Improving Utility Patent Value by Design: future business competitiveness through multi-stakeholder engagement for patent content creation.

by

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ABSTRACT

Growth through innovation is critical to Small and Medium-sized Enterprises (SMEs) and the use of patents is necessary to attract needed funding. SMEs' use of the patent system is not as effective as larger companies and Canadian SMEs' patent success underperforms compared to those from other industrialized countries (Nikzad, 2015). This research inquiry considers product development stakeholder's knowledge to increase the relevance of patent disclosures for more successful patents and business competitiveness. The research uses a mixed method questionnaire to gain insight from a broad selection of product development experts that include design, marketing, engineering, upper management, entrepreneur and legal representation. Stakeholder salience concepts are applied to identify stakeholders with forward looking patent attribute awareness. Insight generation techniques applied to the quantitative and qualitative data indicate that extended stakeholders have important knowledge to improve SME patent disclosures. Key barriers to the acquisition of this knowledge are identified as well as solution approaches that include interdisciplinary activities. The industrial designer is identified as having attributes and knowledge that could effectively assist the cross-boundary communication needed to acquire new knowledge from extended product development stakeholders.

Keywords: designer, stakeholders, salience, boundary objects, patents, patent disclosure.

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TABLE OF CONTENTS

ABSTRACT	i
ACKNOWLEDGEMENTS	ii
LIST OF FIGURES	vii
LIST OF TABLES	ix
LIST OF APPENDICES	x
PREFACE	xi
1. INTRODUCTION	1
1.1 Rationale	2
1.2 Research questions	4
1.3 Contribution	4
2. LITERATURE REVIEW	6
2.1 Literature Review Introduction	6
2.2 Incentive to Patent	8
2.3 Characteristics of Small Firm Patent Strategies	8
2.4 Patent Quality and Value	10
2.5 Intellectual Property Barriers for Small Firms	11
2.5.1 The Legal Document Content	12
2.5.2 Establishing Patent Disclosure Information Internally	13
2.5.3 Patent Usefulness in the Future	14
2.6 Knowledge Acquisition	14
2.6.1 Barriers to Information Flow in Product Development Teams	16
2.7 Stakeholder Theory and Identification	18
2.8 Product Development Stakeholders	19
2.8.1 Marketing and Sales	20

2.8.2	Engineering	21
2.8.3	Designer	21
2.8.4	Management and Chief Executive Officer	22
2.8.5	Legal	22
2.8.6	Entrepreneur and Inventor	23
2.9	Stakeholder Salience to Patent Content	23
2.10	Dynamic Capabilities and Business Competitiveness	24
2.11	Establishing future Oriented Attributes of Patents (X-Factors)	25
2.11.1	Awareness of New Product Specification	26
2.11.1	Awareness of the Product's Full Development Cycle	26
2.11.2	Awareness of Technology and Industry Trends	26
2.11.3	Awareness of Usability and User Understanding	27
2.11.4	Awareness of Product Cost and Quality Drivers	27
2.11.5	Awareness of Competitive Understanding	28
2.12	Literature Review Summary	28
3.	METHOD	30
3.1	A Philosophical Approach	30
3.2	Methods Map	31
3.3	Research Design	31
3.4	Research Method	32
3.4.1	Participant Selection	34
3.4.2	Questionnaire Design	35
3.4.2.1	Quantitative Data Codification	38
3.4.2.1.1	Stakeholder Positioning Graph	41
3.4.2.1.2	Determining Stakeholder Influence on Future Attributes	42

3.4.2.2	Qualitative Data Codification	43
3.4.2.3	Questionnaire Delivery	45
4.	DATA COLLECTION AND ANALYSIS	46
4.1	Questionnaire Data Collection Period	46
4.1.1	Section 1 - The Participants	46
4.1.2	Section 2 - Networking Between Stakeholders	50
4.1.3	Section 3 - Stakeholder Understanding and Communication About Patents	52
4.1.4	Section 4 - Effect of time and cost on their participants involvement in IP	54
4.1.5	Section 5 - Future Oriented Attributes for Patent Disclosure (X-Factors)	55
4.1.6	Section 6 - Acquisition of Information for Patents	58
4.1.7	Stakeholder Positioning	61
4.1.7.1	Product Development - Stakeholder Positioning	61
4.1.7.1	Patent Development - Stakeholder Positioning	62
4.1.7.2	Stakeholder Salience Mapping	64
4.2	Qualitative Questions - Section 7	65
4.2.1	Qualitative Question 1 (Q47)	66
4.2.2	Qualitative Question 2 (Q49)	67
4.2.3	Qualitative Question 3 (Q50)	68
4.3	A Specific Look at Legal Stakeholder Responses	69
4.4	Affinity Insight and Foresight Scenario from Open Questions	70
4.5	Limitations of the Study	73
5.	DISCUSSION	75
5.1	Insights from the Data Analysis	75
5.1.1	Adapting Stakeholder Salience	75
5.1.2	Specific to Legal Stakeholders	76

5.1.3	Extended Patent Content	77
5.1.4	About Stronger Intellectual Property through Stakeholder Involvement	78
5.1.5	Competitiveness	78
5.1.6	About Knowledge Acquisition	79
5.1.7	Patent-Storming	80
5.1.8	About designers facilitating patent disclosure	82
5.1.9	Patent Timeline with Barrier and Solution Approaches	82
6.	CONCLUSION	83
6.1	Contribution to the Field	86
6.2	Future research / development	87
	REFERENCE LIST	91
	APPENDICES	97

LIST OF FIGURES

Figure 1-1. Patent Timeline - The Examination Process that Follows	2
Figure 2-1. Initial Literature Review Map	6
Figure 2-2. Product Development Concepts Result in a Single Product	7
Figure 2-3. Disclosure Supports Patent Claims	10
Figure 2-4. Updated Literature Review Map – New Items in Bold Outline.....	29
Figure 3-1. Research Methods Outline with Key Elements Indicated.....	31
Figure 3-2. Position Map Concept with Increased Relevance Toward Upper Right.....	42
Figure 3-3. Visualization of a Stakeholder’s relevance to all Forward Looking Attributes.....	43
Figure 3-4. Combined Coding Technique – Open and Template Coding	44
Figure 4-1. Participant Experience with Product Development in Years	47
Figure 4-2. Research Participant’s areas of Experience Relating to Patents	48
Figure 4-3. Participant Sample Predominantly from Across North America	49
Figure 4-4. Most Networked Stakeholders	51
Figure 4-5. Least Interactive Stakeholders	51
Figure 4-6. Stakeholder Knowledge and Input into Patents	53
Figure 4-7. Stakeholder Communication During Patent Disclosure Building	54
Figure 4-8. Each Stakeholder’s Relevance to Each x-Factor	57
Figure 4-9. Relevance for Each Stakeholder to All x-Factors is Indicated by Area.....	58
Figure 4-10. Helpfulness of Brainstorming to Improve Stakeholder Contribution	59
Figure 4-11. Brainstorming Value for Time and Effort.....	60
Figure 4-12. Communication vs Knowledge for Product Development	62
Figure 4-13. Communication vs Knowledge for Patent Development.....	63
Figure 4-14. Product Development Centric Stakeholder Salience	64
Figure 4-15. Patent Centric Stakeholder Salience	65
Figure 4-16. Codified Results for Qualitative Question 1	67
Figure 4-17. Codified Results for Qualitative Question 2	68
Figure 4-18. Codified Results for Qualitative Question 3	69

Figure 4-19. Insights: Affinity (left and top right) and Foresight Scenario (bot. right)	71
Figure 5-1. Outline for Patent-Storming session	82
Figure 5-2. Pre-Patent Actions – Research Informed Update to Patenting Timeline	83
Figure 6-1. Simplified Visualization of the result from the Affinity and Foresight Scenario	86
Figure 6-2. Updated Research Map with New Knowledge Generation	87
Figure 6-3. New Patent Content Creation from Interdisciplinary Inputs.....	90

LIST OF TABLES

Table 3-1. Description for Each x-Factor Code.....	38
Table 4-1. Participants main professional roles	47
Table 4-2. Comparing two Methods of Calculating per Participant	52
Table 4-3. Questions to Participants about X-Factors	55
Table 4-4. Inductive Codification Categories from Qualitative Question 1	67
Table 4-5. Inductive Codification Categories for Qualitative Question 2	68
Table 4-6. Inductive Codification Categories for Qualitative Question 2	69
Table 4-7. Foresight Scenario Frame 1 - Current Barriers from Insight Generation.....	72
Table 4-8. Foresight Scenario Frame 2 - Future Solution from Insight Generation.....	72
Table 5-1. Patent Stakeholder Salience as an application of Mitchell’s Salience	76

LIST OF APPENDICES

Appendix A – Invitation to Participate in the Research	97
Appendix B – Consent Form for Participation in Research	99
Appendix C – Data from Qualitative Question 47	102
Appendix D – Data from Qualitative Question 49	103
Appendix E - Data from Qualitative Question 50.....	104
Appendix F – Research Questionnaire	105

PREFACE

As a professional, my 20+ years of experience developing products within a team context where we involve many stakeholders to ensure a broad scope of needs satisfied, has have resulted in an interest to further inquire into aspects of design.

My design education has taught me to look at design solutions through an adaptive and iterative approach and has highlighted the role of the designer as an advocate for the end user. This ensures that the end user is not forgotten in the process that unfolds prior to their contact with the product. An extension to this is to consider all contact points that the emerging product will encounter as ‘users’. As a result, there is a responsibility to ensure that the design of the product considers its manufacturer, the equipment of manufacture, secondary processing, logistics, the people that these processes engage and many others who are also users or facilitators of the product prior to the end user.

In my experience, protecting innovation through patenting has been important for the ongoing growth of several Small and Medium-sized Enterprises (SME) that look to protect their investment and fund the ongoing innovation process.

The investment in patents is a significant cost for many SMEs. Product development professionals are needed to support the SME endeavour into patent use. The process of providing a level of patent support is not always clear. This process was not taught in my design education, nor is it clearly indicated once in the field.

Experience showed that the decision to file a patent was the beginning of a process that could be quite removed from the development team and for which results were unassured. This led to an academic inquiry into understanding, improving and increasing the consistency of those outcomes. What follows is research into product development, patent development, stakeholders and their associated relationships.

1. INTRODUCTION

“Inventions should be carefully considered before patent application is sought. By the time claims are allowed and rejected, the area of the patent could become very narrow.” – Lee Epstein (Epstein, 1977)

There is a gap in the creation process of high value patents for Small and Medium-sized Enterprises (SMEs).

This research is an inquiry into the barriers that product development teams experience when creating utility patents for new products. The inquiry will endeavour to better understand the following: stakeholder interaction during product development, stakeholder interaction during patent process activities, extended stakeholders’ awareness of patent information, barriers to the process of their patenting involvement and key factors that may improve the patent. A further focus of this research is to understand stakeholder involvement in the product development process compared to their involvement across key metrics during the patent development process using a comparative approach.

The steps for creating patent content include the collection of information that describes the invention, the communication of this information to the person or group writing the patent and their final selection and formatting of the information into the patent disclosure format. The patent disclosure is also called the description, it is composed of both text and drawings, that can be reviewed and approved by the patent applicants prior to filing.

Granted patent claims result from a process to establish claims of invention. The claims of invention require direct support from the disclosure that must clearly outline the details and function of the invention. The patent examiner’s role is to determine that the claims of invention are novel, inventive and useful. The patent itself, once granted, is an asset defining rights to the established claims of invention that can be used by its owner for commercial advantage to exclude others from its use.

The concern is with Small and Medium Enterprises' (SMEs) lack of knowledge about the patenting process as it may make the outcome of this process less effective than it otherwise would be (Burrone, 2005). Insufficient communication and coordination of effort between team members, while establishing information to transfer, may contribute to uncertain or lesser outcomes. The World Intellectual Property Organization's (WIPO) Patent Drafting Manual emphasizes the importance of the filed patent disclosure content since it is not possible to file amendments to include new technical disclosure during its prosecution. ("WIPO Patent Drafting Manual," 2007, p. 35). The specification must carry sufficient disclosure to support the claims and its terms.

For context, the typical patent process is outlined in Figure 1-1 below, where the authors have added dates and interactions along a timeline. A delay follows the application's filing prior to it becoming public, then a series of interactions between the patent office and the applicant result and this is called the patent prosecution phase. The patent is typically rejected in the first round and this drives a necessary response from the application where the claims of invention are narrowed in response ("WIPO Patent Drafting Manual," 2007, p. 106).

Figure 1-1. Patent Timeline - The Examination Process that Follows

1.1 Rationale

The specific area of focus for this research inquiry, is the activity prior to completing the transfer of information to the person or group writing the patent. It is an inquiry into the product development stakeholder team and the process by which the inventive information is

collected and codified for transfer to the patent agent or attorney. This research assumes a co-creation perspective where the generation of patent content can be the result of a team effort.

Current literature does not review this activity directly or extensively. There is research into small versus large firm patenting behavior that indicates that they do act differently (Coughlin, 2007). This research indicates that in response to the fewer patents that they can afford to file, each individual patent is of higher importance for small firms than for large firms (Coughlin, 2007, p. 381). However, this literature does not guide firms toward adjusting patent content in response to the importance required of them. Patent authority guidelines exist that guide the patent filing entity towards engaging the inventor and seeking input into questions that yield the disclosure of inventive information (“WIPO Patent Drafting Manual,” 2007) but they do not clearly guide the activity of selecting or generating patent content to optimize the patent for the future. There are many articles from a legal perspective that consider aspects of patent quality and how the patent disclosure contents affects this but the term ‘quality’ has a range of meanings from the legal perspective where the specific content that inventors should include is only peripherally discussed (Fromer, 2008; Lemley & Shapiro, 2005). Legal practitioners do offer some guidance about patent value where the notion of needing the right content to support the claims in the future when patents are actually prosecuted is identified (Wagner, 2009) but the actionable specifics are elusive. Regarding the research question, with the evaluation of multiple stakeholder involvement, there is a significant body of research into team dynamics and challenges resulting from cross disciplinary communication and exchange of information in a product development context (Carlile, 2002) but this is not specific to the context of patent content generation. Civi’s research into the field of knowledge management corroborates the challenges in transferring local and embedded information and ensuring its accessibility through the process of conversion from tacit to explicit. Research states that this is critical to the firm’s ability to maintain competitiveness (Civi, 2000) but does not directly focus on patent related information for SMEs.

This area of research is important since resources significant to SMEs are already being spent (Nikzad, 2015), and there are indications that SMEs are underperforming in patent

participation and grant awards (Burrone, 2005). Research clearly indicates that SMEs' ability to gain patents is directly correlated to their ability to access capital funding to support ongoing innovation (Nikzad, 2015). There are also signs that, if it is considered to be a role for legal to improve this shortcoming, legal is not directly embedded with SMEs and their involvement is disconnected from the developments team (Nikzad, 2015).

1.2 Research questions

The focus of the research is to determine whether a gap in the information capture process involving multiple stakeholders for patents disclosures exists in small and medium-sized enterprises and whether it can be filled by designers.

Research questions:

How can designers facilitate knowledge acquisition for extended patent disclosure content from product development stakeholders for stronger intellectual property and business competitiveness?

Additional related questions will be considered as well:

- *What barriers to further patent involvement are currently encountered?*
- *Are there any stakeholders with useful information towards the improvement of patents that may not currently be considered?*
- *What would a better process look like for communicating and sharing patent information?*
- *Are legal stakeholders of similar opinion to the other stakeholders?*

1.3 Contribution

- The potential information available from extended stakeholders might benefit small companies already trying to patent innovation.
- The implied implementation of the approach toward acquiring new and relevant information for patents could result in very little incremental cost and it might improve team dynamics and future competitiveness of SME patents.

- By clearly identifying the gap of communication between the 6 stakeholder groups as a problem and indicating that they may have relevant information to contribute, it is possible that the barrier to patent engagement can be overcome with actions that these groups have the capacity to perform in the product development context.
- Encourage industrial design education to consider the designer in a role that leverages their position in the product development team to advance patent content through a design thinking process and interdisciplinary engagement capacity.

2. LITERATURE REVIEW

2.1 Literature Review Introduction

The literature covered several areas of academic inquiry in order to contribute to a better understanding of the research question and focus the research. The research question centers on understanding opportunities to improve the intellectual property of small and medium-sized enterprises (SMEs) through improved use of their existing product development team. It was divided into smaller areas of inquiry to understand SMEs, the barriers they may face with patents and how their needs may differ from those of larger firms. Literature was reviewed to understand SME's product development team stakeholders and the level of contribution that extended stakeholders could be expected to usefully contribute towards improved patent contribution.

In parallel, the literature review was focused on research methods useful to the active collection of empirical knowledge from experienced professionals. The findings from this would be used to inform the empirical research methods that would be used in this study.

This map, Figure 2-1, shows the initial outline of the literature review includes the key elements and steps thought to influence the patent disclosure generation process.

Figure 2-1. Initial Literature Review Map

The literature review grew from its initial scope in response to ongoing literature review findings and the updated map is found in Figure 2-4 following the literature review. Small and Medium-sized Enterprises and Innovation

“Innovation happens deliberately more often than it does by inspiration.” (Petre, 2004, p. 477)

Srinivasan outlines a strategy for innovation that is customer-centric where a wide range of customer prototypes are created, and along with available competitive products, are presented to customers for their reaction. Commercialization decisions are made based on an assessment of each design direction’s cost to commercialize while also considering the specifics of the customer reaction to its prototype. The final direction is selected based on the best profit equilibrium (Srinivasan, Lovejoy, & Beach, 1997, pp. 154–163). Product development can create an abundance of initial concepts and then narrow to a single commercialized product (N. Cross, 2011; Watters & Craib, 2017). This visualization, Figure 2-2, shows the abundance of activity at the outset and its narrowing to a single solution for commercialization.

Figure 2-2. Product Development Concepts Result in a Single Product

SMEs are found to be drivers of innovation and contribute 95% of new business employment but their execution of intellectual property as it relates to business strategy is a challenge (Burrone, 2005, p. 35). Nikzad studied surveys and studies from select countries but with a focus on Canadian SMEs, found that Canadian SMEs constitute about 80% of businesses with 15% in goods producing sectors (Nikzad, 2015, p. 179). SMEs are often innovation dependent as they develop technological improvements to stand out from established companies (Coughlin, 2007,

p. 384). Increases in the use of global manufacturing can also necessitate SMEs' need to protect (Burrone, 2005) their intellectual property. Nikzad indicates that Canadian SMEs' under-use of the patent system is even lower than that of other industrialized countries' SMEs (Nikzad, 2015, p. 179). Also noted is a disconnect between SME self-reported awareness of IP versus their knowledge when questioned (Nikzad, 2015, p. 180). This indicates a knowledge gap where SMEs may know even less than they think they know.

Industry is also undergoing a transformative shift from product dominant logic to service dominant logic where demands that were satisfied by products are more often being thought of as services delivered to the end user (Vargo & Lusch, 2008, p. 255). They identify that goods were considered in units, but services are considered as processes, and that value capture can be derived from the co-creation involving multiple parties. The incorporation of the product into the system becomes strategic (Vargo & Lusch, 2008, p. 258). As a result, the capture of the full opportunity of the intellectual property may not be comprehended by one single contributor on the product development team.

2.2 Incentive to Patent

Pisano and Teece recognize that achieving solid value capture from innovation is a critical issue at the enterprise level but that it is not assured for innovators. Strong appropriability regimes are the mechanisms and agreements whereby companies can derive value from the protections they are afforded and these can result from strong IP protection (Pisano & Teece, 2007, p. 1343). Patent rights can protect SMEs' technologies from infringement and can help offset the risk of financing innovation and support SME efforts to secure necessary venture capital financing (Nikzad, 2015, p. 176). Patents are sought to exclude competitive activity that would infringe on their granted claims of invention.

2.3 Characteristics of Small Firm Patent Strategies

Patenting strategies between SMEs and large firms have some differences (Coughlin, 2007) and the use of patents is positively correlated to the size of the company (Nikzad, 2015, p. 178). Portfolio theory explains the value of patents to large firms but does not explain the value they have to SMEs that are often trying to break into a market (Coughlin, 2007, pp. 273–374).

Portfolio theory indicates that larger firms file a greater number of patents with incremental improvements to create families of patents (Coughlin, 2007, p. 382). SMEs' patenting often requires significant risk as they attempt to capture wholly new technologies with patents that are less incremental than large firms (Coughlin, 2007, p. 385). Coughlin indicates that small firms gain fewer patents but they cover greater technological increments (Coughlin, 2007, p. 385). The specific resulting utility and quality of individual claims for small firms is critical to their growth and competitive advantage as compared to large firms (Coughlin, 2007, p. 381). Coughlin's research indicates that small firms' patents typically have a greater number of claims and more time is allocated to their prosecution (Coughlin, 2007). Small businesses are more likely to be involved in litigation than large companies (Allison, Lemley, Moore, & Trunkey, 2004, p.448,455; Coughlin, 2007, p.384). If successful, this can be good for SMEs since high value patents are often characterized by a lengthy prosecution which can increase their value and improve the ability to seek venture capital (Allison et al., 2004; Coughlin, 2007).

“Typically, the inquiry into the appropriateness of functional language is driven by the language of the claims. Where an invention is defined in terms of an overly broad functional limitation, the claim seeks to monopolize speculative embodiments that the inventors have not adequately described. The corollary is that the description is not sufficient to support the invention as claimed.” - (“MOPOP - Chapter 9 - Canadian Intellectual Property Office - 9.05 Special topics – December 2010,” n.d.)

The claims of invention that can be made by the SME are entirely dependent on the content of the patent disclosure. The patent disclosure is the result of the efforts and consideration made by the applicant firm and their legal partners (Watters & Craib, 2017, p. 374). Wagner says that the words in the disclosure are entirely in the control of the firm (Wagner, 2009, p. 2149). Allison describes patent continuation where the same disclosure is used to file different sets of claims (Allison et al., 2004; Coughlin, 2007) thus requiring supportive content for each claim set within

the original disclosure. The diagram below, Figure 2-3, serves to illustrate that claims are reliant on the content provided within the disclosure.

Figure 2-3. Disclosure Supports Patent Claims

The claims must be supported by the specification and the drawings. There must be a basis of support in the disclosure for the subject matter of each claims made (“WIPO Patent Drafting Manual,” 2007, p. 100).

2.4 Patent Quality and Value

Companies are incentivized to disclose subject matter appropriately in order to obtain a valid patent in return for the capital expenditure that they must commit and the opportunity costs that they forgo (Wagner, 2009, p. 2147). Full disclosure of the invention’s function may offset future risk of prosecution rejection, invalidation during litigation, loss of rights, and the associated costs (Wagner, 2009, p. 2147). Wagner clarifies that his use of ‘quality’ is defined as patents that meet non-obviousness and novelty requirements as a minimum but also clarifies that these attributes will finally be determined if litigated. He also makes clear that patent value is different than patent quality. Patent value has many determining factors that are beyond patent law and this includes the alignment of the scope of the patent with that of the marketable product (Wagner, 2009, pp. 2138–2139). The point that Wagner makes is that it is a valuable attribute for patents when the granted claims map onto the features of the commercialized product and there is an alignment between the granted claims and the product in the market. Allison describes valuable patents as those that are successful at excluding competitors and that provide substantial economic benefit to their owners (Allison et al., 2004, p. 440).

Parchomovsky, through the study of patent portfolios notes, that small firms do not follow the same volume based patent portfolio acquisition strategy of larger firms but rather file fewer patents and place greater emphasis on the higher quality of each patent and its specific claims (Parchomovsky & Wagner, 2005, p. 54,56). Lemley describes how patents can block the patent system if the idea of the invention, only, is disclosed while there being insufficient detail about how the idea is executed from a physical perspective; this is described as demonstrating a poor reduction to practice (Lemley, 2016). The incentive to invent theory focuses on the need for the invention to be functional and ultimately made available for the benefit of society (Cotropia, 2016, p. 1563).

The patent process imposes significant time pressure on the applicant. If there are two applicants with the same invention, it is the first to file that will receive the patent grant, as a result, there can be a tendency to hurry the patent process and file quickly (Lemley, 2016, pp. 1185–1187). Wagner's review indicates that patentees face certain institutionalized incentives that encourage speed over filing quality since reducing the invention to practice (figuring out how the inventions really works) takes more time and may result in a later filing date than the inventor that simply files an idea with little substantive enablement (Wagner, 2009).

According to Fromer, another way to increase patent quality is to include useful redundancies in the construction of the disclosure: communicating the most important aspects of the invention in a number of modalities will improve the chance of it being more widely understood (Fromer, 2008, p. 573). Of particular importance for SMEs with a limited patent portfolio is the quality of the claims (Coughlin, 2007, pp. 373–374) that result from prosecution. Lemley notes the level of technical knowledge that results from reducing the invention to practice benefits both the company's knowledge and the quality of disclosure to the public (Lemley, 2016, p. 1187). The focus of this research is on SMEs that develop products and file patents to protect their products from market competitors.

2.5 Intellectual Property Barriers for Small Firms

The cost of patenting acts as a disincentive to SMEs if the expectations of gaining a patent are low (Burrone, 2005, p. 37). Small firms file fewer patents but their quality must be higher (Coughlin, 2007, p. 373) and there are indications that they too need to build larger portfolios to

keep pace (Parchomovsky & Wagner, 2005, pp. 55–56). Having an increased quantity of patents can help to decrease litigation (Coughlin, 2007, p. 391). Burrone and Li indicate that support or services for small entities exist but are often focused on the technical and administrative aspects of patenting rather than the innovation building aspect (Burrone, 2005; Li, Lan, & Liu, 2015).

In a longitudinal case study over a 10 year period in which they follow a product development and manufacturing group, Manzini refers to strategic complications arising from the disconnected relationship they had with legal services that drove them to formalize an IP strategy (Manzini & Lazzarotti, 2015, p. p6) and bring legal representation in house.

Regarding the capture of value from innovation, Pisano and Teece indicate that managers working towards competitive advantage, often consider the intellectual property environment and architecture of the industry as being “beyond their control” but the authors argue that they can be shaped (Pisano & Teece, 2007, p. 279). This suggests that management may be underutilizing patents because the control of it, and its use, is not understood.

Despite the benefit that patents offer, SMEs’ lower participation rate seems broadly attributed to a range of factors that include lack of experience with the process and uncertainty of a reward for the effort placed into the acquisition of patents (Burrone, 2005; Nikzad, 2015, p. 178). SMEs could benefit from learning how to de-risk the patenting process.

2.5.1 The Legal Document Content

The creation of intellectual property is complex. Fromer indicates that the patent document is poorly structured with mixed information types that hinders the stimulation of inventive activity (Fromer, 2008, p. 563). Fromer suggests that there are two layers of information in a patent document, the legal layer and the technical layer but that they are scrambled and do not meet the needs of all audiences. The technical layer is the inventive material using text and drawings and it contains the inventive rationale and contents of the disclosure (Fromer, 2008), or as often called, the specification. Patent documents can be hard to understand and considering them in this simplified form might make them more broadly accessible.

If the extended stakeholder group could avoid Fromer’s legal layer, this might help with their focus on providing content to the technical layer. The construction of the patent document should

describe both the best mode of the invention and the best exemplar which is often a simplification that is helpful in conveying the concept of the innovation (Fromer, 2008, p. 578). The importance of this is to draw our attention to the fact that a patent document's disclosure should not simply be one state of the invention which risks being too narrow and with a patent there should be a range of useful redundancy to ensure the diversity of content is covered and understood (Fromer, 2008, p. 585).

2.5.2 Establishing Patent Disclosure Information Internally

All companies that file for utility patents must identify and select the information to include in the patent disclosure. Ideally, the disclosed information will offer a basis of support that will allow the company to achieve relevant granted claims that will provide them a business advantage (Wagner, 2009, p. 2148).

Their rate of failure at obtaining patents is higher than larger companies and it is noted that in part this can be because of poorly drafted patents (Burrone, 2005, p. 37). Burrone indicates that a failure at obtaining patent rights can dissuade further attempts (Burrone, 2005, p. 37).

The specific claims granted for a patent are important as they describe the boundaries of the invention, but it is also important that stakeholders, from patentee, examiner, competitors and juries, have a common understanding of the claims, unfortunately, this is not always the case (Burk & Lemley, 2009, p. 1751). There is concern that granted claims might not align with what the inventor believes they have invented (Burk & Lemley, 2009, p. 1749?). This is an issue and this might be mitigated by the content initially provided into the patent disclosure.

Regarding the content of the disclosure, "the power of the language remains in the patentee's hands" at the outset with the filed application (Wagner, 2009, p. 2164). Fromer indicates that there is value to including redundancy into the disclosure to ensure that the invention is presented and described in more than one mode (Fromer, 2008, pp. 576, 579).

In Fromer's study of the role of patent disclosure, a patent document is described as having several audiences and it is stated that if the document were considered as layers of information directed to each audience the document's effectiveness as a communication tool would improve (Fromer, 2008, p. 567). Fromer's legal layer of information could be considered separate from

the technical information where the technical content (description of the invention's function) could more easily be understood, or in the case of this research, the separation of layers may make it easier for a broader audience to participate in its creation.

In his patent claim writing course at Stanford, Wagner considers the objective of having an element of “prognostication” in order to allow a range of patent claim scope possibilities (Wagner, 2009, p. 2149). This is in recognition of the extended lapse of time between when the patent is written and when it is used, and that by considering the future at the time of writing the disclosure, the patentee may have a greater opportunity to prosecute useful patent claims.

2.5.3 Patent Usefulness in the Future

Patent prosecution can take a number of years during which many market and competitive changes may take place (Wagner, 2009, p. 2148), and ideally, the patent, as granted, will still be useful to the patentee at that point in time. Importantly, the disclosure should be written in anticipation of these changes in order to maintain competitive relevance (Wagner, 2009, p. 2148). If firms consider this challenge, they may realize that they have readily available responses for inclusion into the disclosure that resulted from their product development process (Watters & Craib, 2017, p. 353). Indicative of the complexity of the patenting process, by the end of the patent prosecution process, Lemley indicates that granted claims may only partially represent the invention or the product intended for commercialization (Burk & Lemley, 2009, pp. 1747, 1777).

2.6 Knowledge Acquisition

“Factors that make replication difficult also make imitation difficult. Thus, the more tacit the firm's productive knowledge, the harder it is to replicate by the firm itself or its competitors. When the tacit component is high, imitation may well be impossible, absent the hiring away of key individuals and the transfer of key organizational processes.” (D. Teece & Pisano, 1994)

Knowledge within a firm is one of its most important strategic assets and it resides within stakeholders until it is converted and made accessible to others and often there is an experienced person who's tacit knowledge could be beneficially shared with others (Civi, 2000, pp. 171–172). Transmission of knowledge within the company can be a challenge where knowledge is

described as both a “barrier and information” (Carlile, 2002, p. 442) and it is observed that information exchange can be considered differently across a company’s functional groups.

Knowledge is described as “localized, embedded and invested” and its identification and transfer can result in challenges when working across disciplines (Carlile, 2002, p. 445). Kogut suggests that it is the firm’s stakeholders, interacting according to the firm’s organizing principles, that are critical to the firm’s knowledge and capability function. Firms are social organizations with expertise that generates profitable output (Kogut & Zander, 1992, p. 384). At the product development level, Manzini’s case study research suggests that most product development information remains inaccessible especially in the early stages of development since it is not codified (Manzini & Lazzarotti, 2015). Codification, is the conversion of knowledge to a level where it is usefully accessible.

Organizations not only transfer knowledge, but they can generate new knowledge through social interaction within the organizational context of the firm using combinative capabilities where currently codified knowledge is combined with acquired knowledge (Kogut & Zander, 1992, p. 384). The researchers consider that the activity of creating forward looking patent disclosure information results in a form of new and codified knowledge that can be used for competitive advantage by the firm.

“Effective communication is very important in making existing knowledge profitable to the firm; however, bureaucracy can make knowledge very difficult to transfer because formal structures limit each division’s access to knowledge accumulated by other divisions. In contrast, if a firm supports communication networks that operate freely within minimal rules and where knowledge providers and knowledge seekers can access knowledge through the shortest path, this infrastructure will enhance knowledge transfer inside the firm.” (Krylova, Vera, & Crossan, 2016, p. 1054)

The research question of this paper pertains to the acquisition of knowledge that is not readily available as information from several stakeholder groups that may be separated by interdisciplinary boundaries. The challenge with converting knowledge from multiple

stakeholder groups is not insignificant and the conversion of knowledge benefits from face to face interaction (Cairó Battistutti & Bork, 2017; Civi, 2000). Battistutti suggests that knowledge engineers can then assist in the conversion of mental models to a common language among participants. Saviotti indicates that knowledge creation is collective and requires communication where the process of codification of a subject can be gradual at the start. In the case of new disciplines, the developing frontier is less codified, but communication concepts and definitions are established over time resulting in increased codification and accessibility to the knowledge as the field becomes established (Saviotti, 1998, p. 848).

Kolko recognizes the designer's visual generative capabilities but encourages the value and importance of designers to also communicate in textual format. Because design is increasingly complex and tied to business strategy, Kolko suggests that textual communication will allow designers to play a more structural planning role in strategic business activities (Kolko, 2005).

2.6.1 Barriers to Information Flow in Product Development Teams

In the context of this research, product development activity generates the innovations that may be selected for patenting. A one-year ethnographic study by Carlile shows that knowledge boundaries exist between the four key functions in practice. The distinct groups within the organization studied were sales/marketing, design engineering, manufacturing engineering, and production. Moving knowledge across these boundaries is made difficult and results in challenges for product development (Carlile, 2002). He indicates that the specific characteristics developed to drive innovation within disciplines can limit successful interdisciplinary innovation (Carlile, 2002, p. 442).

Carlile explains that two previous barriers to inter-disciplinary communication are syntactic and semantic, but proposes a third described as a pragmatic barrier to cross boundary communication (Carlile, 2002, p. 443,445). Semantic barriers include differences in terminologies used by different stakeholder groups that may have different interpretations which can make cross boundary communication difficult but also notes there are additional practical considerations. Pragmatic barriers include behavioral barriers, where the process of exchanging information has the potential to negatively affect the actors if there is a bad outcome and these learned negative consequences from may result in communication avoidance (Carlile, 2002). The interaction

required to exchange information can result in the questioning of an actor's skills and effective cross-boundary interaction requires an openness towards changing one's original position as a potential outcome of the exchange (Carlile, 2002, p. 445). Overcoming cross boundary communication should involve a participatory attitude and a willingness to communicate to work through the process. Petre discusses characteristics of highly collaborative teams where interdisciplinary groups were located near each other to encourage communication. Informal meetings and communications were preferred over formal meetings but importantly, the project leader needed to clearly communicate any ensuing decisions among the other team members (Petre, 2004, pp. 491–492).

Gibbs indicates that efforts to interact with other disciplines is a responsibility of the Product Quality Management team and that in some cases additional effort is required to engage with others since their expressed needs can seem bizarre but indicates that it is important to try to understand the relevance and the underlying problem that requires inventive solution (Gibbs & DeMatteis, 2003, p. 136).

Manzini's multiyear case study research noted the challenge of tracking inventive content among multiple stakeholders in order to offer adequate IP protection. It is noted that in the early stages of new product development ideas are not yet codified so they are hard to protect and communicate, but as the development process progresses, the level of codification of the 'idea' increases, allowing for improved protection of the knowledge opportunities (Manzini & Lazzarotti, 2015, p. 9).

Importantly, the boundaries that resist smooth communication during the product development process may also offer an opportunity for innovation. An empirical study observing practices of 12 engineering companies involved with multidisciplinary teams with strong innovation track records indicates that innovation occurs at the boundaries between disciplines and from the transfer of information across boundaries (Petre, 2004, pp. 478–479). It is often in the zone of a conflict such as between technology and price, or between design and engineering, where the effort to resolve issues can lead to true innovation (Petre, 2004, p. 485). Cross recognizes that innovative design can arise from conflicting stakeholder goals or requirements, and that creativity seems to result when trying to resolve the conflict (N. Cross, 2011, p. 77). This is a very

important insight indicating that cross discipline communication and interaction can be leveraged for insight or innovation.

“ ...what should also be recognized is that all three categories of boundary objects have a portfolio effect; repositories and standardized forms support the use of objects, models, and maps as well as support processes to manage knowledge at a pragmatic knowledge boundary.”
(Carlile, 2002, p. 452)

Boundary objects in new product development are assets that must function across disciplinary boundaries or that are created in order to assist in the communication across boundaries. They may have a shared syntax to represent their knowledge (ie. assembly drawing) and they may use standardized forms or methods to improve the awareness of semantic differences and mediate information between groups using a standardized form, or a physical part (Carlile, 2002, pp. 451, 452). According to Carlile, in order to truly allow individuals to transform their knowledge through their interaction together, effective boundary objects such as objects, models and maps are needed. Nicolini, in their 18 month ethnographic study of the development of a bioreactor indicates “that different types of boundary objects were more useful at different stages of a cross-disciplinary endeavor.” (Nicolini, Mengis, & Swan, 2012, p. 625).

2.7 Stakeholder Theory and Identification

Considering the preceding review of small to medium size business patent barriers and strategy, the next stage of the literature review is an inquiry into the persons or groups involved in product development and their potential as sources of information for patent content.

Stakeholder theory originated as the identification of external actors with a stake in a business as defined by their ability to affect the course of the associated business or be affected by that business. The original goal of 'stakeholder theory' and 'stakeholder thinking' was to allow managers to address the complexity of interconnected business problems; Value Creation and Trading, Business Ethics and Capitalism (Parmar et al., 2010, p. 4).

Stakeholder theory evolved to also concentrate on the identification of stakeholders within an established organization as entities that could affect the company and this was in contrast to shareholders where the company was considered only responsible to its owners (Parmar et al.,

2010, p. 20). There are strong indications that the focus on stakeholders by a firm can be a successful economic advantage for firms (Parmar et al., 2010, p. 21). Parmar and Freeman suggest that further studies consider a broad range of stakeholder interests and not simply be classified as economic and non-economic stakeholders.

Within the context of this research, the authors are using the term product development stakeholders as entities that are involved in, and participating in, the product under development. These stakeholders are arguably impacted by the course of action and the success of the new product. Mitchell also agrees that primary stakeholders can include employees, customers, finance holders and other communities and notes that the competing interests of stakeholders can be reconciled through common purposes that can include the drive for innovation (R. K. Mitchell, Van Buren, Greenwood, & Freeman, 2015, pp. 856–857). Also indicated is “how stakeholder logic for value-creation relationships supports and comports with knowledge-building and more effective risk taking” (R. K. Mitchell et al., 2015, p. 854). Parmar indicates flexibility in the negotiation of stakeholder status, and on the definition of stakeholder, where different definitions satisfy different companies’ or researchers’ needs (Parmar et al., 2010, p. 14).

2.8 Product Development Stakeholders

The knowledge within a company exists within its people, it is not easily transmitted, but it is necessary to codify and replicate, as it creates the knowledge base for the company’s competitive capabilities (Kogut & Zander, 1992, p. 384,387). Within the context of this research, it is the product development participants that are being studied as sources for useful contribution towards the improved patent information.

“... knowledge in new product development is localized around particular problems faced in a given practice. The effective development of knowledge in organizations demands that individuals specialize or localize around different problems.” (Carlile, 2002, p. 445)

For the purposes of this research, the determination of product development stakeholder groups for further inquiry is important for the creation of the research questionnaire.

Carlile's year long ethnographic study researched differences in knowledge structures between functional groups and the challenges with communication between these groups (Carlile, 2002, p. 442). Carlile identified the following functional group divisions when exploring communication boundaries during product development: sales/marketing, design engineering, manufacturing engineering, and production (Carlile, 2002, p. 445).

Manzini, in their longitudinal case study identify five phases of the New Product Development (NPD) process from which intellectual property must be considered differently because of boundaries between these groups and the differences in the knowledge they hold. In Manzini's study of internal product development the group classifications were; business development, industrial design, engineering, manufacturing, and mass production with commercialization (Manzini & Lazzarotti, 2015, p. 7).

Gibbs recognizes that even where patents are the responsibility of engineering, it is necessary to stay engaged with other departments as they are often the source of innovation and improvement opportunities for competitive products. Their classification of these external groups includes; Product Quality Management (PQM) team (this included engineering representation), upper management, manufacturing department, marketing department, as well as a connection to augmented innovations (Carlile, 2002; Gibbs & DeMatteis, 2003, p. 135).

In summary, for this research, the resulting grouping classification draws from typical team structures found to be used by SMEs involved in product development. The number of categories used was limited to keep the scope manageable, and this resulted in us not directly targeting access to manufacturing groups.

2.8.1 Marketing and Sales

A predominant paradigm for marketers is to think of a product as a collection of attributes. Srinivasan indicates that the attributes are often considered as quantifiable, where any given feature exists or does not exist in an attribute based approach (Krishnan & Ulrich, 2001, p. 14; Srinivasan et al., 1997, p. 156). A concern with the simple consideration of attributes is that it can "tend to ignore the constraints of underlying product and production technologies" (Krishnan & Ulrich, 2001, p. 14). This attribute centric lens that marketers use can be helpful in the

definition of new products and the understanding of competitive products. Marketers have a strong big-picture understanding of market trends.

2.8.2 Engineering

Engineering plays a traditional and significant role in many companies' patenting strategy, and the responsibility for patenting is often theirs (Gibbs & DeMatteis, 2003). Krishnan's study of product development decisions concludes by suggesting marketing and design engineering disciplines work together by applying methods of design engineering and marketing to resolve complex technological constraints (Krishnan & Ulrich, 2001, p. 14). This issue is indicative of differences between disciplines that become apparent at their boundaries and an opportunity to mitigate negative consequences (Carlile, 2002, p. 453). Gibbs describes engineering as needing to keep current on knowledge and to keep their connection current to other disciplines while noting that their job is also to advance and protect corporate intellectual property (Gibbs & DeMatteis, 2003, p. 136). Gibbs indicates that in the 1900's the role of engineering was manufacturing driven, and that is was not until the use of quality management systems in the latter half of the 20th century that the focus began to shift to be customer driven (Gibbs & DeMatteis, 2003, p. 126).

2.8.3 Designer

Where marketing can think in terms of quantitative attributes, designers tend to think in terms of qualitative product attributes and these include; aesthetic, emotive characteristics, ergonomics, ease of use, manufacturing quality, and product integrity where these are less binary and are more subjective than marketing's attribute approach (Srinivasan et al., 1997).

The role of the designer has expanded over time while yet the original roles continue (Valtonen, 2005). According to Valtonen, designers' involvement continues to expand as they "have actively strived to participate in the development process in an earlier stage, and also to increase their own impact on this process and business in general".

Valtonen describes that the designers' role grew in the 1960's into a team-role with engineering and marketing (Valtonen, 2005, pp. 1–2) and as an engaged team member, they can access the greater team. Industrial designers often work in teams and have familiarity with engaging other

team members and often with people from different professions (Boyer, Cook, & Steinberg, 2013). According to Boyer, this arises from interactions and collaborations emerging from the development process.

2.8.4 Management and Chief Executive Officer

Dynamic capability activities that involve the sensing, seizing and reconfiguring of business to maintain competitive advantage within the changing market place is described as a CEO activity. Pisano describes that a challenge for managers is to innovate and then capture value from that innovation such that imitators are unable to siphon those benefits (Pisano & Teece, 2007, pp. 278–279). The dynamic capabilities approach is an approach for maintaining competitive advantage within the changing environment by leveraging internal and external competencies of the firm (D. J. Teece, Pisano, & Shuen, 1997, p. 510).

Teece describes how we have now associated entrepreneurial activity to that of starting a business but that the entrepreneurial management function within dynamic capabilities is not constrained to one individual and it involves the recognition of problems, trends and responding with reshaping the organizational to address the opportunity while maintaining alignment with the customer (D. J. Teece, 2007, p. 1346,1347). Seizing the opportunity now to make use of patents and patent strategy can secure future competitive advantage for companies.

2.8.5 Legal

For many SMEs the use of a patent professional for assistance in the capture and filing of intellectual property means the use of an out of house firm and its professionals. For many SMEs in the product development space their infrequent use of patent services does not warrant their onboarding of a full-time patent agent or attorney (Nikzad, 2015, p. 178). The engagement of legal services is often at the last moment when there is a need to file a patent prior to an upcoming event where the inventive content is anticipated to be shown (“WIPO Patent Drafting Manual,” 2007, p. 29). Timing is often the priority and the disclosure content that is made available is the content that is used for the patent filing. Mitchell indicates concern for legal’s proactive communication capabilities and concern that the end user might not clearly understand the work output document created. This results in a concern for communication efficacy with stakeholders (J. A. Mitchell, 2015, p. 13), especially for those that are not experienced with legal

practice. Haapio indicates that ongoing research into proactive advancement of legal practices is growing and notes that design principles can inform lawyers in their role as a problem-solver (Haapio, 2010, p. 30). Mitchell indicates that lawyers could learn from designers and consider the end user experience (J. A. Mitchell, 2015, p. 15). The researchers consider that the interdisciplinary barrier between legal and others is an issue to extended stakeholder involvement.

2.8.6 Entrepreneur and Inventor

Early research into the study of the inventor-entrepreneur typology was performed on a sample from the National Science Foundation grant recipients and is reported in a paper called “Defining the Inventor-Entrepreneur in the Context of Established Typologies” (Miner, Smith, & Bracker, 1992, p. 103) . It was determined that patents were important and defining for many inventor-entrepreneurs but this was secondary to the importance of the new product development strategy that defined the technical basis of new venture (Miner et al., 1992, p. 106,112).

The entrepreneur and their firms are closely linked and they can go to great lengths to overcome deficiencies resulting from the newness of their firm where they may place the importance of their stakeholders at a higher level than a manager of the firm might (R. K. Mitchell & Cohen, 2006, p. 3). Entrepreneurial activities are hard to replicate, they take time to develop as the understanding of the processes that result in productive activities take time be understood.

Nikzad indicates that investors may not consider inventors that do not have patents filed which places importance on patenting (Nikzad, 2015, p. 186). The researchers note that any of the other stakeholders could technically be named inventors on a patent, as such, inventor is not a term that is exclusionary to other roles.

2.9 Stakeholder Salience to Patent Content

Mitchell notes that Freeman uses one of the broadest definitions of stakeholder where a stakeholder is defined as having an ability to affect or be affected by the achievement of the firm and notes that Clarkson’s narrower definition is where stakeholders bear some risk because of their investment of something of value in the firm (R. K. Mitchell, Wood, & Agle, 1997, p. 856).

The issue of determining which stakeholders should receive the attention of management is the concept of stakeholder salience where Mitchell, Agle and Wood suggest the addition of 'urgency' as a sorting criteria in addition to Freeman's criteria of stakeholders requiring 'power' and 'influence' (R. K. Mitchell, Wood, et al., 1997, p. 862). The resulting test for stakeholder salience is measured against 3 criteria; the power to influence the firm, the legitimacy of their relation to the firm and their urgency of claim to the firm. They also outline a three level ranking in descending importance depending on the number of criteria they meet; 'definitive stakeholders' - 3 criteria met, 'expectant stakeholders' - 2 criteria met and 'latent stakeholders' - 1 criteria met (R. K. Mitchell, Wood, et al., 1997, p. 873). Westrenius performed an empirical study using an interview method about salience in the context of SMEs since most salience research was focused on large firms (Westrenius & Barnes, 2015, p. 1118).

The researchers are considering stakeholder salience with respect to the product and patent development within SMEs. A seemingly simple task, the determination of who participated in the claimed inventive aspects of a new product (NP), is not that simple (Murphy, 2012, p. 225). Murphy notes that, not long ago, inventing was done by a small number or a single inventor within a firm, but that post 1990's, inventorship is most often multiple people and frequently extends beyond the company and with increasing frequency inventors reside in different countries (Murphy, 2012, p. 215).

There may often be stakeholders of different capacities, training and level of patent awareness related to any given new product development being considered for filing that may need to be engaged and their involvement does not need to be as an inventor, they can offer other useful context to the patent (Gibbs & DeMatteis, 2003).

2.10 Dynamic Capabilities and Business Competitiveness

Business moves quickly, and dynamic competencies are needed to refocus and maintain competitiveness (Pisano & Teece, 2007, p. 1319). Dynamic capabilities are often considered CEO activities with the ongoing sensing and seizing of opportunities necessary for business sustainability, adaptability and reconfigurability for competitive business advantage (Pisano & Teece, 2007, p. 1340) and patenting is a forward-looking activity towards building opportunity. The identification and generation of IP creates a bottleneck capability and can prevent the

competitive capability of other firms (Kogut & Zander, 1992, p. 393). The researchers consider whether patent strategy, as it is set in place, may affect strategic options that can be realized from the dynamic capability activities in the refocusing of a firm for competitive advantage in the future.

2.11 Establishing future Oriented Attributes of Patents (X-Factors)

“Patent prosecution can take years, ... This means that a patent applicant must necessarily be a futurist: she must look down the road of technological advancement, perhaps a decade or more, to predict the market for the technology and the behavior of competitors, among other things. A patent application written in year zero might be enforceable only in year three (due to the pendency of prosecution), and the market might not be significant until year five. By then, competitors will have the benefit of intervening technological advancements and the teachings of the patent itself. In order for the patent to retain power (and thus value for the patentee) in the marketplace, it will have to be written in anticipation of these changes and be a substantial advance over the prior art alternatives.” (Wagner, 2009, p. 2148)

Competitors want to understand the patent contents in order to design around the patent where their improvement or new invention does not infringe on the patent itself (Fromer, 2008, p. 590). With patents, there is a need to include content that will effectively protect the product in the market of the future (Wagner, 2009, p. 2148).

The authors arrived at six attributes that could be used during the empirical research as a focus of inquiry into the understanding of stakeholder knowledge regarding these attributes. These attributes are referred to as future oriented attributes, forward looking patent attributes or x-factors by the researchers and they might enable future competitiveness of a product's patent disclosure. It should be noted that this research was not an extensive study about x-factors and the researchers realize that firms may want to consider other or additional attributes with specific value to their future products.

2.11.1 Awareness of New Product Specification

Product requirement specifications significantly influence the development path of the new product and attribute driven definitions can cover many aspects of a new product (Krishnan & Ulrich, 2001, p. 6). Srinivasan suggests that a physical model representation can convey the desired look and feel better than words but also notes a shortcoming where the listed attributes or their combination can be in conflict (Srinivasan et al., 1997, p. 157). The specification of a new product must anticipate both the capabilities and limitations of the producing company but also reflect a comprehension of the market needs at the point of the new product introduction into the market. Patent disclosures should be carefully considered so that they have an advantage over competitors, once they are in force (Wagner, 2009, p. 2148).

The researchers see specification building and influence of the product specification as a forward capability that would be useful when considering the patent disclosure for any new or future products.

2.11.1 Awareness of the Product's Full Development Cycle

It is understood that product development direction changes as a result of many influencing factors (Civi, 2000) and that involved stakeholders are more likely to understand the reasons for these decisions. The researchers feel that when building patent disclosure, it may be useful to have available, the knowledge of how the product development process proceeded. Boyer, in a report about six independent design efforts identifies an important attribute that contributes to getting the project done despite the challenges, it is called stewardship. Stewardship requires a combination of analysis, execution and availability (Boyer et al., 2013, p. 15). Boyer notes that designers often exhibit this stewardship. Petre explains that exceptional teams placed a high value on keeping track of decision making and its rationale, as well as record keeping (Petre, 2004, p. 492) for the effectiveness of the project.

2.11.2 Awareness of Technology and Industry Trends

Recognizing the importance of technology trends, Gibbs indicates that state of the art technology trends should be continually monitored and that R+D should use marketing as a resource for emerging trends (Gibbs & DeMatteis, 2003, p. 128). Petre observes the behaviour of engineering teams and notes that they are constantly seeking out knowledge that include new

technology, key industry advancement through technical journals and conferences, observations on industry response to new products and changes to industry standards. At the outset of a project, research into the current state of the industry is performed where the researcher will then report findings back to the team (Petre, 2004, p. 481). Wagner notes that technological advancement over a decade or more should be considered by the patent applicant in order to predict the future market for the technology (Wagner, 2009, p. 2148).

2.11.3 Awareness of Usability and User Understanding

In Srinivasan's empirical study, the issue of usability is considered where marketing considers its attribute features. Also noted is designers that seek to identify usability aspects that the user has not yet identified (Srinivasan et al., 1997, p. 156). Cross, through observation, recounts the thought process of a very experienced designer starting on the design of an unfamiliar product where he notes that concern for product usability played a predominant role (N. Cross, 2011, p. 80). The use of the product is important and securing yet to be realized gains in this regard could allow for future competitive advantage. Sanders notes that the growth of user-centered design combined with the user as a partner approach now leads to design where the user and designer collaborate to generate solutions (Sanders & Stappers, 2008, p. 6). Usability innovation seem to be a consistent driver for new products, along with their enabling technologies. The researchers anticipate that advancements to usability can add to product competitiveness into the future.

2.11.4 Awareness of Product Cost and Quality Drivers

Determining methods and advances to control future product cost are important (Gibbs & DeMatteis, 2003; Petre, 2004). Srinivasan provides empirical support for benefits that extend beyond attribute based direction for new products but integrates an approach that leverages the strengths of marketing, design and manufacturing where price is almost always important (Srinivasan et al., 1997, pp. 154–155). In an integrated design course with business and engineering at Stanford University students work to understand how market share and revenue are affected by changes to both design concept variation and pricing (Srinivasan et al., 1997, p. 157). Guerrini indicates that there is not a single universal standard for quality and that different stakeholders may consider different dimensions of quality. It may not be possible for

manufacturers to cost effectively optimize quality across every dimension but firms' need to develop a vocabulary around quality in order to tailor it to their niche (Guerrini, 2014, p. 117) .

Incorporating inventive aspects that can allow for future cost reduction and quality improvements into the patent disclosure could offer the firm an advantage in the market of the future.

2.11.5 Awareness of Competitive Understanding

Gibbs notes that it is important to understand the competitive landscape. This means that it is very important to consider that not everything should be derived internally and that there are competitive advantages to bringing in technology at times (Gibbs & DeMatteis, 2003). Petre indicates that a characteristic of all observed companies is to actively search external sources to keep at the forefront of knowledge including patents, technical literature, regulatory requirements and a review of the competition (Petre, 2004, p. 482).

Gibbs indicates the importance of observing and understanding competitors. Their initiatives need to be observed and the market response to these initiatives needs to be understood (Gibbs & DeMatteis, 2003, p. 128). Awareness of competitive groups as potential partners, through licensing or cross licensing could be strategically beneficial, especially when seeking bottle neck points from which to drive value capture (Pisano & Teece, 2007, p. 281). Competitive and industry landscape awareness as well as understanding barriers are important when determining a value creation and capture system (Partanen & Möller, 2012, p. 484). When Wagner notes that the patent applicant must be a futurist, he indicates that the timeline to consider might be a decade or more and that predicting the behavior of competitors should be a focus of consideration (Wagner, 2009, p. 2148).

2.12 Literature Review Summary

As presented, a literature review was conducted to determine existing and current knowledge regarding the topic of SME creation of knowledge for robust IP disclosure through the use of input from extended stakeholders. Additional research included a review of stakeholder connectivity and a consideration of stakeholder theory which revealed that the boundaries between product development stakeholders consisted in a larger barrier than originally

anticipated. Also added was a review aimed at gaining a more specific understanding of the conversion of potential IP knowledge into information that can be considered for patent content. Initial stakeholder research lead to the importance of salience of individuals with respect to patent content to be considered in the empirical research. The review identified forward looking patent attributes that are the test of stakeholder relevance to their potential contribution to patents.

Identified in the research were the pragmatic challenges with engaging team members from multiple disciplines and the associated challenges with tacit to explicit knowledge conversion (Carlile, 2002; Manzini & Lazzarotti, 2015). Product development teams are frequently under time constraints to complete a commercialized product within time and budget (Srinivasan et al., 1997). If these teams are considered for an augmented role with respect to the generation of patent content, the process should be considered for its efficiency.

The chart below, Figure 2-4, is an updated literature review map where key areas of the literature review in bold indicate additional areas of inquiry from that of the original.

Figure 2-4. Updated Literature Review Map – New Items in Bold Outline

The time lag from when the patent disclosure is filed until when it is prosecuted places a high degree of importance on the original selection of information to effectively address future uncertainties including market conditions and competitive moves (Parchomovsky & Wagner, 2005, p. 8). Questions remain where the literature does not outline a path forward or a framework to use, to assist SMEs in improving their practice of acquiring and accessing appropriate knowledge from their stakeholders about their innovation and the incorporation of future oriented content into patent disclosures.

3. METHOD

3.1 A Philosophical Approach

Creswell explains of the importance of indicating the philosophical orientation, or worldview, from which the researchers are guiding the research (Creswell, 2014, p. 6). Constructivism emphasizes the role of the participant, their abilities to confer meanings to their experiences and to things (Creswell, 2014). Also, constructivism places emphasis on interactions of individuals, and the context from which their opinions form. In the case of this research, we are looking to understand participants' informed experience but through a static document and cannot observe them or interact with them as they provide responses. Pragmatism, another worldview, has an acceptance from researchers that use of many methods in order to understand the research problem (Creswell, 2014, pp. 10–11). The use of a mixed method approaches that does not rely on one reality of philosophy such as qualitative research or quantitative, offers flexibility on how to collect data and allows for the data to influence how it might be codified (Creswell, 2014, p. 11). This flexibility is needed in this research, where it can allow the researcher to adjust or extend their analysis in response to the findings. Corbin and Strauss note that Pragmatism and Social Interactionism form the foundation of Grounded Theory which will inform the codification process for the qualitative component on this research (Corbin & Strauss, 1990). The results of the primary analysis of the qualitative data was then used in a secondary data analysis and insight generation process. This further step was in response to a review of the initial findings and the subsequent decision to explore for further insights.

3.2 Methods Map

Figure 3-1. Research Methods Outline with Key Elements Indicated

The methods map, Figure 3-1, shown above, indicates the five key components of this research in sequential order, left to right. Under each component is a list detailing the key activities and sub-activities that were performed.

3.3 Research Design

Following the literature review, key elements of the research question were unresolved, and it was determined that empirical data from professional people, with significant experience in product development and patents, needed to be collected. Participants with this combination of attributes were anticipated to have useful knowledge to contribute towards the understanding of this specific subject matter. What follows is the exploratory research which Friedman describes as determining specific questions to ask and the consideration of specific methods to ask those questions (Freidman, 2017). Due to a lack of previous research and theory into stakeholder salience specific to SME businesses, Westrenius selected an inductive theory-building approach, as opposed to deductive theory testing, and their methods included a mix of close ended and open-ended questions. The close-ended questions allowed researchers to apply measurement

scales and the open ended question allowed the researchers to triangulate in order to minimize discrepancies (Westrenius & Barnes, 2015, p. 1119).

It was anticipated that gaining access to qualified participants could be difficult. The participants were sought for their extensive knowledge and experience with product development and patenting experience. Participants with this level of qualification and knowledge of the patenting process is a narrow sample requiring years of experience. The researcher wanted to respect their limited availability and wanted to ensure that the participants' time was used effectively.

The researchers determined that the research method should establish a broad mapping aimed at better understanding more about the individual participants for considered qualification, understanding more about the product development team's knowledge, their interactions as stakeholders, and understanding more about their process experiences with generating patent content.

3.4 Research Method

Resulting from the literature review was a clear awareness that current literature into enhancing forward-looking patent content using extended stakeholders for the benefit of SME patent performance is extremely limited. The literature review was focused on peripherally associated literature. In response, the researchers determined that a mixed methods research approach with both quantitative and qualitative data collection was required for this study. This offered the ability to triangulate about the question in order to develop "a more coherent justification for themes" (Creswell, 2014, p. 201). Methodological triangulation where "The combination may also result in a healthy mix of quantitative and qualitative data, mutually informative to the same inquiry" could offer additional information on the subject (Hanington & Martin, 2012, p. 188). A mixed methods approach could also assist in gaining broad information about the sample as well as specific opinions from individuals.

A Delphi method was considered as a method for gaining insight from these professional persons. Its general process allows for multiple individuals to provide responses to a stimulus set, often a series of questions, which is then collected by the researcher where all collected responses from the individual participants are analyzed (Hsu & Sandford, 2007, pp. 3–4).

Following the researchers' consideration of the collective responses, the still unanswered aspects of the research questions inform an updated stimulus set. This is then redistributed. Subsequent responses are collected, and this iterative process repeats until a refined result in response to the evolved question is determined from the many independently participating professionals (Skulmoski, Francis Hartman, & Krahm, 2007, p. 1). Hsu notes a strength of Delphi is the independence of each expert that is not pressured into group conformity but also notes that a challenge is that it can take time to administer a round of questions, receive and analyze, develop and update an instrument for the subsequent round (Hsu & Sandford, 2007, p. 2,4). Also noted is the increase prevalence of electronic devices and their software (Hsu & Sandford, 2007, p. 4) where online distribution could improve the process. Linstone and Turoff explain the evolving nature of Delphi with online access to expert communities. They indicate that allowing for participation, where participants are afforded flexibility in their time to respond, will continue as a strength of the method and they also suggest the potential benefit of rolling (ongoing) data collection and even mediation of that data by the community (Linstone & Turoff, 2011, p. 1718). The Delphi method of interviewing professionals is experiencing ongoing evolution in response to technology and the approaches that facilitate participation.

This research draws from the Delphi method in two regards while being a single inquiry. Firstly, the collection of data is from participants that are remote and anonymous from one another and secondly, the participants targeted for detailed insights, are knowledgeable professional people that are experts in their fields (Skulmoski et al., 2007). Skulmoski indicates this approach is flexible, and that often professional people are short on time and that concise and engaging questions improve participation (Skulmoski et al., 2007). Skulmoski indicates instances where a single round of this method is used, but more typically the number of rounds range from 1-6. He also indicates that it is a flexible research tool that is well suited for areas of inquiry where there is incomplete knowledge (Skulmoski et al., 2007, p. 12).

Considering the practicality of different data gathering methods, the time limitations on this study, and the desire to maximize input from the greatest number of available participants, it was determined that the method of data acquisition would be a distributed questionnaire.

It is important to note that a questionnaire accommodated two key barriers in accessing expert professionals with knowledge into the team dynamics of the patenting process; their distributed geographic location and their limited availability of time. As such, where the most appropriate method was an online questionnaire that could more easily obtain data from remote professional participants (Creswell, 2014, p. 157). A case study was considered, then dismissed as a research approach for this study due to its resource intensiveness that would have limited breadth of input from a broad range of participants from different firms.

The questionnaire was hosted by Qualtrics online survey platform. Qualtrics is associated with, and available through, Carleton University. Data was collected and recorded by Qualtrics' survey platform and downloaded at the end of the survey period in (.tsv) format.

3.4.1 Participant Selection

The participant population inclusion criteria required industry experience in the development of products that have been patented or experience in the legal aspects of generating patent disclosures for product patent application. Participants were required to have a minimum of 5 years of product development experience. Qualifying participants were required to read in English. Hsu, describes expert participant selection criterion according to the Delphi method, as not having a set of fixed standards, but states that the primary importance is the participants' disciplinary area of expertise, their high level of training and competence and their backgrounds being somewhat related to the target issue (Hsu & Sandford, 2007, p. 3).

Palinkas (Palinkas et al., 2015, p. 534), in their review of best practices for purposeful sampling, describes the wide use of purposeful sampling for qualitative research into information-rich cases in order to arrive at deep knowledge. The researchers understand that a random sample selection from the qualifying population would have been ideal, but considering the constraints of this research, purposeful sampling enables access to the greatest number of qualified participants with a willingness to contribute their time and considered attention toward responding to the detailed research questionnaire.

The sampling from this population was non-probabilistic and relied on accessing known people to the industry, the advisors, and the researcher. The participant sample range focused on product

development professionals with a range of roles in product development and with a depth of experience in patenting products. The participants had no awareness of this research prior to the receipt of an invitation to participate. The researchers had no knowledge of how the participant might respond to the questions in the questionnaire.

Palinkas indicates that guidelines for purposeful sample selection are not clear, especially for mixed method study with more than one specific objective but does indicate the importance of providing a clear rationale for the sampling procedure used (Palinkas et al., 2015, p. 542).

Palinkas also notes that with purposeful sampling, the selection of a sufficient range of variation in the sample set is desirable, but that this range may not be known at the outset prior to knowing the range of possible responses as they respond (Palinkas et al., 2015, p. 536).

Ensuring variation of the sample was a goal of the researchers. The researchers reached a non-homogenous professional group that extended across multiple professions involved in product development, thereby increasing the variation of participants.

3.4.2 Questionnaire Design

The purpose of the data collection questionnaire was to allow for a broad mapping of the responses obtained from the extended range of participating product development stakeholders, to a series of questions relating to the patenting process in a format that could be compared quantitatively. Secondly, to receive individual opinions to several open-ended questions as detailed qualitative data to allow for triangulation with a different method regarding the same overall research question (Creswell, 2014, p. 201,231).

Considering the challenges with accessing this caliber of participant, the researchers felt it was important to incorporate a mixed methods approach. Tashakkori indicates the importance of having overarching questions that can link quantitative and qualitative methods and related sub questions in order to derive clear analysis and conclusions from the mixed methods (Tashakkori & Creswell, 2007, p. 10).

A position that the researchers took was to not limit the questioning of participants to their direct performance and direct experience. There were many questions that asked participants to reflect on their observed performance of other stakeholders.

There were several reasons for this approach. Firstly, it could offer a respite for the participant from continually reflecting and reporting on their historical performance in relation to a given question. The concern was that participants would repeatedly be hunting for personal experiences associated with the question being asked, or inversely, would be required to mentally triage from many associations that came forward to arrive at the one that most closely fit the context of the multiple-choice question. In the researchers' opinions, in excess, this can be tedious since the question may not fit exactly to the participants' recalled experiences and a mental process of over rationalization that is unreported to the researcher, occurs.

There was a concern with causing unnecessary participant fatigue or apathy if the direct question was the only question type provided. Considering the questionnaire length was significant, we wanted participants to not become frustrated and still have 'goodwill' remaining for the open-ended questions at the end of questionnaire.

Lastly, and possibly more importantly, it was anticipated that many professional persons involved in product development are involved with patents less frequently than many other aspects of the product development process. We did however believe that participants may have gained knowledge of how patent creation happens through exposure to legal teams even if their involvement to each observed experience was not necessarily extensive. In time, the combination of their engaged experience and their observations of others' experience might form their overall opinion and the researchers wanted to also draw responses from that informed opinion.

It should be noted that the open-ended questions were placed at the end of the multiple-choice questions. This was purposeful. The intent was that the participants would have a better sense for the research and its context, through having read the preceding instructional information and answered the associated multiple-choice questions. The expectation was that there would be a greater degree of correct interpretation and understanding of the questions because of the prior exposure through the multiple choice.

The Qualtrics online questionnaire was composed of 40 questions. As a research tool it contained 7 distinct sections of inquiry, each to solicit feedback about the main research question, or its sub questions, through a range of approaches. From the participant's point of view there were fewer apparent sections.

Six of the sections consisted of multiple choice questions and the analysis of the questionnaire data refers to these sections. The researchers developed the questionnaire such that it was appropriate for the broad range of professionals from different professions including both lawyers and product developers. There were also several guiding statements throughout to orient the participants to some of the terms being used. This included defining the use of the 'product development stakeholder' and a clarification that 'being involved with patenting' did not require the status of being an 'inventor' since it is feasible that stakeholders to the subject, can offer useful information that can trigger others to have inventive responses (Gibbs & DeMatteis, 2003, p. 136).

It should be noted that a randomization function within Qualtrics was selected, such that questions requiring a participant to select from a list of stakeholders, was randomized and as a result, participants were not all seeing the list in the same order. This was to reduce the potential of bias in choice selection (Vannette, 2015).

Multiple choice design structure and purpose:

Section 1 establish the experience of the participants in relation to product development and patenting (Q2-Q10). The responses to these questions were used to qualify participants.

Section 2 inquire about the networking and communication between stakeholders (Q11, Q12). Increased communication capabilities is widely seen as an advantage to knowledge building and to overcoming challenges (Kogut & Zander, 1992, p. 389).

Section 3 inquire about their perception of stakeholder understanding and communication flows about IP (Q13-Q18)

Section 4 inquire about the effect of time and cost pressures on the participants patent involvement (Q19, Q55)

Section 5 inquire into which stakeholders had the most influence on a range of factors that might improve patent robustness (Q20-Q30). The x-factors are shown in the table below along with their description.

x-specification	Play the greatest role in specifying the new product
x-user	Advocacy for end user and contact with end user for feedback
x-dwell	Long duration involvement and awareness of product's innovation
x-trend	Understanding of technological and future enhancements
x-cost.qual	Ability to affect cost and quality of the product
z-competitive	Awareness of competitive product compared to new product

Table 3-1. Description for Each x-Factor Code

Section 6 inquire into the patent related team dynamic and their codification (Q32-Q36, Q38)

Section 7 was composed of two open ended questions about accessing extended stakeholders and one about the involvement of product designers in improving patent content (Q47, Q49-Q50).

3.4.2.1 Quantitative Data Codification

The multiple-choice data analysis design and codification is outlined below. The researchers note that additional analysis was performed following the initial analysis of the data as there were emerging themes that arose (Thomas, 2006).

Section 1 -Participant qualification: Review of Section 1 multiple choice responses was performed to ensure that participants qualify and have 5+ years of product development experience, and experience with patents or intellectual property. Participants that did not meet these criteria were not be included in this study.

A histogram showing the participants' number of years of experience presented. As well as a table showing will show the participants responses to a question about their main professional

roles with the frequency of response for each category option as a percent. Another histogram shows participants' responses to a question about the types of products that they are involved with.

Section 2 - Stakeholder Interaction: Section 2 was used to learn about stakeholder groups' levels of interaction with other stakeholders. Participants were allowed more than one response.

Two methods of evaluating the responses are shown in Section 2 codification. Method 1, where there may be more than one response to the question, the total value of each participant's response is a value of 1 for their response and if they have more than one response, each of those responses receives an equal fraction of the value of 1. Method 2 will measure frequency of response, where every selection is counted with an equal weight (A table showing both of these methods is shown in 4.0 Data Collection and Analysis for the analysis of Section 2).

Questions Q11 and Q12 are each be shown as a histogram and will show the results of the two questions as a percentage response to each selection option (Method 1).

Section 3 - Stakeholder group understanding of IP: This series of questions was aimed at understanding participants' reported perception of which of the stakeholders they associate with, have the most knowledge of intellectual property and the process.

Questions 13 and 17 are presented as a single histogram to show the different level of patent knowledge for each stakeholder group. The responses from the two questions are averaged. Each has a weighting of one per participant, and if more than one answer was provided, an equal fraction of one was allocated to each of the multiple responses the participant provided. The combined results from these 2 questions was used to establish the x-axis on the Patent Centric Stakeholder Positioning diagram as it is an indicator of stakeholder experience with patent.

Questions 15 and 16 are presented as a histogram to show the different level of communication for each stakeholder group. Each has a weighting of one per participant, and if more than one answer was provided, an equal fraction of one was allocated to each of the multiple responses the participant provided. The results are used to establish the y-axis on the Patent Centric

Stakeholder Positioning diagram as it is an indicator of the level of communication when patenting.

Section 4 - Participant reporting of their IP availability

Questions 19 and Q55, inquire into the effect that time and budget have on their level of patent involvement. Frequency of response was evaluated to determine the role of cost and timing as a potential limitation to further patent involvement.

Section 5 - Stakeholder groups' level of awareness of future oriented elements of patents

A series of 11 questions about researcher generated forward looking attributes (x-factors) that may offer relevance to patents in the future. Analysis of responses informed the research understanding of the different stakeholder groups' relevance with respect to the 5 key factors. Repetitive question variants are used to triangulate and ensure the participants' response related to the research question. Each participant was weighted with a value of one for their response, if more than one response was provided from a participant, an equal fraction of one was allocated to each of their responses. Some related questions were combined by simply averaging the responses.

A histogram shows each stakeholder group, adjacent to each other with their percentage of relevance to each of the six forward looking attribute (x-factor). Each stakeholder group has a colour, and the overall histogram allows for an understanding of each group's knowledge with respect to each x-factor.

This data was also used in support of an alternate visualization to further understand stakeholder salience in a salience map.

Section 6 - Participant opinion on stakeholder team function with respect to capturing patent information

a. Question 32 asks about the level of challenge with selecting information for patent applications, participants selected a single answer, the results are presented as a percentage of the total responses for each selection option and reported within the results section.

- b. Questions 31 and 34 ask about the ease of getting stakeholders together to discuss patent and the other about the level of challenges experienced with communicating among stakeholders about the application. The responses are presented as a percentage of the total response for each response option and reported within the Results section.
- c. Question 33 asks about whether having support with visual images would help facilitate the capture of knowledge from stakeholders. Responses are shown as a histogram.
- d. There were two specific questions, 35 and 36 relating to the option of using team brainstorming activity prior to patenting activity. The percentage of participants' responses for each selection option are reported as text.
- e. The responses to question 38 about which stakeholders would be best to run the team brain storm session are reported as a percentage of the total of responses for each stakeholder option.

3.4.2.1.1 Stakeholder Positioning Graph

The key assets resulting from multiple choice data are visual documents such as positioning diagrams, that position each of the stakeholder groups relative to each other along two axes. Figure 3-2 below, indicates that these axes are level of knowledge on the horizontal (for each of two conditions), and degree of communication participation on the vertical (for each of two conditions). This yields an understanding of stakeholder relationships and knowledge. The two conditions are the product development team context, and the patent capture process context. The relative difference in the stakeholder positions between the two contexts yielded insights that informed the research question and provoked new questions.

Figure 3-2. Position Map Concept with Increased Relevance Toward Upper Right

This analysis outline is consistent with furthering the inquiry into stakeholder communication is in response to the importance of team communication for effective development and for overcoming the challenges of cross boundary communication and the opportunity for a creative result arising from overcoming these boundaries (Carlile, 2002; Manzini & Lazzarotti, 2015).

3.4.2.1.2 Determining Stakeholder Influence on Future Attributes

Section 5, is a series of questions that requested that participants select which stakeholder groups had the most relevance to several attributes (x-factors). The responses were analyzed to determine each stakeholder group's relevance to each of the six x-factor variables. Each stakeholder group has a relevance to each x-factor that is the percentage of participant responses of the total for each stakeholder. Stakeholders might rank differently to each x-factor, and as a result have a specific relevance to each x-factor attribute.

A different visualization method from that of section 5 is shown here. In Figure 3-3, each stakeholder group's aggregated relevance across all of the x-factors was derived from a sum of their relevance percentage to each of the x-factors. The researchers represented this in a visual format. For each stakeholder, their relevance to each x-factor, expressed as a percent forms the area of a circle for each x-factor. The cluster of each Stakeholders x-factors together creates a large area that bounds the clusters. The bounding area represents that stakeholder group's percentage of relevance with respect to all x-factors. Below is shown a schematic of a single stakeholder group, with that group's relevance to each of five x-factors. An overall bounding circle's size is a size that is sufficient to contain the sub circles. A stakeholder with a smaller total area in its sub-circle has a smaller overall bounding area.

Figure 3-3. Visualization of a Stakeholder's relevance to all Forward Looking Attributes

3.4.2.2 Qualitative Data Codification

Common options for the analysis of qualitative data include deductive and inductive analysis. Deductive analysis compares research to the assumption of an existing theme, theory or hypothesis. Inductive analysis includes grounded theory, discourse theory, and phenomenology (Thomas, 2006). The researchers decided on categorizing key emergent themes using an inductive approach in accordance to the realist philosophical approach. For each question, the participants' responses were reviewed and each of the key ideas within that response were codified. Thomas notes that emerging themes are to be responsive to the data but that frequently determining what is working well, and what is not, is a frequent 'framing' of inductive analysis (Thomas, 2006, p. 238). Blair, in exploration of two coding techniques using identical data, uses both open coding and template coding, and describes a combined process that he felt was most pragmatic where the objectiveness of the open coding is mediated by the researchers concept of relevance, resulting in a balance (Blair, 2015, p. 26). The chart for this is shown below as Figure 3-4.

Figure 3-4. Combined Coding Technique – Open and Template Coding (Blair, 2015)

Corbin indicates the importance of researchers providing the reader with sufficient information to allow an assessment of the codification (Corbin & Strauss, 1990) and the response data and its codification is available in the appendices.

With the three open ended questions, the goal of the codification was to form categories of ideas from the responses provided by the participants. The goal was to reduce the number of idea categories by combining the multiple participants' similar ideas into fewer categories while adjusting the category titles to more accurately describe the combined responses, as needed. Reducing the number of categories to a manageable number was the goal as long as they still clearly reflect the initial ideas. Creswell describes this as an approach to codification of qualitative data from many participants (Creswell, 2014, pp. 197–198). Blair, lists this approach as 'open coding' where the concepts emerge from the data. This is in alignment with Grounded Theory methodology where the theory results from the data (Blair, 2015, pp. 17–18). Corbin and Strauss describe that basic units of analysis, or themes, emerge from the participant reporting or response. It is not the actual incidents that create the theory, it is through observation and comparing of incidents where like incidents are named with the same term and they may then form a theme or concept, and become the units of analysis (Corbin & Strauss, 1990, p. 7). Additionally, keeping note of the ideas that do not fit into any category may be important as these outliers may also become the source of insight.

In a data sheet next to the participant responses, columns were made with each of the key participant ideas identified at the top of the column; this formed a category with similar ideas.

Two approaches to measuring the responses were used. For the first approach, every participant had a weighting of 1.0 for their responses. If a participant responded with one idea, it received the full weighting of 1.0. If a participant responded with 4 different ideas within their response, each of the 4 ideas, each in a different category, were equally weighted and received one fourth of the full value, a weight of 0.25. The goal of this approach is to ensure that one respondents' opinion was not able to overly affect the weighting of other respondents' responses.

As a second approach, the frequency of response for each resulting theme were calculated. Participants with a greater number of answers identifying with a theme would register more responses than would a participant with a single answer assigned to a single theme. The frequency with which each theme was recorded was totaled. The analysis using frequency of response more clearly identifies the ideas that were most frequently mentioned.

Comparisons were made and where the difference between the approaches is significant, this is considered in the analysis, and in the discussion section of this paper. The sum of responses within each category is expressed as having received a specific percentage based on the total responses to that question. These are be presented as histograms with the resulting theme categories.

3.4.2.3 Questionnaire Delivery

The process for delivering the questionnaire followed Carleton University ethics' requirements where the ethics approved invitation was sent from the lead researcher's university email account. When a potential participant replied and indicated interest in participating in the questionnaire, an email was sent from the Qualtrics' email server with a link to the online questionnaire. When the participant selected the link, it led the participant to the Qualtrics site and the online questionnaire. The questionnaire itself started with the ethics approved Consent form informing the participant of the potential implications of the research questionnaire. Only with their selection of consent were they immediately flowed through to the online research questionnaire.

4. DATA COLLECTION AND ANALYSIS

4.1 Questionnaire Data Collection Period

Questionnaire responses were collected over a 23-day period. There were forty multiple choice questions presented to the participants. Upon completing the questionnaire, the participant had to select the completion button to terminate. They had the option to leave the questionnaire and return later to complete it however this feature was used by only a few. Qualtrics estimated that the time to complete the questionnaire was 18 minutes. 43 participants responded positively to the invitation, were sent a questionnaire link, and 38 of those completed the survey.

4.1.1 Section 1 - The Participants

The people invited to participate in this research were professionals with extensive product development experience who were accessible to the researchers. Each has worked on product development teams during their professional career. The least experienced participants were in the 6-10 years of experience range. Most of the participants reported having 16 years or more of professional product development experience.

Q51 For approximately how many years have you been involved in product development? - Selected Choice

Q2 What best describes your main professional roles? (select up to two) - Selected Choice

Q10 What types of products have you had patent or intellectual property experience with? (multiple answers accepted) - Selected Choice

Figure 4-1. Participant Experience with Product Development in Years

The participants' main professional roles were wide ranging. There was research participant representation for all stakeholder groups categorized in the questionnaire. The following table below indicates the frequency of response from the full sample of participants.

Question 2			
What best describes your main professional roles? (select up to two)			
Marketer	5.3%	Inventor	3.5%
Sales	1.8%	CEO/President	14.0%
Engineer	8.8%	Upper management	10.5%
Patent attorney/agent	10.5%	Entrepreneur	12.3%
Patent examiner	0%	R+D research	3.5%
Product designer	26.3%	Other	3.5%

Table 4-1. Participants main professional roles

The figure below shows that the participants to this survey indicated experience with an extensive range of product types. The product types selected, except for government policy and possibly software, are types of physical products that can be the subject of device patents, or as they are also called, utility patents. Participant experience with this type of product supports their

relevance to this research. The researchers reviewed the data and confirmed that all participants that selected software, government and other, did also select physical product options.

Figure 4-2. Research Participant's areas of Experience Relating to Patents

All participants indicated experience with products that had a form of intellectual property (Question 8). Over eighty percent of the respondents indicated utility patents as one of the intellectual property types that they had the most experience with.

The six participants representing the patent attorney/agent element of this research worked for legal firms. None of them were in-house to product development companies

The 38 participants generally spanned North America, as illustrated in Figure 4-3, and were all actively involved in product development. Many have had long careers with two thirds of participants having at the time of the research more than 15 years of experience.

*Figure 4-3. Participant Sample Predominantly from Across North America
(Google Maps & Watters, 2018)*

Understanding the world class caliber of these participants is important. To meet the Carleton University Ethics requirements, we cannot mention names or companies, but descriptive examples include:

- recent former VP of design for US division of one of the top 3 consumer electronics companies globally
- design director of a fortune 500 consumer and tool product company
- engineering manager producing commercial energy products at a \$250Mn revenue subsidiary, of a \$6Bn+ conglomerate
- director of design for a top tier US design consultancy with 75+ people

- senior director of marketing for a \$200-500Mn subsidiary of a \$6+Bn small appliance group consortium
- president of a world leading biomechanical consultancy for human protection and safety product development
- senior director of program management for a regional subsidiary of a \$1-2Bn defense and security company
- PhD IP Scientific advisor at a top 60 global law firm by revenue, \$700+Mn
- attorney, deputy chair of patent litigation and counseling at a 300Mn+ revenue law firm
- inventor and president of small multi award winning California environmental packaging startup

The researchers were comfortable that all participants had experience with products that fall within the scope of this research. As a summary, the participants were very experienced product development stakeholders, and all had experience with products that have been patented.

4.1.2 Section 2 - Networking Between Stakeholders

Analysis of communication between two questions about stakeholder communication are shown as histograms. The actual questions to the participants are in the histogram title. Q11 asks about the most networked stakeholders, and Q12 inquires about which stakeholders have the least amount of team interaction. The two questions each target aspects of communication but they are different in their focus and with the negative question in Q12, the groups most selected, represented those with the least communication.

Q11	Based on your experience, which two stakeholders are typically the most networked to the greatest number of other stakeholders? (please select two answers)
Q12	Based on your experience, which two stakeholders typically interact least with other product stakeholders? (please select two answers)

Which two stakeholders typically interact least with other product stakeholders? (Q12)

Figure 4-4. Most Networked Stakeholders

Which two stakeholders typically interact least with other product stakeholders? (Q12)

Figure 4-5. Least Interactive Stakeholders

Findings: These charts indicate that legal has both a low level of networking (Q11) and a low level of interaction (Q12) with the team. The following three stakeholders are the most networked and their percentage of response is shown; designer (21.5%), management/CEO (21.1%) and entrepreneur/inventor (20.6%). The following are the stakeholders that are least interactive with other stakeholders; Marketing (25%) along with management/CEO (26.3%) and legal (23.6%).

Stakeholders	Q11 'stakeholders most networked'			Q12 'stakeholders interact least'		
	M1 - Value 1/participant (in)	M2 - Frequency of response (in)	Difference	M1 - Value 1/participant (in)	M2 - Frequency of response (in)	Difference
Designer	21.5	22.1	-0.6	6.6	6.8	-0.2
Engineer	16.7	16.9	-0.2	13.2	13.5	-0.3
Marketing/sales	13.2	13.0	0.2	25	25.7	-0.7
Mgmt/CEO	21.1	20.1	1	26.3	24.3	2.0
Legal	6.1	6.5	-0.4	23.7	24.3	-0.6
Entre/Inventor	20.6	19.5	1.1	3.9	4.1	-0.2
Other	.9	1.3	-0.4	1.3	1.4	-0.1

Table 4-2. Comparing two Methods of Calculating per Participant

Two methods to evaluating the codification of responses are shown in the table above. Method 1, where there may be more than one response to the question, the total value of each participant's response is a value of 1 for their response and if they answer more than one response, each of those responses receives an equal fraction of the value of 1. Method 2, will measure frequency of response, where every selection will count with an equal weight

Finding: The two described methods (M1 and M2) for calculating participant responses each yield results that are similar for the purposes of this research.

The data from the Q11 chart will form the Y-Axis of the Product Centric Stakeholder Salience.

4.1.3 Section 3 - Stakeholder Understanding and Communication About Patents

There are two subcomponents to this section.

The first histogram conveys participant opinion regarding other stakeholders' level of input into patents and stakeholder knowledgeability of the patent process. It is an average between the two following questions:

Q13 Based on your experience, which stakeholders typically provide the most input into the patent process?

Q17 Based on your experience, which stakeholders are typically the most knowledgeable about patent process details? (please select up to two answers) - Selected Choice

Findings: Legal, followed by entrepreneur/inventor have the most input into patents, followed by engineering and design. There were no responses identifying marketing/sales as having the most knowledgeable or input about patents.

Q13.Q17 Stakeholders with knowledge of and input into patents.

Figure 4-6. Stakeholder Knowledge and Input into Patents

The second histogram presents responses to patent related communications between stakeholders including intra stakeholder patent related communications, and specifically their communications with legal stakeholders. The histogram presents an average of the responses received by the two questions.

Note: The data from this chart will form the Y- axis of the Patent Centric Stakeholder positioning as well as the salience visualization asset.

Q15 Based on your experience, which stakeholder do you communicate with the most to get guidance on patent related information?

Q16 Based on your experience, which stakeholders communicate directly with the patent agent/attorney during the patent process?

Figure 4-7. Stakeholder Communication During Patent Disclosure Building

4.1.4 Section 4 - Effect of time and cost on their participants involvement in IP

The third inquire is into time availability and whether it affects patent creation (Q19, Q55).

Q19 Is your available time typically a barrier to you having more involvement in the patent process?
(please select one) - Selected Choice

Q55 Is budget typically a barrier to you having more involvement in the patent process? (please select one) - Selected Choice

Findings: For Question 19, on a three-tier scale, 11% indicated that time was ‘always’, 52% indicated that time was ‘sometimes’ 29% that time was ‘rarely’ an issue to their further involvement with the patent process. For Question 55, on a three-tier scale, 16% indicated that cost was ‘always’, 42% indicated that cost was ‘sometimes’, and 37% that cost was ‘rarely’ an issue to their further involvement with the patent process.

4.1.5 Section 5 - Future Oriented Attributes for Patent Disclosure (X-Factors)

Listed below are the questions presented to the participants regarding the identification of stakeholder groups that have relevant knowledge with respect to the future oriented patent attributes. The questions posed to the participants were as follows.

Q20	Based on your experience, which stakeholders play the largest role in specifying the new product requirements? (please select two answers) - Selected Choice
Q21	Based on your experience, which stakeholders generally have the most direct contact with the end user and their feedback? (please select two answers) - Selected Choice
Q22	Based on your experience, which stakeholders' involvement typically spans from start to finish of the product development process? (please select two answers) - Selected Choice
Q23	Based on your experience, indicate stakeholders that best understand technological trends that lead the advancement of new products. (please select two answers) - Selected Choice
Q24	Based on your experience, select stakeholders that most often understand the actual innovation in the new product the best. (please select two answers) - Selected Choice
Q25	Based on your experience, indicate stakeholders that best understand product enhancements needed for future product competitiveness. (please select two answers) - Selected Choice
Q26	Based on your experience, indicate stakeholders that are the strongest advocates for the product's ease of use. (please select two answers) - Selected Choice
Q27	Based on your experience, select stakeholders that have the ability to cost reduce current and future products. (please select two answers) - Selected Choice
Q28	Based on your experience, indicate stakeholders that have the awareness and ability to improve the quality and reliability of the product. (please select two answers) - Selected Choice
Q29	Based on your experience, indicate stakeholders that understand competitive products' strengths and weaknesses the most thoroughly. (please select two answers) - Selected Choice
Q30	Based on your experience, which stakeholders best understand how the new product actually compares to its competitors' strengths and weaknesses? (please select up to two answers) - Selected Choice

Table 4-3. Questions to Participants about X-Factors

Findings:

X-specification: The results of Question 20 show the top-ranking stakeholder is marketing followed by the management/CEO, entrepreneur/inventor and the designer, in their capacity to affect the new product specification.

X-user: The results of Question 21 and 26 averaged show the top-ranking stakeholder is marketing, then design in their access to users and promotion of user related issues.

X-dwell: The results of Question 22 show the top-ranking stakeholder is design, then entrepreneur/inventor as stakeholders who's involvement most closely spans from start to finish of the new product's development process.

X-trend: The results of Question 23 and 25 averaged show the top-ranking stakeholder is marketing, followed by design and entrepreneur /inventor as having a high awareness of technological trends that lead to advancement and of the innovation in the new product.

X-costqual: The results of Question 27 and 28 averaged show the top-ranking stakeholders is design and then engineering with the ability to reduce cost and affect the quality of current and future products.

X-competitive: The results of question 29 and 30 averaged show the top-ranking stakeholder is marketing, followed by design with the best understanding of the new products and its competitor products' strengths and weaknesses.

According to both methods of analysis, Method 1, a maximum value of 1 per participant and Method 2, measuring frequency of response, the stakeholder groups with most relevance to each of the x-factors is as follows. The x-factors are forward looking attributes for patents.

The chart below shows, side by side, (in the left to right order of designer, engineer, marketing sales, mgmt CEO, legal, entre/inventor, other), each stakeholder groups relevance to a particular x-factor. These groupings are repeated adjacent to each other for each of the x-factors.

Figure 4-8. Each Stakeholder's Relevance to Each x-Factor

Another method of visualization, this time to understand each stakeholder groups' relevance to all forward looking x-factor attributes, is by visual area where the increased area represents greater relevance. Below each stakeholder group has their relevance ranking to each x-factor expressed as a circle sized to their stakeholder's percentage of response to each specific x-factor. The grouping of all of a particular stakeholder group's individual x-factor circles is then encompassed by a large circle that tightly contains them. This large circle carries an area that is visually representative of that stakeholder group's relevance to all x-factors. This is performed for each stakeholder.

Note: this circular area visualization will be used in a combinative visualization to represent salience.

Findings: Each stakeholder group's x-factor percentage of response is shown, and the resulting relevance bubble is shown. Design has the highest relevance to this study's forward looking x-factors, Marketing/ sales is second followed by engineering. Least relevance to x-factors is Legal, followed by Management/ CEO and then Entrepreneur/ Inventor.

Figure 4-9. Relevance for Each Stakeholder to All x-Factors is Indicated by Area

4.1.6 Section 6 - Acquisition of Information for Patents

There were four lines-of-questioning presented to the participants in this section.

First was a question into the level of challenge that the selection of information for patenting represents.

Q32 How much of a challenge is the selection of information for the creation of patent applications?
(select one) - Selected Choice

Findings: The predominant response was ‘somewhat challenging’ which was the middle option. The remaining respondents were divided between either extreme with fourteen percent selecting ‘very challenging’ and eleven percent indicating it as ‘not challenging’.

The second was an inquiry into participant opinion on the value of having a group brainstorming session prior to the patent filing (Q35, Q36).

- Q35 Do you think that a group brainstorming session in advance of the patent application would help you increase your contribution to the patent application? (select one)
-
- Q36 Based on your experience, would the time and effort that it takes to have a group brainstorming session about the upcoming patent be worthwhile towards improving the patent application? (select one)

Findings: The two histograms below show that over half of the responses indicate the highest level of support for such a session. Most of the remaining participants indicated that such a session would be ‘somewhat helpful’ which was the middle response. The two histograms below present the responses as frequency of response as a percentage of total responses.

Would a group brainstorming session help you increase your contribution to the patent?
(Q35)

Figure 4-10. Helpfulness of Brainstorming to Improve Stakeholder Contribution

Would the time and effort for a group brainstorming session be worthwhile towards improving the patent? (Q36)

Figure 4-11. Brainstorming Value for Time and Effort

The third was a question about whether having assistance with visual images and sketching would facilitate the capture of knowledge for patent applications.

Q33 Would some support with the creation of visual images and sketches facilitate the capture of knowledge from stakeholders for patent applications? (select one)

Findings: Seventy percent of the respondents chose the top selection, indicating full support, and all remaining participants selected ‘somewhat helpful’, again indicating support.

The fourth was about which stakeholders might be best to run a pre-patent application group brainstorming session.

Q38 Which stakeholders might be the best to run a pre-patent application group brainstorming session? (please select two)

Findings: 26% indicated legal, 24% indicated designer, 17% selected inventor entrepreneur and 11% marketing. Other stakeholders received less than 10% of the responses.

4.1.7 Stakeholder Positioning

Two axes were used to position each stakeholder onto a positioning diagram. The intent was to present an understanding of the data that allowed for each stakeholder group to be understood for the level of communication and knowledge.

The positioning was looked at in two variations; product development context and patent development context. Collected data was used to drive the cartesian positioning of each stakeholder group. In both cases the Y-axis represented stakeholder level of communication, and the X-axis represented stakeholder knowledge and experience. For each of the two graphs there was different data driving the X and Y axes. The X and Y for the product centric positioning were derived from communication and experience questions relating to the participants product development insight. The X and Y for the Patent centric positioning were derived from participants' patent development experience.

4.1.7.1 Product Development - Stakeholder Positioning

The Y axis positions are based on percentage of stakeholder's responses to Q12 where the question was asked as a negative where the respondent with the largest negative number exhibit the least of the target attribute - the most communicative stakeholders are at the top of the axis.

The X axis positions are based on percentage of stakeholder responses to Q22, Q26-28 that have been averaged. Stakeholders with the greatest product development knowledge/experience are to the right.

Y.Axis	Q12	Based on your experience, which two stakeholders typically interact least with other product stakeholders?
X.Axis	Q22	Based on your experience, which stakeholders' involvement typically spans from start to finish of the product development process?
	Q26	Based on your experience, indicate stakeholders that are the strongest advocates for the product's ease of use.
	Q27	Based on your experience, select stakeholders that have the ability to cost reduce current and future products.
	Q28	Based on your experience, indicate stakeholders that have the awareness and ability to improve the quality and reliability of the product.

Product Development related communication vs PD experience - Positioning of Stakeholders

Figure 4-12. Communication vs Knowledge for Product Development

Findings: As shown in Figure 4-12, designers and engineers were indicated as having the most experience with the product's development with regards to cost, quality, usability and their time involved with the product. The entrepreneur/inventor, designer and the inventor were identified as having the highest level of stakeholder team communication in that order. In the product development context, reported to be least communicative by the participants are Upper Management/CEO, Marketing/Sales and Legal.

4.1.7.1 Patent Development - Stakeholder Positioning

The Y axis positions are based on percentage of stakeholders' responses to Q15-16 that have been averaged - the most communicative stakeholders are at the top of the axis.

The X axis positions are based on percentage of stakeholder responses to Q13, Q17 that have been averaged. Stakeholders with the greatest patent development knowledge/experience are to the right.

Y.Axis	Q15	Based on your experience, which stakeholder do you communicate with the most to get guidance on patent related information?
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	Q16	Based on your experience, which stakeholders communicate directly with the patent agent/attorney during the patent process?
X.Axis	Q13	Based on your experience, which stakeholders typically provide the most input into the patent process?
	Q17	Based on your experience, which stakeholders are typically the most knowledgeable about patent process details?

Patent related communication vs patent experience - Positioning of Stakeholders

Figure 4-13. Communication vs Knowledge for Patent Development

Findings: As shown in Figure 4-13, legal stakeholders are identified as having the most patent and patent process knowledge. This is followed by the entrepreneur/inventor. The stakeholder with the highest level of communication in the patent development context was the entrepreneur/inventor, followed by 3 stakeholders all with similar percentage of responses; legal, engineer, and designer. Of note, Marketing/Sales is the least communicative during the patent preparation phase as well as reported to be the least knowledgeable

4.1.7.2 Stakeholder Salience Mapping

The researchers created a mapping visualization that combines two previous visualizations; the stakeholder relevance to the x-Factors, and the relative Stakeholder Positioning in relation to key attributes of Communication (Y-axis) and Knowledge (X-axis). This mapping combined the positioning across the important axis of communication and knowledge, with the stakeholder groups' relevance to x-factors. As described in the method section, the goal is to understand to what degree each stakeholder group carries salience with respect to having valuable knowledge for contribution to forward-looking attributes, their level of interaction with the team and their overall experience for the potential to improve patent content. Both product salience (Figure 4-14) and patent centric salience (Figure 4-15) maps are shown below and the difference in relative position of the same stakeholder groups is seen by comparing their product and patent mode positions.

Figure 4-14. Product Development Centric Stakeholder Salience

Figure 4-15. Patent Centric Stakeholder Salience

Findings: The charts clearly show Marketing / Sales with the weakest level of communication about patenting and a weak level of knowledge about patenting, while having the second largest total relevance to forward looking patent attributes (x-factors). In the context of patent contribution, Marketing/sales is strong in one out of 3 attributes defining patent contribution salience. Having one of the 3 salience attributes would result in that stakeholder being considered as having latent salience in the context of the traditional definition salience (R. K. Mitchell, Wood, et al., 1997). Designers with the highest level of relevance to the forward looking patent attributes, maintain an upper 25% ranking with respect to levels of communication in both the patent and the product development modes, and their legal knowledge is similar but less than engineering.

4.2 Qualitative Questions - Section 7

In relation to acquiring knowledge for patent disclosures, there were three open-ended questions; why extended stakeholders were not accessed, how to access information from extended stakeholders and how to use industrial designers to improve patent content.

- Q47 Any quick thoughts on why the full range of stakeholders might not currently be considered when it comes time to contribute to patents?
- Q49 What one or two things could help facilitate input from many stakeholders for consideration by the patent agent/attorney?
- Q50 How might product designers be helpful in facilitating patent input from stakeholders? (bullet points are fine)

Their responses were codified using an inductive codification approach as described in the Method section. The average length of response provided was very similar for each question, with an average between 20 to 22 words per responding participant for each of the three questions. There were between 1 and 5 ideas per response with the average being about two.

4.2.1 Qualitative Question 1 (Q47)

The question presented was: Any quick thoughts on why the full range of stakeholders might not currently be considered when it comes time to contribute to patents?

Findings: The results are shown in a histogram chart with each of the resulting themes indicated along with the frequency of response each received. Note: the raw data can be found in the appendix. The empirical research identified barriers to the involvement of extended stakeholders participation in informing patent disclosure.

Why full stakeholders might not be considered when it comes time to contribute to patents (Q47)

Figure 4-16. Codified Results for Qualitative Question 1

Categories resulting from the inductive codification:

Category 1	Cost limits to more involvement
Category 2	Available time limits to more involvement
Category 3	Extended stakeholders are not seen as having content to contribute
Category 4	Inertia for existing process
Category 5	Patent complexity is a barrier to more involvement
Category 6	Patents are seen as an engineering function
Category 7	Competitive value of IP is not understood
Category 8	Other

Table 4-4. Inductive Codification Categories from Qualitative Question 1

4.2.2 Qualitative Question 2 (Q49)

The question presented was: What one or two things could help facilitate input from many stakeholders for consideration by the patent agent/attorney?

Ideas that might help facilitate more input from many stakeholders (Q49)

Figure 4-17. Codified Results for Qualitative Question 2

Categories resulting from the inductive codification:

Category 1	USE COMPETITIVE IP and product as reference
Category 2	OUTLINE GOALS and the evolution of the new product
Category 3	GUIDANCE on stakeholder roles / potential contribution
Category 4	PATENTING PROCESS and attainability clarification
Category 5	INHOUSE PROCESSES, communication, brainstorming
Category 6	CONNECT with Legal more, comms and information
Category 7	REMOTE methods of working together
Category 8	VISUALIZATION of content for accessibility is needed
Category 9	COMPLICATED, not sure

Table 4-5. Inductive Codification Categories for Qualitative Question 2

4.2.3 Qualitative Question 3 (Q50)

The question presented was: How might product designers be helpful in facilitating patent input from stakeholders?

How product designers might help facilitate patent input from stakeholders (Q50)

Figure 4-18. Codified Results for Qualitative Question 3

Categories resulting from the inductive codification:

Category 1	Organize information and clarify areas for input
Category 2	Create visual stimuli of areas of product / process for patent
Category 3	Be the hub across stakeholders to seek info and support brainstorm
Category 4	Share insights from the development process.
Category 5	Designers could share insight from their experience in the design process.
Category 6	Designer may not be the right resource

Table 4-6. Inductive Codification Categories for Qualitative Question 2

4.3 A Specific Look at Legal Stakeholder Responses

Since patent attorneys/agents (referred to as ‘legal’ participants in this research) are typically an outsider to the product development team, the researchers looked at their responses to four specific questions that we thought may yield some insights.

Question 35: Do you think that a group brainstorming session in advance of the patent application would help you increase your contribution to the patent application?

Findings: Four of the six legal participants (66%) selected the top response, indicating that brainstorming prior to patenting would be ‘extremely helpful’. The baseline for the group is 48%

Question 33: Would some support with the creation of visual images and sketches facilitate the capture of knowledge from stakeholders for patent applications?

Findings: Five of the six (83 %) legal participants think that visualization support to capture knowledge from stakeholders would be good, baseline for the group is 70%

Question 38 Which stakeholders might be the best to run a pre-patent application group brainstorming session?

Findings: Five of the six legal participants (83%) indicated that they should run a patent brainstorm, but each also had multiple selections and these included entrepreneur/inventor, management/CEO, engineer and designer.

4.4 Affinity Insight and Foresight Scenario from Open Questions

“The incidents, events, and happenings are taken as, or analyzed as, potential indicators of phenomena, which are thereby given conceptual labels.” (Corbin & Strauss, 1990, p. 7).

Corbin and Strauss describe the process of identifying concepts when reviewing the data where some concepts about a common phenomenon may be grouped and form a category (Corbin & Strauss, 1990, p. 7). Categories are at a higher level and are more abstract than concepts but are formed using the same analytic process to highlight similarities and differences (Corbin & Strauss, 1990, p. 7). Also the importance of using theoretical memos to capture the concepts behind or emerging from the codification that can result in a less elaborate or satisfying analysis result (Corbin & Strauss, 1990, p. 10). Martin describes affinity diagramming as “the visible clustering of observations and insights into meaning full categories and relationships” that can result in tacit knowledge becoming visible for research synthesis (Martin & Hanington, 2018, p.

3). Below in Figure 4-19 is a working version of an affinity diagram insight exercise followed by a foresight generation technique.

Figure 4-19. Insights: Affinity (left and top right) and Foresight Scenario (bot. right)

The categories arrived at through the inductive analysis process for the three open-ended questions were collected and are seen on the left of the figure above in typed font. Similarities and differences between the categories were evaluated and new concepts, through analysis, were generated and labeled resulting in the definition of new category themes through the use of an affinity diagramming and insight generation approach (Martin & Hanington, 2018, p. 3). The researchers identified that these results then required additional analysis to offer the opportunity for further insight generation or meaning making from emerging themes (Corbin & Strauss, 1990; Thomas, 2006). These resulting themes from the affinity approach were then considered with the lens of Kumar's Foresight Scenario process 6.5 (Kumar, 2013, p. 265) on the right side of the figure above, with its projection frame images inspiring a framing set where Q47 drove the

Barriers Identified frame (blue box outline in the figure above) and a related foresight frame was projected from this using the Q49 and Q50 solution oriented insights to drive the Solutions Identified frame (orange box outline in the figure above).

Findings:

Frame 1, shown as Table 4-7, is called ‘Barriers to Increased Stakeholder Involvement’ indicates the current barriers that were identified with regards to furthering stakeholder knowledge contributions to patent disclosure. There are two dominant barriers and two related issues.

A possible explanation based on the data is that there is a combination of factors due to the absence of understanding that patents could be strengthened if extended stakeholders were more involved, and because of the overall complexity of patenting, internal levels of patent support persist. This results in a status quo approach that does not attract additional resource and attention.

BARRIERS TO INCREASED STAKEHOLDER INVOLVEMENT	
Patent Potential is not realized	Complexity of Patents
Resource Shortcoming	Inertia for Status Quo

Table 4-7. Foresight Scenario Frame 1 - Current Barriers from Insight Generation

Frame 2, shown as Table 4-8, is called ‘Solution Approaches to Increased Stakeholder Involvement’ presents possible approaches to furthering stakeholder knowledge. There are two dominant areas; ‘Education and Orientation’ and ‘Knowledge Conversion’. These can be seen below.

SOLUTIONS APPROACHES TO INCREASED STAKEHOLDER INVOLVEMENT			
EDUCATION + ORIENTATION		KNOWLEDGE CONVERSION	
Drive Stakeholder Awareness		Drive Stakeholder Engagement	
Clarify the Patenting Process	Clarify Contribution Guidance	Provide the New Product Context Information	Provide Knowledge Capture Assistance

Table 4-8. Foresight Scenario Frame 2 - Future Solution from Insight Generation

Based on the data, possible approaches towards engagement of extended stakeholders can be divided into two themes; ‘drive stakeholder awareness’ and ‘drive stakeholder engagement’. First, providing stakeholders education and orientation on, 1. the patenting process and 2. their potential roles within this process. These activities could be undertaken prior to requiring input into patents to prepare them for further involvement in patenting. Secondly, providing assistance with engaging the stakeholder for knowledge conversion about the new product to be patented. This has two sub-components, 1. provide the stakeholder with contextual information about the product and its development, and 2. provide ways to help extended stakeholders convert their knowledge into useful information.

4.5 Limitations of the Study

Several limitations to this study are indicated below.

Participants were not representative of a randomized sample of the population. This was because purposeful sampling was required to perform this research within the time frame (Palinkas et al., 2015) while connecting experienced participants. Purposeful sampling allowed access to participants with deep experience and since there was a connection, participants were more willing to take the time to undertake the rounds of the invitation process, consent and execute the questionnaire. Considering the purposeful sampling approach, the majority of the participants had dated and very minimal connection with the researchers and had evolved in their careers for years or decades since in the first initial contact with the author through product development activity. Accessing thirty-eight qualified participants was a challenge and was very time consuming considering the scope of resource available to this research. It would be interesting to perform this study on a greater scale, with many more participants and with a randomized sample set of extended product development stakeholders.

Terminology and Definitions: One participant emailed the lead researcher to indicate that he/she found the term “stakeholder” a little misleading since it implies some vested interest in the outcome of the product development or patent process whereas the questionnaire implies stakeholders as just having influence over these.

The blending of responses from multiple similar questions as supported by grounded theory was used to derive axes for the positioning visualization of stakeholders (Creswell, 2014). The instinct of the researchers was to provide equal weight to each question. The approach taken seems appropriate considering the absence of other research to inform the positioning of stakeholders with respect to relevance to both communication (Y-axis) and knowledge (X-axis) positioning charts but other approaches could have been taken.

The axes (X and Y) for the ‘Product Centric Stakeholder Positioning’ graph and for the ‘Patent Centric Stakeholder Positioning’ graph was not derived from exactly the same questions asked of the participants in each the patent centric and product centric context. In this sense the two charts are non-direct comparisons, but this approach did allow for evaluation of a comparison of two modes, or themes, of stakeholder function; product development and patent development.

5. DISCUSSION

5.1 Insights from the Data Analysis

The data analysis has led the researchers to identify several barriers and insights in response to the research question. The discussion of the findings is framed by the original research question and its sub-questions.

The original question:

How can designers facilitate knowledge acquisition for extended patent disclosure content from product development stakeholders for stronger intellectual property and competitiveness?

5.1.1 Adapting Stakeholder Salience

The theory of stakeholder identification and salience (R. K. Mitchell, Wood, et al., 1997) was applied in this research for the identification of stakeholder professions that might have salience toward securing opportunities for future competitiveness through patent disclosure contribution (Wagner, 2009, p. 2149). Our adapted approach applied Mitchell's power to influence the firm, legitimacy of claim to the firm and urgency of claim (R. K. Mitchell, Agle, & Wood, 1997) with these three categories being focused to our specific context. In this applied approach, we tightened the aperture that defined a salient stakeholder to the abilities and information that may have relevance to increasing the content value of patents. In Table 5-1 below, Mitchell's elements of stakeholder salience are seen on the left of the chart below with our adapted version applied to the identification of stakeholder characteristics to improve patent content on the right.

Power to influence	Those within the extended product development team with high levels of team communication. Communicators have an ability to influence the team and their actions.
Legitimacy to the firm	Having knowledge and experience about executing the patent disclosure process. This facilitates bridging patenting knowledge deficits that are characteristic of SMEs.

Urgency of claim	Having knowledge of potentially important forward-looking attributes for the specific patent needing to be filed. These stakeholders may have information that could protect future competitive product attributes in relation to the immediate patent to be filed.
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Table 5-1. Patent Stakeholder Salience as an application of Mitchell's Salience

Mitchell's approach to the identification of stakeholder salience to the firm, with the noted additional transformation that allows for an applied application to intellectual property content identification, was helpful to the framing of this research, and in the identification of salient stakeholders. Further consideration on approaches for the identification of salient stakeholders in an applied context is of interest to the researchers.

5.1.2 Specific to Legal Stakeholders

This research has identified that legal representatives are outliers when it comes to the level of integration they have with the SME product development team. This is shown by the low level of legal communication that legal is indicated to have with the product development team during product development. Each of the legal persons involved in this research indicated more than four diverse areas of industry involvement for which they can draft patents. These ranged from software, to electronics, safety focus products, commercial, consumer, government policy and packaging. It follows that their expertise is in the creation of legally conforming documents of invention that carry different supplied content. It is the SME that supplies the scope of the content and this places a strong responsibility on the SME to supply information that anticipates the future.

An insight resulting from this questionnaire (Q35), is that legal indicated top level support on the use of a patent brainstorm to gather more information with the team (66% vs 48% average). In open ended question 50, it was suggested that the more detailed disclosure sent to them, the better. Also, they have indicated wanting a clear definition of the initial problem, the purpose of the device for patent, and its function. It is a legal participant that indicated that when drafting a patent, their involvement is at the end of the development process, and legal often deals only

with a person that was not on the project since the original team members have moved on. This can severely limit the content made available to legal. The data indicates that legal sees a benefit to having further engagement and information for patent disclosure.

Legal and non-legal participants have indicated that there is a lack of understanding of the value of IP and what it can bring. As one legal participant wrote, you get what you pay for in patent land. The research seems to indicate that there is even more to it than that. A future inquiry may be whether legal is too expensive and specialized, and could this be a root cause for their disconnect from the rest of the stakeholders? This may in part be true, but the research seems to indicate that there is tolerance for a small amount of extra time from legal.

5.1.3 Extended Patent Content

The Forward Looking Patent Attributes (X-Factors) defined for this research were intended to be generic in nature for the purpose of this research. There was a desire to have attributes that were acceptable for all participant stakeholders to facilitate their participation in the questionnaire. SMEs should consider elements of competitive strength that position them in the market and allow for appropriability (value capture) from their patents (Agostini, Filippini, & Nosella, 2016, p. 103) and consider forward looking attributes that are also specific to their circumstance. The inclusion of this content could serve to satisfy Fromer's recommendation of content redundancy (Fromer, 2008, p. 585) and serve as support for relevant future claims (Wagner, 2009, p. 2149).

SMEs could evaluate stakeholders according to X-Factors that are relevant to their business and then adjust the patent team composition according to stakeholder rankings. An insight of this research is Marketing and Sales has the leading connection to the forward-looking attributes. This is surprising since marketing is not a stakeholder group that is associated with patents, but they were indicated to be the top stakeholders with highest awareness in 4 of the 6 x-factors categories. They were also indicated to be one of the most networked stakeholder groups. Yet, they had the lowest amount of interaction with the team in both the product development mode, and the patent generation mode. Their knowledge may be entirely under leveraged in the extended patenting portion. Consideration of their knowledge could help with driving the team to clearly consider the opportunity for future competitive products. The marketing team should be considered as a competitive asset for the contribution of forward looking patent attributes, and to

do so, barriers to their levels of communication and participation with the product development team must be further considered.

5.1.4 About Stronger Intellectual Property through Stakeholder Involvement

Mitchell describes how lawyers' work products, the output documents that they create, are not considered with respect to how well they benefit their client's communication experience. It is suggested that lawyers can learn from designers in terms of improving the user experience of their communications (J. A. Mitchell, 2015, p. 42). The research participants indicated a desire for lawyers and designers to be involvement in facilitating patent stakeholder participation. In question 38 where participants were asked about who should run a patent brainstorming exercise, 26% indicated legal, 24% indicated designer. Those were the top selections. They should consider working together in order to make the patent information distribution and capture process more accessible to other stakeholders. The open-ended question (Q47) prompting participants to express ideas that might facilitate their themselves might further contribute to the patent. Twenty-four percent indicated a need for 'Guidance on stakeholder roles and potential contribution'. Another significant response was stakeholder wanting clarification about 'Patenting process and attainability clarification' at 16% and 12% wanting support with visualization. With knowledge and assistance from legal and design, stakeholder's ability to assist with strengthening patents could increase.

5.1.5 Competitiveness

Some participant responses indicate that the competitive value of patents is not understood, and others indicate that preparing patents is an engineering duty which seems to indicate that the current state is acceptable for these respondents and they may not have a conception that it could be improved. Nikzad indicates that, in a survey of 90 participants at a round table with the Canadian Intellectual Property Office (CIPO) and with some involvement with Canada's Industrial Research Assistance Program, the use of the "IP system is primarily used defend against infringement or to leverage funding". Many participants indicated that owning IP provides extra leverage in marketing their business to potential clients" (Nikzad, 2015, p. 182).

The potential competitive advantage that is suggested from this research is that extended stakeholders do appear to have knowledge about the betterment of their products and have a

willingness to assist in providing this knowledge. On a scale of 3 response option (Q35), no participant indicated bottom box, all participants indicated that a brainstorming session would be 'somewhat helpful' at 51% and 'extremely helpful' at 49%. To the researchers this seems like an area for further research towards improving the likelihood that the patent filed today has a better chance of anticipating the competitive marketplace of the future (Wagner, 2009, p. 2148).

Several qualitative responses lead the researchers to believe that some companies do not understand the competitive advantage that a patent could represent beyond their current state (Pisano & Teece, 2007, p. 279). Statements such as patents being engineering work (Gibbs & DeMatteis, 2003) or as reported by participants, that money goes to the new thing in marketing instead of IP or that some stakeholders just do not have the patience for it, indicate that the status quo process might be acceptable. It is even possible that these firms do not see that improvements might be desirable, since they might have no reference for what 'better' may look like, let alone how to achieve it. One participant currently with a fortune 500 consumer goods company indicates that PD teams are getting smaller while companies are getting larger and more complex and that this results in less attention into IP from leadership.

5.1.6 About Knowledge Acquisition

The research data indicates that a barrier to furthering extended stakeholder involvement into the patenting process partly results from their lack of understanding about the patent process, and this is also a barrier to stronger IP. Participants expressed a need to further understand the patent process, but more specifically to understand how the process works at the product development level. Another insight from the research data is that extended stakeholders want to be made aware of the role they could play and to be provided with a sense for the types of contributions they could be expected to make. Suggested approaches to achieving this included being provided with a simplified understanding of the process which brings us to Fromer's suggestion of considering the technical layer in isolation of the legal layer in order to simplify and facilitate greater contribution (Fromer, 2008, p. 585). Also understanding the new products in relation to competitive products was noted where 6% of Q49 responses were in the codified category called 'Use Competitive IP and product as reference'. Petre notes the engineering development team indicated the need to study competitive product prior to each project (Petre, 2004).

There are two related and distinct themes resulting from the insight generation. Insight generation tools identified that ‘education and orientation’ of stakeholder knowledge about patenting could happen prior to, and independent of, knowledge conversion for a specific patent. To contribute content into a patent disclosure, participants indicate that they want to know more about the external patenting process, the company’s internal process for patenting disclosure and stakeholders’ individual roles. This education and orientation activity could happen in advance of the need to patent a specific product.

Education and Orientation about Patents:

- Patents - some contextual information about the effort to file IP
- Potential roles for stakeholders
- SME process for gaining knowledge
- Simplification into non-legalese.

When stakeholders are asked to contribute to the knowledge conversion of information that is relevant to a specific real product needing to be filed for patenting, they have expressed the need to be supported in the following areas:

- Provide information about the specific product (some product development stakeholders may have had limited involvement) and about its development process, its other concepts and about competitive products.
- Facilitate capture - This communication with respect to upcoming IP interaction should be considerate of cross disciplinary boundaries. A range of methods could be considered to accommodate the participant diversity.

5.1.7 Patent-Storming

This is a term that was developed by the researcher in response to this research. It combines the idea of Brainstorming for content on improved Patents into the term: Patent-Storming.

Participant support for a brainstorm session prior to patenting to arrive at improved patent content was significant in the multiple-choice question and the open-ended questions.

Given the barriers with cross discipline design, it would be important to consider establishing an inclusive environment for patent brainstorm exercises and to consider the effective use of boundary objects to facilitate the participation from the interdisciplinary team (Carlile, 2002). The desire was expressed for patent process information in general, to be translated into something simple, visual, and not legalese. The semantic characteristics of legal documents creates a barrier to the accessibility of IP information (Carlile, 2002).

Based on the research data and the researchers' awareness of the patenting process, the following are some key points for consideration when considering using a patent brainstorming session.

Designated stakeholder to lead session for extended stakeholder group (consider designer+ legal if available)	
Provide examples and Introduction to IP (must be explained simply and with visual assistance)	
	With extended stakeholders new to this, some predeveloped explanatory materials (visuals and simple) should be prepared ahead of time.
	For efficiency, experienced persons may not need to attend the introduction.
Provide information about new product being developed and needing IP protection	
	Refresh group to initial development goals, any key changes and history of actual product being finalized.
Provide competitive products, or their IP, for context.	
Provide stakeholder opinion on current and future trends in this market.	
Provide examples of how the stakeholders can participate	
	Types of information that can be provided and indicate the relevant x-factors
	Suggest how participants can supply information (verbal, words, drawing, etc)
Run mini brainstorms on each of the <i>product</i> x-factors to consider potential advances/innovations on:	
	Cost/quality, usability, competitive attributes, and others specific to the industry
Capture stakeholder input	
Consider additional insight generation exercises - affinity mapping, foresight scenario, role play, prototyping, availability of competitive, etc. Full participation is a goal. Arrival at innovative and desirable future-oriented insights is also a goal.	
	Bulk collection of information must be considered

	Summarize collected information in to key elements must be considered
Connect and provide information to legal (if they were not involved)	

Figure 5-1. Outline for Patent-Storming session

5.1.8 About designers facilitating patent disclosure

Participants indicated strong support for ‘designers’ as patent disclosure facilitators as well as ‘legal’ and ‘entrepreneur inventor’. The data also shows that designers have the longest consistent experience throughout the product development process. Designers have a stronger role in affecting product cost/quality (highest ranking to x-factor for cost quality in this research; design 43%, engineering 40%). They have a solid degree of knowledge about patents, but they could also require further training. Designers have visualization capabilities (Nigel Cross, 2001) and an understanding of processes that could facilitate getting more information from the extended stakeholders (Sanders & Stappers, 2008). They were indicated to be well connected to the stakeholders through PD activities.

In consideration of the barriers identified by participants, their insights into ways to overcome the barriers, the following are roles in which designers may be able perform well in order to improve patent contribution disclosure .

- Help package and present team information to legal for consideration.
- Help to extract (convert) knowledge, from stakeholder into available information.
- Help to make the competitive product features and patents understandable to the team, and this could involve visualization.
- Help the team to understand how they can contribute to patents.
- Help to synthesize input into competitive new product attributes and features

5.1.9 Patent Timeline with Barrier and Solution Approaches

Based on the findings from this research the original timeline map shown in Figure 1-1 has been expanded. The timeline map in Figure 5-1, below, incorporates the updated findings that informs the timeframe prior to the filing of the patent application. There is an Education and Orientation

quadrant, seen in the upper left of the figure, that should be considered prior to the need to patent. It can be used to orient the extended stakeholder team to the internal patenting process. There is also a Knowledge Conversion quadrant, seen in the lower left of the figure, outlining solution approaches to the acquisition of data from extended stakeholders for creating patent disclosure content.

Figure 5-2. Pre-Patent Actions – Research Informed Update to Patenting Timeline

6. CONCLUSION

The patenting of innovation is important and unique to many Small and Medium-sized Enterprises (SME) where they are often dealing with inventive steps that are greater than those of larger companies with their incremental patents (Coughlin, 2007, p. 376,380). Small and Medium-sized companies face more challenges and do not have as much success with gaining patents as large firms and this is in part due to lack of experience and legal knowledge (Burrone, 2005; Nikzad, 2015). SMEs are often expected to have patent applications or grants in order to be considered for venture capital (Coughlin, 2007; Nikzad, 2015). Effective patent content must

be considered for its usefulness over the next decade or more (Parchomovsky & Wagner, 2005, p. 2194).

For this research a mixed method questionnaire was completed by 38 North America-wide experts with product development and utility patent experience. They are extended stakeholders to the development process and include design, engineering, marketing/sales, and upper management/CEOs, legal, and entrepreneur/inventors. Through this study they generated quantitative and qualitative data about: product development (PD) teams, the creation of patent content, and insights into the barriers and opportunities related to increased stakeholder engagement for more competitive patent content. This data was analyzed, and insight generation techniques were applied to the qualitative data.

This research defined and used a set of product and stakeholder attributes, referred to as X-Factors, that could increase the competitive advantage of future products. The research findings indicate that there are extended stakeholders that have awareness of these attributes but they are removed from the current patent process. Their knowledge may not be considered in the development of the patent, and if shared, could add direct value to the patent disclosure or could trigger an inventive step by other stakeholders (Gibbs & DeMatteis, 2003, p. 136). The literature has identified significant potential barriers to effective interdisciplinary communication (Carlile, 2002) and our empirical research has indicated that stakeholders will require assistance and guidance in order to effectively support extended patent disclosure through the contribution of new information

The research participants indicated that designers have capabilities that could facilitate their contribution. These include the ability to simplify information, acquire necessary knowledge, have contextual awareness about the new product's development path, and have abilities to communication with multiple engaged stakeholders in order to capture or create new content. Through analysis of the data, designers, as a stakeholder group, have definitive salience (R. K. Mitchell, Wood, et al., 1997) with respect to patenting along with Legal and Entrepreneur/Inventors.

As shown in Figure 6-1, this research identified two key barriers that result in limited patent participation from the extended stakeholders. To some, there is a lack of awareness to the potential of having better patenting outcomes than their current experience. The other is the complexity of patents is a barrier to further engagement. Together, these barriers do not incentivize SMEs to consider altering their patenting process. This figure also shows research results that point towards solutions that could increase extended stakeholder participation. Insight generation resulting from the data indicates two components. There is the need to educate stakeholders with an awareness about patents and about the types of information that they could usefully contribute. This activity could be performed before there is a need to patent a specific product. The second solution component identifies the need for assistance with the conversion of stakeholders' knowledge about the product to be patented into information that can be considered for the patent disclosure.

Extended stakeholders may have intermittent involvement over the development period and should be provided with context about the product development history including the status of competitive products. The research findings show that they would benefit from assistance in generating and capturing their knowledge. This could include the provision of simplified visual information and support with capturing ideas. Designers have the communication and visualization skills to support this knowledge conversion and designers also have a significant awareness of the product's forward looking patent attributes.

Figure 6-1. Simplified Visualization of the result from the Affinity and Foresight Scenario

The findings of this research indicate that the content of SME patents can be improved through better use of extended stakeholder knowledge. Access to this information is not simple but an augmented effort by the designer and increased participation by legal could result in a significant improvement to future competitiveness resulting from improved forward looking patent disclosure.

6.1 Contribution to the Field

- This research indicates that there is information available from extended stakeholders that might benefit companies that are already trying to patent innovation. Currently, SMEs underperform large companies and if they were to consider improved methods, as outlined in the results of this research, they might significantly improve the future competitiveness and strategic opportunities resulting from their patents.
- The implementation of the approach could result in very little incremental cost to the SME and it might improve team dynamics and future competitiveness of SME patents. This research clearly identifies gaps of communication between the tested stakeholder groups and this is a barrier to improved patents.
- The empirical research indicates that the designer has capacities, visualization skills, network connections and creation abilities to assist with extended patent disclosure.

Based on this research, legal and design stakeholders may have a complementary skillsets that could be evolved by working together.

- The engagement of extended interdisciplinary stakeholders could be further considered as a co-creation opportunity where the activity of co-creating new content for patents (Sanders & Stappers, 2008), through the engagement of interdisciplinary stakeholders, may offer competitive advantage.
- Patents are complicated for many stakeholders and the research indicates this is a barrier to their further participation. This research has offered a way of simplifying the content of patents when considering new content into distinct categories of attributes called X-Factors where less knowledgeable stakeholders could be asked to contribute only to certain categories. This approach may simplify and focus their participation.

Figure 6-2. Updated Research Map with New Knowledge Generation

6.2 Future research / development

Forward Looking Attributes (X-Factors) as Boundary Objects:

The researchers have generated six forward looking attribute categories as probes that were used in the research questionnaire to gain feedback about stakeholder group knowledge of patent content. The researchers consider that these attribute categories could serve as boundary objects for communicating across inter-disciplinary boundaries about specific content that needs to be considered, collected or generated (Carlile, 2002, p. 451). Further research into the effective use of boundary objects for mediating patent content between extended stakeholders and into the characteristics of effective boundary objects for patent related communication should be considered.

Forward Looking Attributes to Target Effective Content for Disclosures:

A helpful inquiry could be to evaluate whether these six forward looking attribute categories are effective in either targeting useful patent-oriented information or gaining access to stakeholders with useful knowledge and capabilities to improve the patent content. Does this approach function similarly for SMEs and large corporations? Are there more effective forward-looking attributes? To what degree should the X-Factor categories differ depending on the product being patented and on what basis should they differ?

Brokering information and the potential for over-disclosure of patent content:

The focus of this research is on the product development team during patenting, and on whether their further involvement would be useful. An area of research for further study could be into determining what content can be expected from the extender stakeholders that is not typical of the disclosure normally generated about a product to be commercialized. How does the information that is gathered from the extended stakeholders get added to the typical information about the invention? Considering the salience of designers to extended patent content and its conversion into information, what might the designer's role be in the brokering this information for distribution? With the addition of this information to be considered by the patent agent/attorney, what steps need to be taken to ensure that there is not an over-disclosure of descriptive information into the patent application while also ensuring that Fromer's useful level of redundancy is considered (Fromer, 2008, p. 578,573)? What, if any, additional information does the patent agent/attorney require about the company to make this assessment?

A process for designers to engage extended stakeholders:

The results of this research indicate that designers could be well placed to support the improvement of patent disclosure content. Industrial design education should consider the designer's role in patenting with regards to leveraging their position in the product development team, their design thinking abilities and their interdisciplinary engagement. Considering the interdisciplinary nature of the extended stakeholders, what are effective ways for designers to engage them? What information do they need prior to having an interdisciplinary participation session? A brainstorming session has been identified but that is a broad term. Future study could

evaluate the effectiveness of different approaches to stakeholder involvement that ensure efficient engagement, proper information capture, while also ensuring that inter-disciplinary boundaries are not problematic (Carlile, 2002; Manzini & Lazzarotti, 2015).

Designers and Legal stakeholders working together:

Respective design education bodies could consider the synergistic opportunity between legal and design professions to improve patent disclosure content. Research into the facilitation of knowledge flow is one area where designers' sense for the process, their tools for communicating, and possibly creating new content with multidisciplinary teams, could be applied to legal interactions. This could be helpful to legal stakeholders, that have been shown by this research to have limited access to the development team during regular product development but legal stakeholders themselves indicate that patent quality can increase when they are provided with more of the development content and context.

Designing content for the patent:

The application of a design phase that builds onto the stakeholder Patent-Storming data and the established set of relevant X-Factors, could be performed prior to patenting, to ensure additional relevant content. Could the result of a design-for-patent phase successfully encapsulate the input into a design presentation format that helps the new competitive ideas be easily considered for the disclosure? The design activity could add an important level of reduction to practice content to the disclosure (Lemley, 2016) to support the new ideas. Future research could consider a design-for-patent process; its opportunities and limitations. Figure 6-3, in phase A, shows the filing of information about the to-be commercialized product. Figure 6-3, in phase B, shows the additional step of designing new concepts, for the following generation of product, as content for the to-be commercialized patent disclosure. Additional academic inquiry could consider how stakeholders could mediate the boundaries related to the amount and types of new content that is useful towards extending competitive patent disclosure while not over disclosing patent content.

Figure 6-3. New Patent Content Creation from Interdisciplinary Inputs

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APPENDICES

Appendix A – Invitation to Participate in the Research

School of Industrial Design

3470 Mackenzie Building
1125 Colonel By Drive
Ottawa, ON K1S 5B6 Canada
Tel: (613) 520-5672
Fax: (613) 520-4465

Invitation for Design Research Study - PH1 Questionnaire

Subject: Invitation to participate in a research project on improving patent content by using designers to gain input from development stakeholders.

CUREB-B clearance # 108557

Dear Sir or Madam,

My name is Rob Watters and I am a Master's student in the School of Industrial Design at Carleton University. I am working on a research project under the supervision of Professors Stephen Field and Michel Rod.

I am writing to you today to invite you to participate in a study entitled "Extending patent disclosure value: A design inquiry into advancing interdisciplinary stakeholder engagement for improved intellectual property patent strategy and entrepreneurial business competitiveness". This study aims to gain insights from professionals towards improving the patent experience for small and medium sized businesses.

It is for professionals with the following experience:

- Experience with the development of new products
- or
- Experience in intellectual property aspects for new products

This phase of the study comprises one online questionnaire through Qualtrics, an online survey resource that is associated with Carleton University's research.

By accepting this invitation, you will be sent a link where you can review and provide your Consent to participating, and then you'll be linked to the ~14 minute Questionnaire. **TO ACCEPT, please reply to this email and indicate your acceptance.**

Data will be collected through the Qualtrics software, which uses servers with multiple layers of security to protect the privacy of the data such as encrypted websites and password protected storage. The data collected will remain on the Qualtrics account until the end of the study and will then be deleted. No backups will be kept on the Qualtrics server after the deletion has been processed. Researchers will disable the option in Qualtrics to collect IP addresses. Please note that Qualtrics is hosted by a server located in the USA. The United States Patriot Act permits U.S. law enforcement officials, for the purpose of an antiterrorism investigation, to seek a court order that allows access to the personal records of any person without that person's knowledge. In view of this we cannot absolutely guarantee the full confidentiality and anonymity of your data. With your consent to participate in this study you acknowledge this.

While this project involves a minimum of professional and emotional risk, care will be taken to protect your identity. This will be done by keeping all responses anonymous and allowing you to request that certain responses not be included in the final project if you wish.

You will have the right to end your participation in the study at any time, for any reason, up until March 30, 2018. If you choose to withdraw, all the information you have provided will be destroyed.

All research data, will be encrypted and your names removed. Any hard copies of data (including any handwritten notes or USB keys) will be kept in a locked cabinet at Carleton University. Research data will only be accessible by the researcher and the research supervisor.

The ethics protocol for this project was reviewed by the Carleton University Research Ethics Board, which provided clearance to carry out the research. (Clearance expires on: 31 March 2019)

If you have any ethical concerns with the study, please contact Dr. Andy Adler, Chair, Carleton University Research Ethics Board-B (by phone at 613-520-2600 ext. 4085 or via email at ethics@carleton.ca).

If you would like to participate in this research project please reply to Rob Watters (Principal Investigator), at: robert.watters@carleton.ca (613-808-3606), you can also reach out with any questions.

Sincerely,
Robert Watters

robert.watters@carleton.ca

Appendix B – Consent Form for Participation in Research

School of Industrial Design

3470 Mackenzie Building
1125 Colonel By rive
Ottawa, ON K1S 5B6 Canada
Tel: (613) 520-5672
Fax: (613) 520-4465

Consent Form: Design Research Questionnaire – R.Watters

Title: Extending patent disclosure value: A design inquiry into advancing interdisciplinary stakeholder engagement for improved intellectual property patent strategy and entrepreneurial business competitiveness.

CUREB-B clearance # 108557

Date of ethics clearance: Ethics clearance date: Mar.16, 2018 • Ethics Clearance for the Collection of Data
Expires: Mar.31, 2019

Ethics Clearance for the Collection of Data Expires: To be determined by the REB (as indicated on the clearance form)

I, choose to participate in a study on stakeholder input into improving patent disclosures. This study aims to determine how designers can assist knowledge acquisition for improved patent disclosure. **The researcher for this study is Robert Watters in the School of Industrial Design at Carleton University.** He is working under the supervision of Stephen Field in the School of Industrial Design within the Department of Engineering and Design and Michel Rod within the Sprott School of Business.

This study involves one Questionnaire through Qualtrics, an online survey resource that serves Carleton University's research that could take approximately 20 minutes to complete. You will be connected to the Questionnaire immediately after your provided consent on this form.

This recruitment is for professionals with the following experience;

- experience with the development of new products
- or
- experience in intellectual property aspects for new products

Data will be collected through the Qualtrics software, which uses servers with multiple layers of security to protect the privacy of the data such as encrypted websites and password protected storage. The data collected will remain on the Qualtrics account until the end of the study and will then be deleted. No backups will be kept on the Qualtrics server after the deletion has been processed. Researchers will disable the option in Qualtrics to collect IP addresses. Please note that Qualtrics is hosted by a server located in the USA. The United States Patriot Act permits U.S. law enforcement officials, for the purpose of an antiterrorism investigation, to seek a court order that allows access to the personal records of any person without that person's knowledge. In view of this we cannot absolutely guarantee the full confidentiality and anonymity of your data. With your consent to participate in this study you acknowledge this.

As this project will ask you about your employment, there are some potential professional risks to you if your statements are critical of your employer. While this risk is expected to be minimal, I will take precautions to protect your identity. This will be done by keeping all responses anonymous and allowing you to request that certain responses not be included in the final project. Your name will not be published in the final report.

You have the right to end your participation in the study at any time, for any reason, up until March 15, 2018. You can withdraw by phoning or emailing the researcher or the research supervisor. If you withdraw from the study, all information you have provided will be immediately destroyed.

All research data will be encrypted. Any hard copies of data (including any handwritten notes or USB keys) will be kept in a locked cabinet at Carleton University. Research data will only be accessible by the researcher and the research supervisor.

Once the project is completed, all research data will be kept for three years and potentially used for other research projects on this same topic. At the end of five years, all research data will be securely destroyed. (Electronic data will be erased and hard copies will be shredded.)

If you would like a copy of the finished research project, you are invited to contact the researcher to request an electronic copy which will be provided to you.

The ethics protocol for this project was reviewed by the Carleton University Research Ethics Board, which provided clearance to carry out the research. If you have any ethical concerns with the study, please contact Dr. Andy Adler, Chair, Carleton University Research Ethics Board-B (by phone at 613-520-2600 ext. 4085 or via email at ethics@carleton.ca).

Researcher contact information:

Robert Watters
Department of Engineering and Design
Carleton University
Tel: [REDACTED]
Email: Robert.watters@carleton.ca

Supervisor contact information:

Stephen Field
Department of Engineering and Design
Carleton University
Tel: 613 520 2600 ext 8371
Email: StephenField@cunet.carleton.ca

Appendix C – Data from Qualitative Question 47

Q47	Any quick thoughts on why the full range of stakeholders might not currently be considered when it comes time to contribute to patents?	Cost limits to more involvement	Available time limits to more involvement	Extended stakeholders are not seen as having content to contribute	Inertia for existing process	Complexity of patenting is a barrier to their greater involvement.	Patents are seen as an engineering function	Competitive value of IP is not understood	Other
P1	Often, they are not as close to the invention			1					
P2	Parents are based on feature invention or design and CEOs and marketing aren't as involved with the actual how it works			1					
P3	Management cost and time	0.5	0.5						
P4									
P5	No, just organizational inertia				1				
P6	Time, cost, hourly rate	0.5	0.5						
P7	Some do not have knowledge of the requirements of patents, and do not see a relationship between their knowledge and the patent process.			0.5		0.5			
P8									
P9	Big picture, can do, what's possible people trump can't do, tried it before, etc.			0.5					0.5
P10	Availability and time constraints		1						
P11	Different geographic locations of participants, time constraints, budget, ego of individuals and the top guy VP or company founder or the client wants to have their name first on the patents. Some managers and VPs receive bonuses from their companies for every patent filled under their name which is meant to elevate innovation and IP retention within their company but it also creates, in some cases, stealing the patent main inventor's credit as the primary main inventor by the manager or VP.	0.33	0.33						0.33
P12	Many departments are siloed in their approach to their roles - sales focused on #, marketing focus on leads, etc.			0.5	0.5				
P13	Maybe too many involved at once.				0.5	0.5			
P14	Budget restrictions	1							
P15	Time, budget, technical ability of full range of stakeholders	0.33	0.33			0.33			
P16									
P17	It takes a long time to get someone up to speed on the patent so that they can contribute meaningfully					1			
P18	Some stakeholders opinions are respected as much as others.								
P19	considered 'engineering' work rather than a source of competitive advantage						0.5	0.5	
P20									
P21	Upper management too busy for downstream projects		1						
P22	Considered an engineering function and responsibility in most corporations. Many folks just don't have the patience for it.					0.5		0.5	
P23	Lack of interest or understanding as to value of IP and how they may contribute					0.5			0.5
P24	Patents / patent applications could be seen as too technical / too labour-intensive for some groups (Upper MGMT/CEO, marketing/sales). Cost of Patent Agent could be too high for lots of involvement, until the process is ready for their specific expertise... Entrepreneur / Inventor might be too close / too emotionally involved to think critically about the value proposition / flaws, etc. However, it seems that (if \$ was no object, and all stakeholders had plenty of time to participate) a diverse set of voices / eyeballs would result in more complete disclosures, and more insightful connections / strategic work.	0.25	0.25	0.25		0.25			
P25	Certain stakeholders may not have any applicable knowledge regarding the technical aspects of the inventions to be patented, and so refrain from participating in technical patent discussions. In some instances, engineers or inventors have moved on to other projects by the time the patenting process begins, and leave project managers or people in other supervisory positions to interact with the patent agents or attorneys.					0.5		0.5	
P26									
P27	For patents filed in the very early stages of a company, key stakeholders (investors, engineers/Ops, marketing/sales, etc.) may not yet be in place.								1
P28	Not all stakeholders are able to see the broad picture behind the I.P. strategy and lack the necessary skills to contribute in a highly meaningful way.			0.5		0.5			
P29	We have a review process in which the inventor presents to representatives of all stakeholders to provide guidance and direction. However at different times it has been more like a secret cabal.				0.5				0.5
P30	Product development teams have gotten smaller and smaller, from a large corporate perspective. At the same time corporations are getting larger and more complex. The result is less attention from leadership on patents, review and investment in their development.	0.33						0.33	
P31	Lack of knowledge of the process		0.33			1			
P32	Old habits die hard... Silo'd approach. Old organizational structure. Some roles (based on where \$\$ goes, for example, Marketing) are considered more important.	0.33			0.33				0.33
P33	takes more time which means more money	1							
P34	Not every stake holder is required in the patent asset gathering stage. Upper management is rarely involved nor is usually needed unless it's a small company. All product stakeholders are necessary.			1					
P35	covered them								
P36									
P37	too many stakeholders, too much explanation of factors important to patenting					0.5		0.5	
P38	The patent agent takes the lead after stakeholder input with later input after the patent is developed. Prefer more interaction during the process.				0.5				0.5
	total of weighted to 1	4.57	4.24	5.25	3.33	6.08	1	3.16	2.33
	29.96	15.3	14.2	17.5	11.1	20.3	3.3	10.5	7.8
	Frequency of response	9	8	8	6	11	2	7	4
	55	16.4	14.5	14.5	10.9	20.0	3.6	12.7	7.3
	% frequency	16.4	14.5	14.5	14.5	20.0	3.6	12.7	7.3

Appendix D – Data from Qualitative Question 49

Q49	What one or two things could help facilitate input from many stakeholders for consideration by the patent agent/attorney?	USE COMPETITIVE IP and product as reference	OUTLINE GOALS and the evolution of the new product	GUIDANCE on stakeholder roles / potential contribution	PATENTING PROCESS and attainability clarification	INHOUSE PROCESS, communication, brainstorming	CONNECT with Legal more, comms and information	REMOTE methods of working together	VISUALIZATION of content to make it accessible is needed	COMPLICATED , not sure
P1	Not sure. It's a fluid and difficult process									1
P2										
P3	provide as much detailed disclosure as possible						1			
P4	1. Visual documentation would be well received by the agent as it clarifies many points. 2. a demonstration if possible would also solidify the intent for the agent to in turn document properly and completely.					0.5			0.5	
P5	Thorough competitive evaluation of the adjacent solutions to the problem the patent is designed to address	1								
P6	Define the problem, define the technical solution		1							
P7	Identify which stakeholder is actually performing each role. Don't rely on titles.			1						
P8										
P9	A way to collaborate without all having to be in the same location.							1		
P10	A set process or instruction that lays out individuals responsibilities			1						
P11	Pre-patent group conference calls and brainstorming sessions would be a good practice to advocate					1				
P12	NA									
P13	Collaborative documentation that helps all stakeholders understand the process/application details in order for each to provide as much relevant information as possible to the agent.			0.5	0.5					
P14	Summary of parameters towards an attainable patent				1					
P15	An established patent submission process, with well established roles.			0.33	0.33	0.33				
P16										
P17	Focused questions with context for someone who isn't experienced with the process			0.5	0.5					
P18	A better understanding of patent law			0.5	0.5					
P19	clarity at project commencement of 'what's unique' and what problem are we solving and then revisiting at patent time would facilitate questions and input				1					
P20	ask for input, ask how the product evolved within the Company / how it has been developed		1							
P21	?									
P22	Translating near neighbor patents and patent application into "plain English" not legalese.	1								
P23	A focused definition of what is needed and a clear purpose.			0.5	0.5					
P24	1. regular communication among team re: process of getting IP. Seems like at the beginning, before it's entirely clear WHAT will be patented, having different points of view would be very helpful to make sure oppy's don't get missed. 2. Also: from early on in the dev cycle, activity of creating, storing, cross-linking, presenting sketches, data, models, images, concepts etc with a relational database (or some other way of organizing / utilizing) to make it easier to surface old (but related and novel) ideas, make connections within the longitudinal work on a project. This database could be regularly (monthly / quarterly?) reviewed by all stakeholders for patterns, innovation, gaps, oppy's for Utility, business oppy's and tagged, organized, prepared for an eventual filing. 3. earlier & richer involvement of IP professionals would be very helpful (part of the monthly reviews from project inception). They could also perform some of the specific tasks along the way (patent searches, freedom to operate, etc etc) that could help direct the development into areas most likely to result in granted, strong IP.		0.2	0.2		0.2	0.2		0.2	
P25	Perhaps arranging a lunch meeting to go over the general patent procurement process with all stakeholders whose input may be required. Once people are aware of the process, its importance the company, and the importance of their role in the process, it may help improve stakeholder buy-in.			0.25	0.25	0.25	0.25			
P26										
P27	A brainstorm or survey of key inputs across disciplines that is led or crafted by the designer of the product.		0.33	0.33		0.33				
P28	A clearly defined product definition and a clearly defined goal of the patent. Far too often I see patent agents/attorneys focused on the wrong areas for patent protection that don't protect the critical I.P.		0.5				0.5			
P29	A clear understanding that being involved and your input may not be considered germane to actual patent-ability of a patent (you are not included just because you were in the room.			0.5	0.5					
P30	More digital review tools could help. Currently we have a new online shop submission system, its pretty complex and does not enable peer review or input from all parties or other development groups.							0.5	0.5	
P31	education									
P32	have a two part "meeting" One together and one individual for brainstorming. So a do it on your own time and a virtual meeting if an in person meeting cannot take place.					0.5		0.5		
P33	Make the input efficient. Reviewing a checklist of features or values is an eg.			0.5		0.5				
P34	Landscape audit covering design, UX, and technology. Visuals - sketches, diagrams, wireframes	0.5				0.5				0.5
P35	dialogue and drawings					0.5				0.5
P36										
P37	drawings marked up, easy for marketing and others less technical to understand			0.5						0.5
P38	Have the patent agent interact with the stakeholders in identifying the IP						1			
	29.48	2.5	3.03	6.61	5.08	4.61	2.95	2	2.7	1
	Weighted to 1 percents	8.5	10.3	22.4	17.2	15.6	10.0	6.8	9.2	3.4
	54	3	5	13	9	10	5	3	6	1
	Frequency Count Percent	5.6	9.3	24.1	16.7	18.5	9.3	5.6	11.1	1.9
	frequency count %	5.6	9.3	24.1	16.7	18.5	9.3	5.6	11.1	1.9

Appendix E - Data from Qualitative Question 50

Q50		Organize information and clarify areas for input	Create visual stimuli of areas of product / process for patent	Be the hub across stakeholders to seek info and support brainstorm	Share insights from the development process.	Designers would need new skills to do this	Designer may not be the right resource
P1	Organize information, track information	1					
P2	Designers usually understand all aspects of a product and help translate engineering into an easier to understand language		1				
P3	It would be helpful if designer could provide what difficulties have been overcome during the design process, reasoning of certain design requirements				1		
P4							
P5	Not sure - engineers and designers have a certain drive to improve things, but not necessarily a strategic vision about the future market and the potential of the invention. In other words, not sure it is worth the effort to drive for cross collaboration on patents. Let the folks who see the market and understand design drive the process.					0.5	0.5
P6	Translate, save time for everyone		1				
P7							
P8							
P9	They need to be more project management focused to progress / follow a process.					0.5	0.5
P10	An in depth knowledge of the patent process would allow a product designer to ask more specific questions tailored to different types of stakeholders, thus streamlining the overall process.	0.5				0.5	
P11	Product designers have a good opportunity of being the patent process facilitator & orchestra conductor with all the various stakeholders as they have the most input and understanding of the whole patent process from concept to design to patent	1					
P12	Learn at lunch about patents (company's own, and the competition), during the new product development planning - IP should be brought up and given a high score to help those ideas that are patentable be explored further by everyone.		0.5			0.5	
P13	Communicate clearly, through drawings, sketches etc. Outline as many iterations of designs that could be incorporated into the application. Sharing any experience of similar patents or products to the application. Clearly define research.		0.5		0.5		
P14	High level feasibility and usability assessment				1		
P15	Translating complex technical ideas into information that is easily digested by non-expert audience		1				
P16							
P17	Providing real-life examples to make concepts concrete		1				
P18	Better communicating limitations and opportunities to all the stakeholders.	0.5	0.5				
P19	sketch idea is good and has been successful. Sharing insights from their research into the design project.		0.5		0.5		
P20	gather the input and 'translate' it into understandable language / pictures		1				
P21	?						
P22	Helping to visualize competitive patent landscape for stakeholders (where there is density and white space). Defining distinct user benefits as a result of innovative features (making it human).	0.5	0.5				
P23	- clearly define/illustrate product distinctions of interest - contribute alternatives to what may otherwise define narrow visions of the product's innovative aspects		0.5		0.5		
P24	Designers are uniquely trained & skilled to elicit information from stakeholders. Their skillset in communication of complex ideas (visually & with words) helps include non-technical stakeholders in the process. Designers are familiar with complex software / tools / services...maybe there's a new visual database tool that designers start to use (like SolidWorks for CAD). Designers are deeply involved in many aspects of a product's development, and so can help to tie together stakeholders' areas of interest, and tease out connections between stakeholder's traditional silos of influence.		0.5	0.5			
P25	Set up guide posts during the design/development process to check in with stakeholders and see whether their input becomes relevant. Each stakeholder's inputs may not be clear at certain points during the process, but may become more relevant as development continues.			1			
P26							
P27	Create a more structured process for input.	0.5	0.5				
P28	Be a hub for all communication, ask the "right" questions of the various stakeholders early on in project to set the direction for all I.P. related activities			1			
P29	By understanding use cases, ease of use, providing images to explain concepts		0.5		0.5		
P30	Brainstorming could be a nice method to explore more input.			1			
P31	-distilling the idea down to concise laymen terms -understanding the value potential	0.5	0.5				
P32	A good designer understands (should understand IMHO) many of the components from A-Z of bringing a product to market (reality). They understand user needs which result in aha (features/benefits) Understand visualization Prototyping Materials/Production Costs/BOMs Packaging Shipping Market/channels etc Patents Distribution They are good at understanding all SH needs and sharing that information in easy to understand methods	0.33	0.33		0.33		
P33	visual material to illustrate ideas, use-cycle scenarios, pose key questions		0.5	0.5			
P34	Visualizations of all unique innovations Lateral thinking exercises Cross functional brainstorm Design sprints Competitive product teardowns, UX flow comparisons,	0.5	0	0.5			
P35	express the value of the invention visually		1				
P36							
P37	again mark up drawings with features and benefits	0.5	0.5				
P38	By providing information as requested but have them better understand the IP elements and process for claiming IP up front to better anticipate information required for input.	0.5	0.5				
	30.99	6.33	12.83	4.5	4.33	2	1
	% fromweighted to 1	20.4	41.4	14.5	14.0	6.5	3.2
	Frequency count	11	21	6	7	4	2
	51	21.6	41.2	11.8	13.7	7.8	3.9
	Frequency of response %	21.6	41.2	11.8	13.7	7.8	3.9

Appendix F – Research Questionnaire

5909 Watters – Research Questionnaire (Qualtrics online)

Start of Block: Informed Consent

Q46

<Consent Content Removed and provided separately in appendices>

- ☐ I consent / agree (1)
- ☐ I decline consent / do not agree (2)

End of Block: Informed Consent

Start of Block: Default Question Block

Q56 **Note:** when we refer to patents, our emphasis of research inquiry is into Utility Patents, while understanding that design patents do play a role.

Section1

About you and your professional experience:

Q1 What is your name?

☐ First (1) _____

☐ Last (2) _____

Q2 What best describes your main professional roles? (select up to two)

- ☐ marketer (1)
 - ☐ sales (2)
 - ☐ engineer (3)
 - ☐ patent attorney/agent (4)
 - ☐ patent examiner (5)
 - ☐ product designer (6)
 - ☐ inventor (7)
 - ☐ CEO/president (8)
 - ☐ upper management (9)
 - ☐ entrepreneur (10)
 - ☐ R+D researcher (11)
 - ☐ other (12) _____
-

Q52 Note: In this context, 'product development' is considered broadly. It is having input into the development of a new product. A few examples of input (but not limited to these) include: user needs discovery, determining product goals and requirements, design and engineering, prototyping, pre-production efforts, testing and user feedback, finalization, the product's intellectual property, and many other associated activities.

Note2: Where there is a multiple choice option labelled 'other', there is also an associated box for text entry, in case you'd like to add clarification.

Q3 What best describes the main product area(s) that you are involved with? (multiple answers accepted)

- ☐ packaging (1)
 - ☐ consumer product (2)
 - ☐ commercial product (3)
 - ☐ safety products (4)
 - ☐ software products (5)
 - ☐ legal expertise (6)
 - ☐ government (7)
 - ☐ services (8)
 - ☐ electronics (9)
 - ☐ other (10) _____
-

Q4 What best describes your level of involvement and/or input into product development? (select one)

- ☐ significant involvement / input (1)
 - ☐ some involvement / input (2)
 - ☐ no involvement / input (3)
 - ☐ other (4) _____
-

Q51 For approximately how many years have you been involved in product development?

- ☐ 1-5 (1)
 - ☐ 6-10 (2)
 - ☐ 10-15 (3)
 - ☐ 16 - 20 (4)
 - ☐ 21+ (5)
 - ☐ none (6) _____
-

Q5 Have you been involved with products that have gone for patenting? (you do not need to have been an inventor)

- ☐ frequently (1)
 - ☐ infrequently (2)
 - ☐ never (3)
 - ☐ other (4) _____
-

Q6 Have you worked with industrial designers / product designers before? (select one)

- ☐ frequently (1)
 - ☐ infrequently (2)
 - ☐ never (3)
 - ☐ other (4) _____
-

Q8 What best describes the types of patents or intellectual property that you have had the most experience with? (select up to two)

- ☐ trademark (1)
 - ☐ design patent / industrial designs (2)
 - ☐ utility patent - device (3)
 - ☐ utility patent - method / process (4)
 - ☐ no direct experience (5)
 - ☐ other (6) _____
-

Q9 As for patent involvement, in what roles have you provided input? (multiple answers accepted)

- ☐ marketer (13)
 - ☐ sales (14)
 - ☐ engineer (15)
 - ☐ patent attorney/agent (16)
 - ☐ patent examiner (17)
 - ☐ product designer (18)
 - ☐ inventor (19)
 - ☐ CEO/president (20)
 - ☐ upper management (21)
 - ☐ entrepreneur (22)
 - ☐ R+D researcher (23)
 - ☐ other (24) _____
-

Q10 What types of products have you had patent or intellectual property experience with? (multiple answers accepted)

- ☐ packaging (9)
- ☐ consumer product (10)
- ☐ commercial product (11)
- ☐ safety products (12)
- ☐ software products (13)
- ☐ legal documents (15)
- ☐ government policy (16)
- ☐ electronics (18)
- ☐ other (19) _____

Section 2 Stakeholders: In the context of this research stakeholders and product development stakeholders are used interchangeably. They are individuals or groups that have an influence on the development of a new product and its definition. It is possible they are all from the same company or that they are formed as a virtual or temporary team during the development of the new product. They may be inventors on the patent, or very often, they contribute guidance and input into the direction of the new product as non-inventors.

Q53 Stakeholders and the patent process:

Q11 Based on your experience, which two stakeholders are typically the most networked to the greatest number of other stakeholders? (please select two answers)

- ☐ designer (1)
 - ☐ engineering (2)
 - ☐ marketing/sales (3)
 - ☐ upper management/CEO (4)
 - ☐ patent agent/attorney (5)
 - ☐ entrepreneur/inventor (6)
 - ☐ other (7) _____
-

Q12 Based on your experience, which two stakeholders typically interact least with other product stakeholders? (please select two answers)

- ☐ designer (1)
 - ☐ engineering (2)
 - ☐ marketing/sales (3)
 - ☐ upper management/CEO (4)
 - ☐ patent agent/attorney (5)
 - ☐ entrepreneur/inventor (6)
 - ☐ other (7) _____
-

Q13 Based on your experience, which stakeholders typically provide the most input into the patent process? (please select two answers)

- ☐ designer (1)
 - ☐ engineering (2)
 - ☐ marketing/sales (3)
 - ☐ upper management/CEO (4)
 - ☐ patent agent/attorney (5)
 - ☐ entrepreneur/inventor (6)
 - ☐ other (7) _____
-

Q14 Based on your experience, which stakeholders have the least input into the patent process? (please select two answers)

- ☐ designer (1)
 - ☐ engineering (2)
 - ☐ marketing/sales (3)
 - ☐ upper management/CEO (4)
 - ☐ patent agent/attorney (5)
 - ☐ entrepreneur/inventor (6)
 - ☐ other (7) _____
-

Q15 Based on your experience, which stakeholder do you communicate with the most to get guidance on patent related information? (select up to two)

- ☐ designer (1)
 - ☐ engineering (2)
 - ☐ marketing/sales (3)
 - ☐ upper management/CEO (4)
 - ☐ patent agent/attorney (5)
 - ☐ entrepreneur/inventor (6)
 - ☐ other (7) _____
-

Q16 Based on your experience, which stakeholders communicate directly with the patent agent/attorney during the patent process? (please select up to two answers)

- ☐ designer (1)
 - ☐ engineering (2)
 - ☐ marketing/sales (3)
 - ☐ upper management/CEO (4)
 - ☐ patent agent/attorney (5)
 - ☐ entrepreneur/inventor (6)
 - ☐ other (7) _____
-

Q17 Based on your experience, which stakeholders are typically the most knowledgeable about patent process details? (please select up to two answers)

☐

designer (1)

☐

engineering (2)

☐

marketing/sales (3)

☐

upper management/CEO (4)

☐

patent agent/attorney (5)

☐

entrepreneur/inventor (6)

☐

other (7) _____

Q18 Based on your experience, which stakeholders may be shortest on available time to deal with the patent process? (please select up to two answers)

- ☐ designer (1)
 - ☐ engineering (2)
 - ☐ marketing/sales (3)
 - ☐ upper management/CEO (4)
 - ☐ patent agent/attorney (5)
 - ☐ entrepreneur/inventor (6)
 - ☐ other (7) _____
-

Q19 Is your available time typically a barrier to you having more involvement in the patent process? (please select one)

- ☐ always (1)
 - ☐ sometimes (2)
 - ☐ rarely (3)
 - ☐ other (4) _____
-

Q55 Is budget typically a barrier to you having more involvement in the patent process? (please select one)

- ☐ always (1)
- ☐ sometimes (2)
- ☐ rarely (3)
- ☐ other (4) _____

Secion3 About stakeholders and the product development process:

Q20 Based on your experience, which stakeholders play the largest role in specifying the new product requirements? (please select two answers)

- ☐ designer (1)
- ☐ engineering (2)
- ☐ marketing/sales (3)
- ☐ upper management/CEO (4)
- ☐ patent agent/attorney (5)
- ☐ entrepreneur/inventor (6)
- ☐ other (7) _____
-

Q21 Based on your experience, which stakeholders generally have the most direct contact with the end user and their feedback? (please select two answers)

☐

designer (1)

☐

engineering (2)

☐

marketing/sales (3)

☐

upper management/CEO (4)

☐

patent agent/attorney (5)

☐

entrepreneur/inventor (6)

☐

other (7) _____

Q22 Based on your experience, which stakeholders' involvement typically spans from start to finish of the product development process? (please select two answers)

- ☐ designer (1)
 - ☐ engineering (2)
 - ☐ marketing/sales (3)
 - ☐ upper management/CEO (4)
 - ☐ patent agent/attorney (5)
 - ☐ entrepreneur/inventor (6)
 - ☐ other (7) _____
-

Q23 Based on your experience, indicate stakeholders that best understand technological trends that lead the advancement of new products. (please select two answers)

- ☐ designer (1)
 - ☐ engineering (2)
 - ☐ marketing/sales (3)
 - ☐ upper management/CEO (4)
 - ☐ patent agent/attorney (5)
 - ☐ entrepreneur/inventor (6)
 - ☐ other (7) _____
-

Q24 Based on your experience, select stakeholders that most often understand the actual innovation in the new product the best. (please select two answers)

- ☐ designer (1)
 - ☐ engineering (2)
 - ☐ marketing/sales (3)
 - ☐ upper management/CEO (4)
 - ☐ patent agent/attorney (5)
 - ☐ entrepreneur/inventor (6)
 - ☐ other (7) _____
-

Q25 Based on your experience, indicate stakeholders that best understand product enhancements needed for future product competitiveness. (please select two answers)

- ☐ designer (1)
 - ☐ engineering (2)
 - ☐ marketing/sales (3)
 - ☐ upper management/CEO (4)
 - ☐ patent agent/attorney (5)
 - ☐ entrepreneur/inventor (6)
 - ☐ other (7) _____
-

Q26 Based on your experience, indicate stakeholders that are the strongest advocates for the product's ease of use. (please select two answers)

- ☐ designer (1)
- ☐ engineering (2)
- ☐ marketing/sales (3)
- ☐ upper management/CEO (4)
- ☐ patent agent/attorney (5)
- ☐ entrepreneur/inventor (6)
- ☐ other (7) _____

Q27 Based on your experience, select stakeholders that have the ability to cost reduce current and future products. (please select two answers)

- ☐ designer (1)
 - ☐ engineering (2)
 - ☐ marketing/sales (3)
 - ☐ upper management/CEO (4)
 - ☐ patent agent/attorney (5)
 - ☐ entrepreneur/inventor (6)
 - ☐ other (7) _____
-

Q28 Based on your experience, indicate stakeholders that have the awareness and ability to improve the quality and reliability of the product. (please select two answers)

- ☐ designer (1)
 - ☐ engineering (2)
 - ☐ marketing/sales (3)
 - ☐ upper management/CEO (4)
 - ☐ patent agent/attorney (5)
 - ☐ entrepreneur/inventor (6)
 - ☐ other (7) _____
-

Q29 Based on your experience, indicate stakeholders that understand competitive products' strengths and weaknesses the most thoroughly. (please select two answers)

- ☐ designer (1)
 - ☐ engineering (2)
 - ☐ marketing/sales (3)
 - ☐ upper management/CEO (4)
 - ☐ patent agent/attorney (5)
 - ☐ entrepreneur/inventor (6)
 - ☐ other (7) _____
-

Q30 Based on your experience, which stakeholders best understand how the new product **actually compares to its competitors'** strengths and weaknesses? (please select up to two answers)

- ☐ designer (1)
- ☐ engineering (2)
- ☐ marketing/sales (3)
- ☐ upper management/CEO (4)
- ☐ patent agent/attorney (5)
- ☐ entrepreneur/inventor (6)
- ☐ other (7) _____

Section 4 A bit about your experience with transferring and communicating information:

Q32 How much of a challenge is the selection of information for the creation of patent applications? (select one)

- ☐ very challenging (1)
 - ☐ somewhat challenging (2)
 - ☐ not challenging (3)
 - ☐ other (4) _____
-

Q31 How challenging would it be to get all stakeholders together to discuss the patent application? (select one)

- ☐ very challenging (1)
 - ☐ somewhat challenging (2)
 - ☐ not challenging (3)
 - ☐ other (4) _____
-

Q33 Would some support with the creation of visual images and sketches facilitate the capture of knowledge from stakeholders for patent applications? (select one)

- ☐ extremely helpful (1)
 - ☐ somewhat helpful (2)
 - ☐ not helpful (3)
 - ☐ other (4) _____
-

Q34 How much of a challenge is communicating among stakeholders about the application? (select one)

- ☐ very challenging (1)
 - ☐ somewhat challenging (2)
 - ☐ not challenging (3)
 - ☐ other (4) _____
-

Q35 Do you think that a group brainstorming session in advance of the patent application would help you increase your contribution to the patent application? (select one)

☐ extremely helpful (1)

☐ somewhat helpful (2)

☐ not helpful (3)

☐ other (4) _____

Q36 Based on your experience, would the time and effort that it takes to have a group brainstorming session about the upcoming patent be worthwhile towards improving the patent application? (select one)

☐ extremely worthwhile (1)

☐ somewhat worthwhile (2)

☐ not worthwhile (3)

☐ other (4) _____

Q38 Which stakeholders might be the best to run a pre-patent application group brainstorming session? (please select two)

- ☐ designer (1)
- ☐ engineering (2)
- ☐ marketing/sales (3)
- ☐ upper management/CEO (4)
- ☐ patent agent/attorney (5)
- ☐ entrepreneur/inventor (6)
- ☐ other (7) _____

Q54 So close to done ... hang in there :)

Q47 Any quick thoughts on why the full range of stakeholders might not currently be considered when it comes time to contribute to patents?

Q49 What one or two things could help facilitate input from many stakeholders for consideration by the patent agent/attorney?

Q50 How might product designers be helpful in facilitating patent input from stakeholders?
(bullet points are fine)

Q45 **Don't forget to select the red box and arrow below to record your responses and exit.**

Thanks so much for providing all of those answers! (Please feel free to add any additional comments or thoughts that you might have):

End of Block: Default Question Block