at Pacific Northwest National Laboratory

- They sell two glove box options for direct attachment to Kratos XPS. One can handle bars.
- Glove box still isn't good enough for some catalyst depending on their reactivity.
- Nano materials can also present problems.
- Glove box does have its limitations from an oxidation standpoint.
- Hydrocarbon back streaming from oil pumps is a problem.
- Will use nitrogen purge if he wants to keep things very clean.
- $30,000 or more for glove box.
- He's trying to spread the word about oxidation.
- Glove box can do something similar to the residual gas analysis capabilities of the ROx™ Interface.
- Omnistar gas analyzer can be very helpful when it comes to tracking down problems.
- Says there is definitely a need for the figures of merit. He has been stressing this for the last ten years. He says it is valuable and that there is a void in this area.
- Interface will be more valuable if it can be easily used on multiple instruments.
- Thinks there is an increasing need for such capabilities.
- Believes working with the vendors will be the best option in his opinion because most people will first go to them first.
- The entire field is in a slow downward slope at the moment in terms of demand given the recession.
- Skeptical of high volume demand for our product, but certain there would be long-term demand.
- Funding at Universities and national labs will be tight for the next few years.

- There is some growth in industry.
- Happy to help anyway he can.

Interviewee: Paul Abel

Position: Student at the University of Texas, Austin

- Has lots of experience with vacuum equipment and while he never used the old interface, he can imagine it well.
- Said the training process for the ROx™ interface was pretty straightforward. Thinks he could do it on his own after seeing it once.
- He could not have done his research without the ROx™ interface. The old interface allowed too much air exposure.
- He future work will again require the ROx™ interface.
- People don’t think about solutions to oxidation until they're faced with a problem where they need one.
- Thinks it would be more successful as buy option.
- $50k price point seems reasonable based on knowledge of parts.
- “You don't miss until you need it, but it makes the paper because you have it.”
- He could think of several labs that could benefit from its use.
- Imagines it would prove beneficial to other universities as well.
- The ROx™ interface has been very helpful in his research.

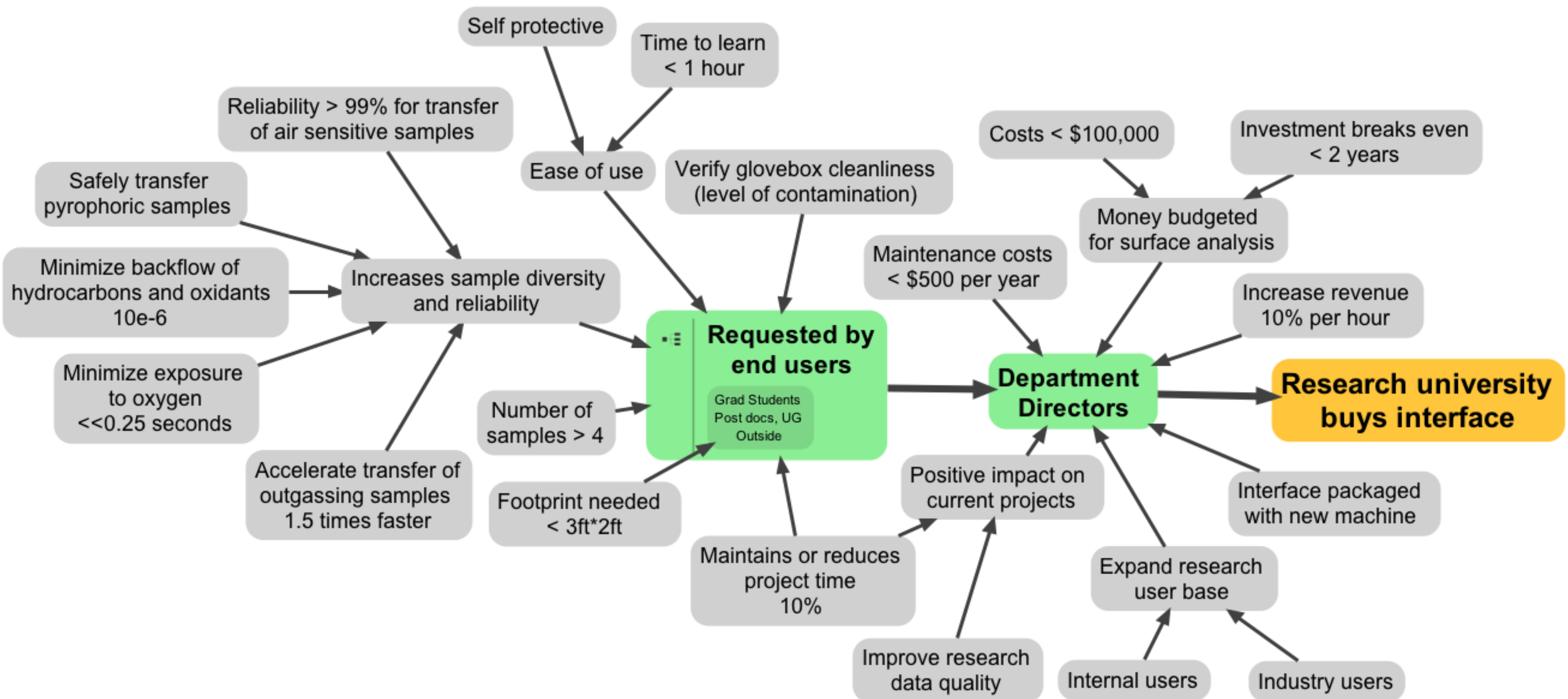
Interviewee: Justin Hall

Position: Student at the University of Texas, Austin

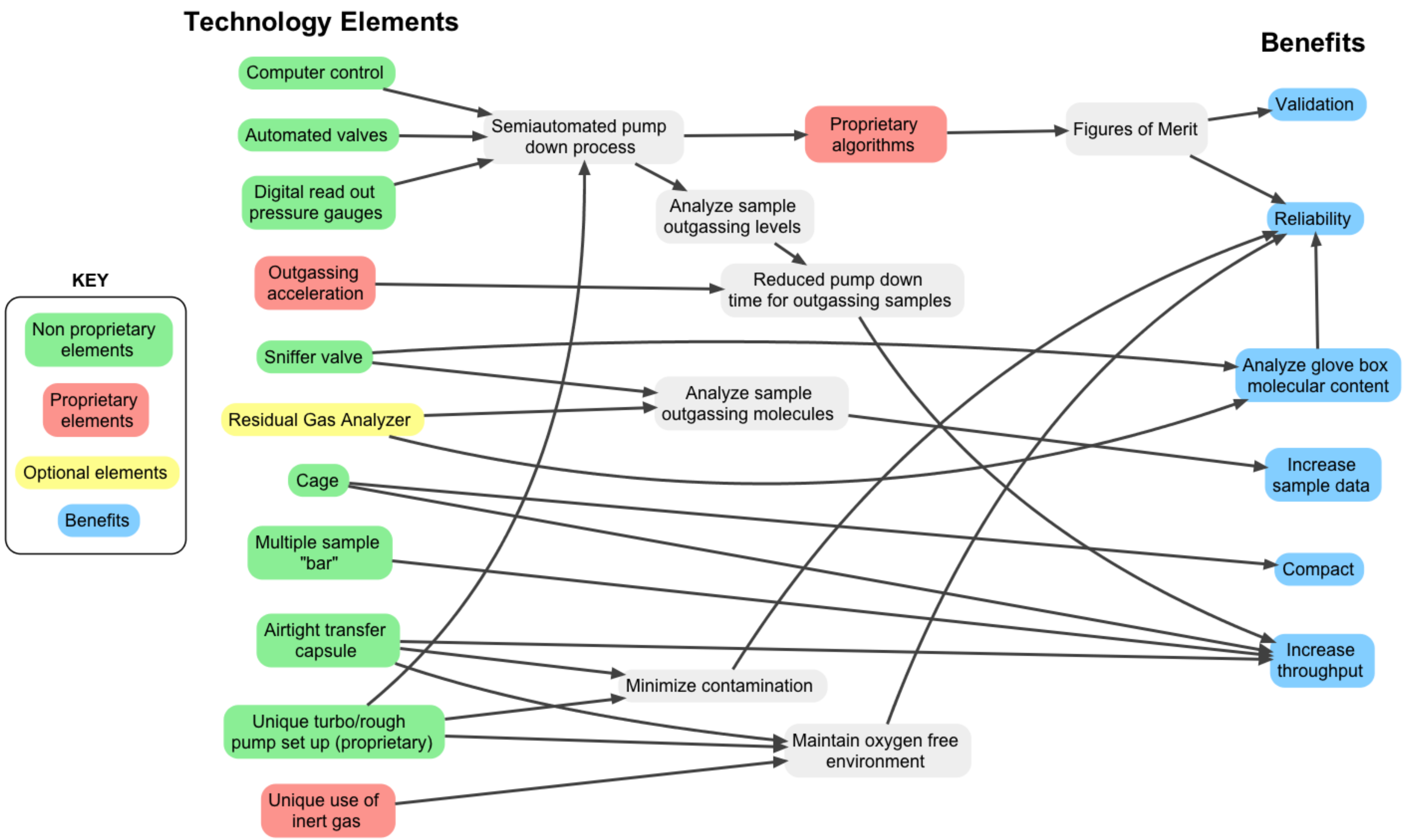
- Dropped transfer time for his samples from overnight to an hour.
- He says speed is a big part of the novelty.
- Says ease of use should be cleaned up before selling and that it's not overly intuitive. He recommends that the interface automatically generate the Figures of Merit.
- Sees the interface as most helpful to inorganic chemists.
- Allows him to get info on bonding environment for the sample.
- Allows them to actually use the XPS.
- Would like to see more of this kind of research.
- The old capsule/interface would take too long and wouldn't validate the success of the transfer.
- Others would certainly find it useful.
- Figures of merit aren't a tremendous value for him, but would be good for analytical users.
- He likes the ability to validate how well the glove box is doing.

APPENDIX 2: FUNCTION ANALYSIS

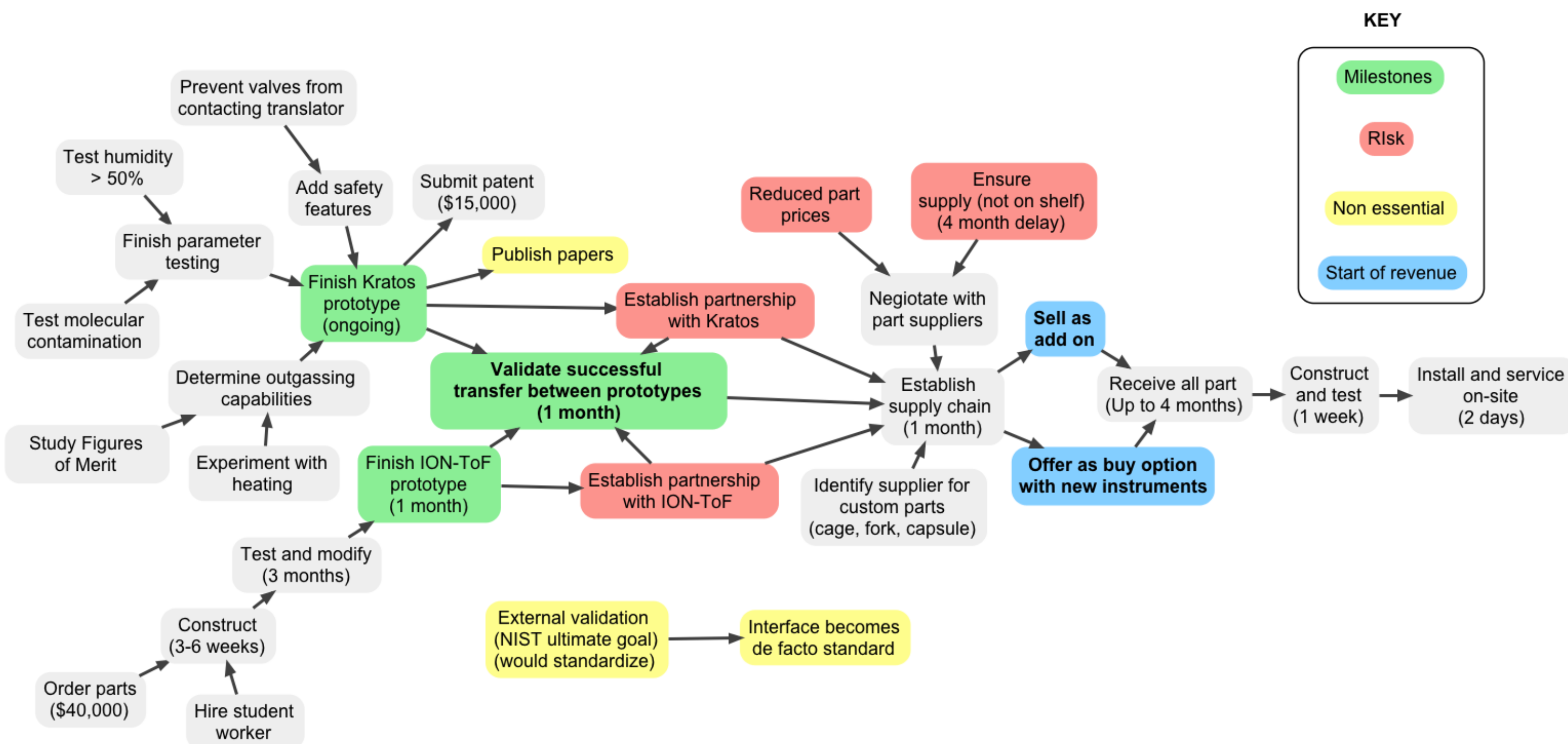
Map 1: Customer Buy Decision



Map 2: Technology



Map 3: Value Adding Activities



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Vita

Andrew Harbert was born in West Virginia. He lived in Pennsylvania for six years before returning to his home state. He holds a B.S. in Mechanical Engineering and a B.S. in Aerospace Engineering from West Virginia University. His future plans involve pursuing the business opportunity presented in this document. He eventually hopes to start a company based on a technology of his own creation.

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This thesis was typed by the author.