SCOT REVISITED: BRINGING POWER AND NORMS INTO THE PRODUCT DEVELOPMENT PROCESS

A thesis submitted to the Faculty of the Graduate School of Arts and Sciences of Georgetown University in partial fulfillment of the requirements for the degree of Master of Arts in Communication, Culture and Technology

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Washington, DC April 19, 2011
ABSTRACT

According to Pinch and Bijker (1987), the authors of the Social Construction of Technology (SCOT) theory, the key actors in any technology-based setting work together to conceptualize and develop a new technology. According to these authors, agreement on the final product comes about based on negotiations among those actors who are party to the development process. Based on the SCOT theory, these actors are relatively equal in status, and hence have an equal voice in determining the outcome. Consensus occurs as a result of rhetoric and convincing people via dialogue.

One must wonder, however, how consensus works in a business organization. According to Mancur Olson\(^1\), actors do not act collectively without a coordinator and collective action does not typically occur because it is costly to the individual. What, then, motivates actors to act collectively within a firm? Likewise, Beinhocker\(^2\) notes that hierarchy is necessary to reduce complexity within a large firm. Most modern-day firms employ various forms of vertical


hierarchy, wherein everyone is a nonequal. If everyone is a nonequal, which actors become the key determinants of a design?

Thus, there would seem to be a paradox between SCOT and the real world of firms, wherein hierarchy is necessary to come to consensus. Not taking power into account, SCOT leaves a 'black box' around the decision-making process in the development of new technologies. This research, based on the theory of the social construction of technology, examines the extent to which authority plays a role within a firm.

This survey-based research explores Bijker and Pinch’s idea of the flexibility of the design of artifacts and the role that certain societal actors and groups play in the design of a product prior to market launch. I hypothesize that the SCOT model cannot fully explain the product development process. To test the hypothesis, I collect data regarding how product development decisions are being made in hierarchical firms. These data inform whether SCOT can fully explain the decision-making process, or whether other additional factors, such as the use of power and norms, must be considered.

The results of this survey neither support nor deny the hypothesis at-large. Rather, the results indicate that the product development process is much more complex than this thesis anticipated, and the process cannot be understood with one set of survey responses alone. However, the results demonstrate importance findings about the perceived influence of workplace relationships, how such relationships are understood, and the need to further investigate the role of social relationships within the corporate environment. The findings also have important implications for the understanding of hierarchy and power and the non-static
nature of these characteristics in organizational structures. This research suggests that power and influence are fluid and change as individuals’ role in the product development process changes.
The research and writing of this thesis
is dedicated to everyone who helped along the way,
especially my advisor, Dr. D. Linda Garcia, and my thesis colloquium colleagues,
Jake Landis, Meredith Clements, and Tarkan Rosenberg.

Many thanks,

CLAIRE M. NAVARO
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Chapter I: Introduction

In modern global society, businesses are constantly making decisions about products, services, transaction costs, technologies, and more. These decisions are made within networks of people within the firm, ranging from small groups of coworkers to large, company-wide collaborations. Technologies and products are developed in this network and are the product of the actors’ discussions and decisions. As the global economy continues to expand and businesses continue producing, these decisions within firms naturally become more complex.

The Social Construction of Technology theory (SCOT) does not account for these large scale firms. It states that technology outcomes are the result of stabilization, or closure, of debate. The SCOT model proposes that such closure occurs in two ways. The first is through rhetorical closure, or the “disappearance of problems,” and the second is closure by redefining the problems at hand to convince relevant actors of their solution. In its theoretical framework, SCOT eliminates a normative structure and power relations, thus giving all actors involved in technology outcomes equal influence over the construction of an artifact. SCOT presumes that all relevant stakeholders are equally involved in the decision-making process, and that negotiation and rhetoric will lead to closure.

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3 Bijker, Hughes, & Pinch, 1987, p. 44
4 Bijker, Hughes, & Pinch, 1987, p. 44-45
5 Bijker, Hughes, & Pinch, 1987, p. 34
6 Bijker, Hughes, & Pinch, 1987, p. 46
According to Pinch and Bijker, the authors of the SCOT framework, the key actors in any technology-based setting work together to conceptualize and develop a new technology.\textsuperscript{7} According to these authors, agreement on the final product comes about based on negotiations among those actors who are party to the development process. Specifically, Pinch and Bijker describe a “multidirectional” model of technology development. This multidirectional model is created as groups and actors voice their opinions on how a product should be changed, enhanced or developed, thus giving all included actors an original perspective on the development process.\textsuperscript{8} Based on this theory, these included actors are relatively equal in status, and hence have an equal voice in determining the outcome.

Because SCOT treats all stakeholders as equal, it does not account for hierarchy in large-scale firms. Such hierarchy is necessary in order to coordinate the increasingly complex economy.\textsuperscript{9} This hierarchy helps coordinate activities in a timely fashion and mirrors power relationships within and around firms.\textsuperscript{10} Firms act within a network of increasing complexity, and operations within such complex networks require certain levels of organization and hierarchy. As a result of this hierarchical structure, power relationships are formed within firms.\textsuperscript{11} Firms also have many external factors that affect the decision-making process, such as timeframes and economic incentives.\textsuperscript{12} Likewise, as Beinhocker in his work \textit{The Origin of

\textsuperscript{7} Bijker, Hughes, & Pinch, 1987, p. 30  
\textsuperscript{8} Bijker, Hughes, & Pinch, 1987, p. 28  
\textsuperscript{9} Coase, 1937; Beinhocker, 2006, p. 272  
\textsuperscript{10} Pfeffer & Salancik, 1978, p. 228, 235; Pugh, 1971; Thompson, 1967; Perrow, 1970; Crozier, 1964  
\textsuperscript{11} Pfeffer & Salancik, 1978, p. 276  
Wealth (2006) notes, hierarchy is necessary to reduce complexity within a large firm.\textsuperscript{13} Most modern-day firms employ various forms of vertical hierarchy, wherein everyone is a unequal. If everyone is unequal, which actors become the key determinants of a design?

This raises the question of just how effective SCOT is in evaluating product development in firms. How well does the SCOT theory apply to large-scale firms, where many of the actors involved in the decision-making process are unequal in rank? In particular, how are decisions made, and to what extent does it mirror the SCOT process?

According to Mancur Olson, author of The Logic of Collective Action (1965), actors do not act collectively without a coordinator and collective action does not typically occur because it is costly to the individual. Though Olson’s work focuses on public goods, he sets up important factors to consider in the production of any good or services: first, there are costs involved in the production of any good; second, rational, self-interesed individuals will not act to achieve their common or group interests “unless there is coercion to force them to do so, or…some separate incentive.”\textsuperscript{14} What, then, motivates actors to act collectively within a firm?

Thus, there would seem to be a paradox between SCOT and the real world of firms, wherein hierarchy is necessary to coordinate behavior and come to consensus. Not taking power into account, SCOT leaves a 'black box' around the decision-making process in the development of new technologies. The effect of the nonequal status of actors within a firm’s network deserves further research. This research, based on the theory of the social construction of technology, will examine the extent to which authority plays a role within a firm’s product

\textsuperscript{13} Beinhocker, 2006, p. 154
\textsuperscript{14} Olson, 1977, p. 2
development process. Such an analysis will identify gaps in the SCOT framework that will require additional theoretical explanation. How is the negotiation among actors coordinated in conversations to produce a consensus? How does power affect the choices of actors? Is everyone a key player, such as SCOT suggests? What does SCOT say about an organization’s vertical hierarchy? As the notion of hierarchy suggests, I believe that decisions are made in networks within networks up a ladder within firms.

It is important to address the existence of alternative frameworks that may fill the gaps that the SCOT theory creates. Recent market developments, aided by the invention and widespread use of the Internet, have expressed a trend towards information economies.\(^\text{15}\) The information economy, which serves as the foundation for open-source economies\(^\text{16}\), emphasizes the production of products and services for the strengthening of relationships and connections.\(^\text{17}\) In information economies, there has been a shift away from groups and hierarchies and towards more flexible and fluid relationships of people, thus changing the traditional economic structure of a centralized (hierarchical) production process to one that is largely nonproprietary and decentralized.\(^\text{18}\) As Benkler notes in his work *The Wealth of Networks* (2006), modern markets that employ open sourcing as a way of sharing information and developing products do not need to rely on economic markets or on managerial hierarchies to organize production.\(^\text{19}\) The networked information economy is generating an interesting revival in the modern economy,

\(^{15}\) Benkler, 2006, p. 30
\(^{16}\) Benkler, 2006, p. 123
\(^{17}\) Benkler, 2006, p. 3
\(^{18}\) Benkler, 2006, p. 18
\(^{19}\) Benkler, 2006, p. 60
where open source technology has taken a new approach on the economic model traditionally used.

Another important theory that will be examined later in this thesis is that of Actor-Network theory (ANT), which addresses various issues that SCOT does not. ANT presumes that actors, both people and the technology they’re interacting with, create an extended network in which consensus is reached via negotiation as relationships grow and roles are redefined. \(^\text{20}\) ANT proposes that both human and non-human actors interact in a way that gives room for ‘translation’ among actors; in other words, actors work together to define the problem, to choose people who can best solve the problem to serve as a delegate of a constituent group, to define roles of actors, and finally to enroll various actors into the suggested path of solution and stability. \(^\text{21}\)

The networked information economy and ANT theory will be further explained in the following chapter of this thesis. However, it is important to acknowledge these alternative theories that may work to fill in gaps left by SCOT in the evaluation of the decision-making process. Depending upon the results of the data, such theories may help explain the modern firm.

This thesis seeks to address these questions about the relevancy of SCOT in the modern hierarchical firm. By laying out a map of the SCOT method of decision-making in relationship to the firms, I will argue that there may be gaps in the framework that must be addressed. I will examine how SCOT may not be complete, and suggest what might be necessary to fill the voids

\(^{20}\) Callon, 1986  
\(^{21}\) Law, 1987
in the framework. I will examine these questions using a case-study methodology, gathering information with a survey tool directed towards a set of acting managers in various hierarchical firms.

This survey will be distributed via email to individuals working on product development teams at firms within the United States. The questions asked of the participants will examine the extent to which hierarchy (power relationships, authority) and other external constraints that are ignored by SCOT (time, money) affect the decision-making process of various teams within firms. The open-ended survey will confirm, deny, or express the need for more research on my hypothesis that hierarchy and time, those characteristics ignored by SCOT, are important factors that affect the decision-making process.

In this thesis, I will show that the structure of firms in reality differs than the structure presented by the SCOT model. In Chapter Two, I will explore the conceptual framework for this thesis. I will examine the theoretical framework of the social construction of technology to provide a conceptual background. I will also explore the theory of collective action, which addresses the need and importance of hierarchy within firms, as well as ANT, which provides alternative explanations for the structure of firms. In Chapter Three, I will detail the survey questions that will be used to gather data and explain the relevancy of a survey methodology. I will also explain the survey process and the method for gathering results. In Chapter Four, I will present the data and the interpretation of the results. The data will provide a foundation on which I will evaluate the SCOT framework in modern firms. In Chapter Five, I will look at the overall results of this thesis and any importance of the results. I will also identify gaps in our understanding of decision-making of large-scale firms and to propose further research.
Chapter II: The Conceptual Framework

This thesis examines the research question: Can the SCOT model of decision making apply to large-scale firms, where actors have unequal status and are under significant time pressure to produce? If not, what other factors help explain decision-making outcomes in large-scale firms? This chapter provides a conceptual framework for answering this question. To this end, it first characterizes the existing literature that has addressed various aspects of this question. Based on this literature, the chapter then defines and operationalizes the elements in the research question, and characterizes their relationship to one another, so as to hypothesize about how hierarchy and power relationships might affect product development decisions in ways unanticipated by SCOT.

The Social Construction of Technology

The Social Construction of Technology theory (SCOT) is a Science and Technology framework that provides a model for determining product (technological) outcomes. SCOT, developed by Trevor J. Pinch and Wiebe E. Bijker in their book, The Social Construction of Technology (1987), was originally designed to show the connectedness of science and technological innovations. Pinch and Bijker sought to demonstrate how both conceptual areas can benefit from the social constructivist notion that human interaction with technologies shapes their development. The authors’ work was centered on the thesis that both science and

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22 Bijker, Hughes, & Pinch, 1987
technology are constructed by actors’ uses of cultural knowledge and resources. Given that science and technology often go hand-in-hand in current literature and cultural understanding, it is important to define these terms in accordance with these original authors.

At the time of Pinch and Bijker’s research, a new field of science studies was emerging, namely the sociology of scientific knowledge. It focused its analysis on the content of scientific research, rather than on science as an institution. This approach differed significantly from previous sociological studies of science that had focused primarily on the norms, habits, and behaviors of scientists. The new sociology of science focuses on the actual research being conducted and the idea that even scientific facts are socially constructed.

The theory of the social construction of science gave rise to the idea that technology is not solely the application of the sciences, but as importantly a product of societal decision-making. A large body of this work was dedicated to the understanding of innovation, an area of study previously considered to be economic in both discipline and practice. The traditional view of technological innovation rarely incorporated an effort to understand the evolution of the technology itself, leaving a “black box” around the development process. As a result, technology studies were biased in favor of those technologies that were successfully produced and used in society, leaving aside any inquiry into failed technologies and products. The question of how and why technologies failed was precisely what Bijker and Pinch aimed to unveil, thereby unpacking the black box of innovation.

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23 Bijker, Hughes, & Pinch, 1987
24 Bijker, Hughes, & Pinch, 1987
25 Bijker, Hughes, & Pinch, 1987, p.22
In their attempt to lay out the process whereby technology/products are developed, Bijker and Pinch expanded and developed the theory of the social construction of technology (SCOT), which was in its empirical infancy at the time of their research.\textsuperscript{26} According to SCOT, technological development results from the variation and selection of relevant actors, social groups, problems and solutions.\textsuperscript{27}

\textit{SCOT Model Figure 1}\textsuperscript{28}: The relationship between the artifact and relevant social groups

\textsuperscript{26} Bijker, Hughes, & Pinch, 1987, p.28
\textsuperscript{27} Bijker, Hughes, & Pinch, 1987
\textsuperscript{28} Bijker, Hughes, & Pinch, 1987, p.35
This variation and selection creates a multidirectional model of decision-making and technological development. This model was in stark contrast to the widely accepted understanding of a linear path of technology development.

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29 Bijker, Hughes, & Pinch, 1987, p.36
30 Bijker, Hughes, & Pinch, 1987, p.28
SCOT: Relevant Social Groups

As characterized by Bijker and Pinch, relevant social groups decide which problems are important, and in so doing, they identify the social groups that have a stake in how the artifact develops and the meanings attributed to it. As the authors note, “a problem is defined as such only when there is a social group for which it constitutes a ‘problem.’” Relevant social groups are defined as institutions, organizations, as well as both organized and unorganized groups of individuals. Despite the potential imbalance of power or economic status, groups in the SCOT model all retain the same level of relevancy, and thus they have the same level of influence in determining the evolution of a technology. When these relevant groups come together to assess or participate in the development of a product or technology, each group’s concerns and problems are considered on an equal basis, generating a variety of problems, solutions, and developments with respect to the technology at hand.

SCOT: Stabilization as Closure

This process, so described, entails various cycles of stabilization, adjustment, and reinterpretation as the groups continue to assess the product’s evolution in terms of their unique understandings of the product. Only when the perceived problems associated with a technology “disappear” is its development considered stabilized and closure reached. Under the SCOT

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31 Bijker, Hughes, & Pinch, 1987, p.30
32 Bijker, Hughes, & Pinch, 1987, p.30
33 Bijker, Hughes, & Pinch, 1987, p.34
34 Bijker, Hughes, & Pinch, 1987, p.44
model of decision-making, closure of the cycle of product development occurs in two ways: the first is through rhetorical exchange, wherein the relevant social groups believe problems to have been solved ("disappeared"), even though the actual problem may still remain; the second is closure through the redefinition of the problem, wherein a design problem becomes stabilized by the actors’ invention of a new problem, for which the original dilemma becomes a solution.35

**SCOT: The Bicycle Case Study**

These forms of closure are illustrated by the classic SCOT example of the development of the bicycle. Development of this artifact was begun in London around 1880, where it was viewed by various social groups, ranging from newsboys to athletes to urban women, as having great potential to affect them. Each group identified various problems with the development of the bicycle. For example, there were safety concerns about the height of the wheels and the materials from which tires were made, as well as concerns about speed, which were related to the physical construction of the bike. As these problems came to light, some “disappeared” as the result of advertising. Thus, for example, one particular version of the bicycle was eliminated due to an advertisement that employed rhetoric touting the “almost absolute safety” of the bicycle, even though safety related problems still existed.36 Thus, safety concerns became less important

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35 Bijker, Hughes, & Pinch, 1987, p.46
36 Bijker, Hughes, & Pinch, 1987, p.44
as the social group concerned with public safety believed, based on the advertising, that all safety problems had been solved.37

As noted above, the second form of closure occurs when the problem is redefined through the translation of one problem into the solution of a separate controversy. For example, the use of an air tire for the bicycle’s wheels was, in the eyes of the engineers, a “theoretical and practical monstrosity.” For the public, it was an aesthetically displeasing ey sore. For proponents of the air tire, it was the answer to an ongoing problem of excess vibration. Thus, three different, but equally important, social groups contested the air tire. However, the air tire “problem” came to be translated into the obvious solution for the problem of speed once a bike equipped with air tires outraced all full-rubber tired bikes. As a result, the problem of vibration was eliminated, and its solution, the air tire, became the solution also to the problem of speed.

37 The bicycle case study can be read in full detail in (Bijker, Hughes, & Pinch, 1987, p.18-50)
38 Bijker, Hughes, & Pinch, 1987, p.44
SCOT Figure 3\textsuperscript{39}: An example of the product development process of the Penny Farthing bicycle, including some relevant social groups, problems, and solutions. Not all problems and solutions of the artifact’s development are shown in this diagram.

\textsuperscript{39} Bijker, Hughes, & Pinch, 1987, p.37
**SCOT: Criteria for Closure**

The SCOT model for designing technologies defines three criteria for closure. The first criterion is, as noted above, that all relevant actors are included in the design process of a technology. The second criterion is that each of these actors retains the same amount of power in determining the design of a technology. The third criterion is that closure eventually is reached via consensus of the actors. Based on these criteria, Bijker and Pinch provide a model that might serve to illuminate how technologies evolve in the context of a firm. This thesis argues, however, that other equally if not more important factors must be taken into account.

For example, the parameters set by the SCOT approach might be applicable in a small, highly networked organization where actors are of equal status and have dense relationships with one another. However, this is not the reality in today’s hierarchical organizations. To address these situations, it is necessary to draw upon additional technology design literature that focuses on two important elements in the decision-making process: the use of power and the normative environment.

**The gaps of SCOT: Power and a normative environment**

Let us examine the gaps in the SCOT model in more detail. First, as we have seen, SCOT contends that all social groups and individuals that use or interact with a final technology artifact are relevant to its development.\(^{40}\) The network of actors is, according to Bijker and Pinch,

\[^{40}\text{Bijker, Hughes, \\& Pinch, 1987, p.30}\]
self-selecting—that is to say, the network expands to include more actors as more uses and users of the product come into play. These relevant actors and social groups thus form a decentralized network, whereby one group or individual does not possess ultimate authority or control over the design of the technology. As such, this decentralization of authority eliminates the use of power in the decision-making process. Despite social influences or standings, actors within this network are presumed to be equally important in determining the final design outcome.

Secondly, SCOT ignores the normative environment in which actors determine technology designs. The model fails to provide a method by which actors make decisions. It simply notes that, eventually, actors reach consensus regarding a design, and this design then becomes the final technology. Although the SCOT model does indicate that certain rhetorical devices are used to reach consensus, it does not delineate how actors handle conflict, relate to one another, motivate consensus, converse about values, and so on. Nor does the model address the environment in which decisions are made, and the relationships that are formed within such an environment. Actors are assumed to discuss the design problems of a technology, weighing each actor’s opinion equally, until all the problems associated with the technology are considered resolved. Moreover, SCOT does not address the existence (or lack thereof) of an incentive structure, of motivation, coercion, reinforcement, social norms and values, or any other guiding mechanism that is commonly used in facilitating group decision-making.

To fill in these gaps, it is useful to look at two different bodies of literature. First, Actor-Network Theory (ANT) provides a model that includes and emphasizes the use of power in facilitating consensus and closure. Second, the literature on information economies and social production stress the role of normative environments, particularly in decentralized networks.
Addressing the gaps: Actor-Network Theory

Actor-Network Theory (ANT), authored by Michel Callon⁴¹ (1986) and Bruno Latour⁴² (1987), identifies an alternative decision-making process for determining technological outcomes, one that focuses on power. ANT presumes that actors, defined in this literature as both people and the technology at hand, attempt to impose individual interpretations of a problem or solution onto other “actants” (humans and technologies) through the use of coercion, control and convincing.⁴³ In other words, ANT suggests that actants use power, negotiation, and coercion to convince other actors to agree with a proposed outcome.

In contrast to SCOT, closure within the ANT model is specifically spelled out; it occurs when actors employ their resources to “enroll” others to their viewpoints. Actors assert their interpretations of the problems and their suggested solutions and project them onto other actors by using their power to gain agreement. Although different actors may have diverse opinions, those with more power and social status induce others to acquiesce to their wills, thereby controlling the final form of a technology. Closure occurs when an actant is no longer questioned, or when the actant has successfully taken control of the outcome.⁴⁴

To gain control of an outcome, actors, in accordance with the ANT model, use two important rhetorical techniques. First, actors use translation to express a problem in their own

⁴¹ Callon, in Law, 1986.
⁴³ Callon, in Law, 1986.
⁴⁴ Callon, in Law, 1986, p.4
words, thereby gaining ownership of it. In so doing, the actor becomes the spokesperson for that particular aspect of a design issue. When that spokesperson then provides the technology problem’s design solution, and convinces others of it, enrollment can be said to take place. The most successful spokesperson is the actor who has gathered the most support during the translation process for his design solution. Thus, power is a prerequisite for closure in ANT.

Just as ANT helps to fill in the gaps left by SCOT, so too does the literature on the information economy. This literature suggests that actors coordinate their behavior based on values and social norms, and that this normative environment encourages closure and consensus among actors.

**Addressing the Gaps: Normative environments**

To examine the literature that highlights the importance of a normative environment to coordinate actions and promote cooperation, especially in highly decentralized networks, we turn to Yochai Benkler’s work on information economies, as well as Steven Weber’s work on open source. These authors suggest an alternative method for decision-making, one that emphasizes the importance of norms.

Benkler’s book, *The Wealth of Networks* (2006), characterizes a shift in economic production from the postindustrial economy to that of a modern networked information economy. As he describes, a networked information economy is one in which information,  

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45 Callon, in Law, 1986, p.18  
46 Benkler, 2006  
47 Weber, 2004
knowledge, and culture are central to all economic activity.\textsuperscript{48} Moreover, in contrast to the industrial era, which was centered on organizational hierarchy, the networked information economy governs the production processes much more through the decentralization of power and the reliance on cooperation and sharing.\textsuperscript{49} For example, in economies such as open source and peer production, cooperation among actors is maintained not through formal, authoritative hierarchical structures, but rather through a combination of “technical architecture, social norms, legal rules, and a technically backed hierarchy that is validated by social norms.”\textsuperscript{50}

In keeping with Benkler’s perspective, Steven Weber (2004) tackles the modern phenomenon of open source production in his book \textit{The Success of Open Source} (2004). In particular, he explores the question of why people contribute to those causes from which they will benefit regardless of whether or not they contribute to the effort. Weber’s (2004) research question is derived from Mancur Olson’s (1971) classic problem of individual free riding in the production and distribution of public goods.

Olson’s (1971) work on public goods explores why decentralized networks often face dilemmas in the production of non-exclusive goods. Olson posits that unless a network is very small or is dense—meaning well-connected—rational actors \textit{will not act} to achieve the common good. However, the coordination of individuals’ actions requires constant communication amongst actors and is often very costly. One way of reducing such costs is by creating a network of people who are alike, thus reducing the possibility of one person emerging as a leader to

\textsuperscript{48} Benkler, 2006, p. 32  
\textsuperscript{49} Benkler, 2006, p. 33  
\textsuperscript{50} Benkler, 2006, p. 104
control the distribution of benefits, and in doing so, increasing the individual benefit from participation. As such, the size and density (small and close-knit) of a network play an important role in facilitating production. As Gulati and Singh (1998) point out, interdependence of actors is necessary for production in a decentralized network to occur. In productive and successful networks, actors must trust each other and free riders must be easily identifiable, thereby creating incentive for individual action towards a common goal.

Based on this research, Weber (2004) seeks to explain how open source production, a complex process that is nonproprietary in nature, dependent upon individual contributions, and relatively unstructured, manages to sustain itself despite the possibility of free riding.

In explaining the open source phenomenon, Weber—like Benkler—argues that critical to any gift economy is an environment based on sharing and reciprocity. It is these values that enable heterogeneous actors to successfully coordinate production. As Weber notes, the open source movement fosters such values and norms. For example, it is in the context of the open source production process itself that the community of distributed open source producers defines its own identity by sharing their contributions and upholding licensing schemes. Although the benefit that each producer receives is not linked to the contributions he or she made, participants

51 Garcia, Leickly & Willey, 2005
52 Olson, 1971
53 Gulati & Singh, 1998
54 Weber, 2004, p. 2
55 Weber, 2004, p. 82-85
56 Weber, 2004, p.82
57 Weber, 2004, p.85: Licensing schemes are typically sets of values and rules that determine a social structure in the absence of hierarchical structure. For example, each actor who contributes to an open source project agrees to ensure access to source code, to pass rights to the user of the code rather than the producer of the code, etc.
in the community feel compelled to adhere to common values and guidelines in order to reach create a product and thereby achieve their shared goals. In so doing, they generate a milieu of social values and norms that are perpetuated and reinforced through each actor’s adherence to them.

The perspectives of ANT and the characterizations of the gift economy provide useful additions to the SCOT model of product development, as outlined by Bijker and Pinch. While ANT provides evidence of the role of power in determine technology outcomes, the works of Benkler and Weber help verify the importance of norms and values in guiding technological decisions. Taken together, these three bodies of literature provide a useful frame of reference and vocabulary for characterizing the evolution of technology development in hierarchical firms.

Key Terms and Definitions

In addressing the research question posed in this thesis, the following key terms will be employed.

Technology is defined as 1) physical objects or artifacts, 2) activities or processes (such as steel making or data sharing) or 3) what people know as well as what they do. For purpose of this paper, the term technology may also refer to artifacts or products, given that the nature of this paper examines the production process of such items.

58 Bijker, Hughes & Pinch, 1987, p. 11
Relevant Actors, are defined as those actors who are self-selected by the members of a decision-making network.\textsuperscript{59}

Closure is defined as the point at which decision-makers arrive at a consensus about the design of a technology.\textsuperscript{60}

Power is defined as “the ability of a subunit to influence organizational decisions in ways that produce outcomes favored by the subunit.”\textsuperscript{61}

A Centralized Organization can be said to exist when actors have the capacity to contribute within the organization, but they are subject to authority from above (in a hierarchical manner).\textsuperscript{62}

In contrast, a Decentralized Organization can be said to exist when actors have the capacity not only to contribute but also to define their own contribution.\textsuperscript{63}

A Normative Environment is defined as a form of community governance in which actors share and enforce a common set of values.\textsuperscript{64}

\textsuperscript{59} Bijker, Hughes, & Pinch, 1987, p. 11
\textsuperscript{60} Bijker, Hughes, & Pinch, 1987, p. 11
\textsuperscript{61} Pfeffer & Salancik, 1978, p. 230
\textsuperscript{62} Benkler, 2006, p. 331
\textsuperscript{63} Benkler, 2006, p. 331
\textsuperscript{64} Bowles & Gintis, 2002; Benkler, 2006, p. 331; Weber, 2004, p. 82
Hypothesis

Building upon these concepts, the thesis will analyze the following hypothesis:

The SCOT model, as defined by Bijker and Pinch, cannot fully address the decision-making process in hierarchically organized firms. In particular, the use of power and the need for normative values—as described by Callon and Benkler & Weber, respectively—will affect product-development decisions in ways unanticipated by SCOT.

As described in the following chapter, a survey methodology will be used to examine the nature and structure of the decision-making process of hierarchical firms. As detailed in Chapter Three, I will distribute a survey to collect data from actors involved in the product development process, and the results of that survey will be analyzed in Chapter Four.
Chapter III: Methodology

Building upon the literature characterized in the previous chapter, the thesis analyzes the following hypothesis:

The SCOT model, as defined by Bijker and Pinch, cannot fully address the decision-making process in hierarchical organizations. In particular, the use of power and the need for normative values—as described by Callon and Benkler & Weber, respectively—will affect product-development decisions in ways unanticipated by SCOT.

In order to test this hypothesis, one must understand how product development decisions are made in hierarchical organizations. How do product development teams come to closure? In particular, how are final product designs selected? What happens in teams where power and organizational norms, which are not addressed by SCOT, are present? Can the Social Construction of Technology theory serve as a comprehensive model for product development in today’s complex economy?

Testing the Hypothesis

I hypothesize that the SCOT model cannot fully explain the product development process; instead, the model is much like a jigsaw puzzle with the borders but no middle pieces, providing only an outline of the product development process. To test my hypothesis, I will determine whether the SCOT model is fully capable of explaining the decision-making process
of product development teams within hierarchical organizations. If the data provides evidence that other factors not considered by SCOT play a role in the development of products, I will conclude that my hypothesis is correct. To carry out my investigation, I collect data regarding how product development decisions are being made in hierarchical firms. These data inform whether SCOT can fully explain the decision-making process, or whether other additional factors, such as the use of power and the norms, must be considered.

**Survey Analysis Methodology**

I use a survey analysis methodology to collect the data necessary to test this hypothesis. The data is comprised of the answers to an open-ended survey instrument that teases out the roles of consensus building, power relations, and norms in the product development process.

I selected an open-ended survey over a closed survey. This type of survey allows me to get a more nuanced picture of how the development process occurs across a variety of industries. Moreover, an open-ended survey allows respondents to interpret the questions based on their individual situations and relationships within the product development process. In contrast, a closed survey might prejudice the answers of the respondents in unanticipated ways. A closed survey would also force me, the investigator, to choose questions that are broad enough to apply to all potential interpretations. A closed survey would also force the respondents to limit their answers about the contexts of their work environment, information that is directly relevant to the hypothesis laid out above.
Participants

I selected and solicited the participants of this survey in the following ways. I distributed the survey to product development associations, individuals who identified themselves as product development professionals, and to product development groups on social and professional media sites, such as LinkedIn. In these social media sites, I posted the survey on discussion boards, thus giving a large number of people direct access to the survey. The survey was also sent to these potential participants via email when such information was publicly accessible.

I also contacted a variety of firms and organizations that have product development teams and personally requested the participation of professionals. Though I solicited no information identifying the participants, the contacted organizations, associations, and firms displayed a heterogeneous pool of participants from a variety of industries.

Together, the survey participants create a representative portion of the larger pool of product development professionals. This representative portion is necessary to make the data credible as a way of understanding the larger trends and behaviors associated with the overall product development process.

The Survey Instrument

Building on the literature of SCOT, ANT and theories of information economies, the survey questions aim to elicit responses about what factors account for product outcomes. The questions seek to address those factors that the respondents find important to the product
development process, including the roles of power, authority, deliberation, closure, and the normative environment as previously defined by the literature. These factors relate directly to the hypothesis.

The survey questions as posted in the online survey are listed below. Each question, or set of questions, is accompanied by an italicized explanation of the categories the question assesses. However, because the survey tool is open-ended, these explanations are not meant to be definitive categorizations. Rather, they anticipate the respondents’ interpretations of the questions as they relate to the thesis’ hypothesis.

**Survey Questions and Objectives:**

1. On average, how many team meetings (a team meeting is defined in this research as a group of employees who are working on a specific product or service) do you attend during one business week?

   *This question provides a base for understanding the level of involvement the respondent has in the product development process.*

2. Within these team meetings, how are the participants chosen?

   *This question allows respondents to independently identify how relevant actors are selected.*

3. Does your input have the same effect on final decisions as those who report to you?

4. Does your input have the same effect on final decisions as your superior’s input?
These two questions address the hierarchical nature of the respondent’s company. They also address the comparative power status of the respondent to his/her colleagues.

5. As a manager, do you feel your presence in meetings affects how your subordinates make decisions?

6. If your superior is present in your team meeting, does his/her presence affect the way your team makes decisions?

Questions 5 & 6 focus on both power roles and the presence of/adherence to the normative environment (Question 5 may not be applicable to all respondents; non-managers are asked to skip ahead).

7. How, as a manager, do you encourage your team to make decisions?

8. How does your superior encourage you to make decisions?

These questions focus on incentives to produce, the presence of normative values, and the importance of hierarchical directives and instructions. (Question 7 may not be applicable to all respondents; non-managers are asked to skip ahead).

9. What happens on your team if not all members agree on a proposed issue? For example, if your superior defines a product in one way, but your team defines it in another, what is the process by which a decision about this product will be made?

This question addresses the process by which product development decisions are made. Because the question is open ended, it also may address power roles, status level, or normative values (respecting authority, etc). It may also address deliberation and other conversational mechanisms.
10. How much leeway is there to extend the decision-making timeframe in order to reach closure?

This question may prompt respondents to discuss firm priorities and values, such as time, budget, product progression; it may also address the (un-)importance of coming to mutual agreement or consensus, as well as the role and function of deliberation in the respondents workplace.

11. What factors most affect your workplace decisions? (time, money, workplace relationships, corporate policy, etc)

This question addresses both those formal policies and guidelines in place (budget, labor roles, etc) and those informal guidelines (normative values, such as respecting coworkers, team camaraderie, etc) that govern a work environment.

12. Have you ever made a workplace decision based mainly on a social relationship, such as friendship or peer pressure?

13. How important are workplace norms in your office? Norms are those workplace behaviors that employees generally adhere to, though the behaviors are not corporate policy. For example, agreeing with superiors’ decisions when faced with them in a meeting, a shared understanding about attending office functions, sharing information in the break room, etc.

These questions directly address the presence and perceived importance of normative values

14. Is trust an important factor in your decision-making process?

This question addresses external constraints on the decision-making process; it indirectly may prompt answers regarding power and hierarchical authority
15. How do you know when your team has reached closure regarding a product’s development?

_Direct question as to how group decisions are made when determining product outcomes._

**Interpreting the Data**

I will employ a coding scheme, checked by a co-investigator, to interpret the data. My co-investigator will independently examine the survey results and categorize the participants’ responses using a coding scheme. This coding scheme will identify “trigger” words and phrases that may correspond to factors addressed in the survey tool, such as power, workplace norms, deliberation, network relationships, and so on. Much like highlighting important phrases and concepts in a textbook, my co-investigator and I will extract those words and phrases that illustrate the codes. When our individual codes agree in 80% of the cases, they will be considered valid and authentic.

**The Coding Scheme**

A coding scheme is necessary for the open-ended survey. Respondents’ answers are neither predetermined nor restricted, thus allowing for various interpretations of the questions being asked. I developed the following coding scheme to provide guidance in interpreting the responses in a meaningful way.
Each question is listed below, and each is paired with a “Measure” and a “Scale.” The measure is a one- or two-word phrase used to categorize the responses in alignment with the objectives of the survey questions. For example, the first question and objective read as follows:

On average, how many team meetings (a team meeting is defined in this research as a group of employees who are working on a specific product or service) do you attend during one business week?

*This question provides a base for understanding the level of involvement the respondent has in the product development process.*

I first categorize each question to identify what measure the responses indicate. I categorize this question as “Engagement,” as the number of meetings a respondent attends during one workweek is a measure of the level of involvement an individual has in the product development process.

Next, I develop a scale to provide guidelines for interpreting the responses. A scale of 1 – 3 was chosen for this question. Numbers will be assigned comparatively, meaning all answers will be evaluated to determine “low,” “average,” and “high” levels of engagement. For example,

- “1” indicates relatively low levels of engagement
- “2” indicates relatively average levels of engagement
- “3” indicates relatively high levels of engagement

Each participant’s answers are provided on a separate sheet void of all identifying information. My co-investigator reads the responses and provides a coding value in the coding table. I develop this coding table to organize and collect my co-investigator’s and my results.
In the table, Survey Question 1 appears as follows:

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>On average, how many team meetings do you attend during one business week?</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEASURE</td>
<td>Engagement</td>
</tr>
<tr>
<td>SCALE</td>
<td>1 = Low Level 2 = Average 3 = High Level</td>
</tr>
<tr>
<td>CODING EXAMPLE:</td>
<td>CODING EXAMPLE:</td>
</tr>
<tr>
<td>Respondent 1</td>
<td>2</td>
</tr>
</tbody>
</table>
Questions 1 – 4:

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>MEASURE</th>
<th>SCALE</th>
</tr>
</thead>
</table>
| On average, how many team meetings do you attend during one business week? | Engagement | 1 = Low Level  
2 = Average  
3 = High Level |
| Within these team meetings, how are the participants chosen? | Stakeholders | 1 = Management Only  
(teams, clients, experts, etc.)  
2 = Stakeholders  
3 = Everyone |
| Does your input have greater, equal, or less impact on a final decision than your subordinates’ input? Please explain. | Impact (Superior) | 1 = Less Impact  
2 = Equal  
3 = Greater |
| Does your input have greater, equal, or less impact on a final decision than your superiors’ input? Please explain. | Impact (Subordinate) | 1 = Less Impact  
2 = Equal  
3 = Greater |

Questions 5 – 7:

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>MEASURE</th>
<th>SCALE</th>
</tr>
</thead>
</table>
| As a manager, do you feel your presence in meetings affects the way those team members who report to you make decisions? | Influence (on Others) | 1 = No Influence  
2 = Indecisive  
3 = Influence |
| If your superior is present in your team meeting, does his/her presence affect the way your team makes decisions? | Influence (on Self) | 1 = No Influence  
2 = Indecisive  
3 = Influence |
| How, as a manager, do you encourage your team to make decisions? | Process (Superior) | 1 = Find Consensus  
2 = Rely on Expertise  
3 = Default to Superior (self) |
Question 8 – 11:

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>How does your superior encourage you to make decisions?</th>
<th>What happens on your team if not all members agree on a proposed issue?</th>
<th>How much leeway is there to extend the decision-making timeframe in order to reach closure?</th>
<th>What factors most affect your workplace decisions? (time, money, workplace relationships, corporate policy, etc)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEASURE</td>
<td>Process (Subordinate)</td>
<td>Conflict</td>
<td>External Factors</td>
<td>External Factors</td>
</tr>
<tr>
<td>SCALE</td>
<td>1 = Find Consensus</td>
<td>1 = Consensus</td>
<td>1 = A Lot</td>
<td>1 = Budget/Time</td>
</tr>
<tr>
<td></td>
<td>2 = Rely on Expertise</td>
<td>2 = Vote</td>
<td>2 = Some</td>
<td>2 = Workplace Relationships</td>
</tr>
<tr>
<td></td>
<td>3 = Default to Superior</td>
<td>3 = Superior</td>
<td>3 = None</td>
<td>3 = Corporate Policy</td>
</tr>
</tbody>
</table>

NON-EXCLUSIVE:

1 = Budget/Time
2 = Workplace Relationships
3 = Corporate Policy
Questions 12-15:

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>HAVE YOU EVER MADE A WORKPLACE DECISION BASED MAINLY ON A SOCIAL RELATIONSHIP, SUCH AS FRIENDSHIP OR PEER PRESSURE? PLEASE EXPLAIN.</th>
<th>HOW IMPORTANT ARE WORKPLACE NORMS IN YOUR OFFICE?</th>
<th>WHEN MAKING A DECISION, IS TRUSTING TEAMMATES AN IMPORTANT FACTOR TO YOU?</th>
<th>HOW DO YOU KNOW WHEN YOUR TEAM HAS REACHED CLOSURE REGARDING A PRODUCT’S DEVELOPMENT?</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEASURE</td>
<td>NORMATIVE VALUES</td>
<td>NORMATIVE VALUES</td>
<td>EXTERNAL FACTORS</td>
<td>CLOSURE</td>
</tr>
<tr>
<td>SCALE</td>
<td>1 = No Important 2 = Somewhat Important 3 = Very Important</td>
<td>1 = Not Important 2 = Somewhat Important 3 = Very Important</td>
<td>1 = Not Important 2 = Somewhat Important 3 = Very Important</td>
<td>1 = Budget/Time 2 = Workplace Relationships (Consensus) 3 = Corporate Policy</td>
</tr>
</tbody>
</table>

In the following chapter, the results of the survey will be presented. I will interpret the results and provide a summary of the participants’ responses and the relevancy of the coding scheme. Following the presentation of results, I will apply the data to either confirm or deny my hypothesis based on the literature of SCOT, ANT, and the information economy.
Chapter IV: Presentation of Results

The open-ended survey produced very interesting, unanticipated results. Twenty-one respondents fully completed the online survey. The results were aggregated via Survey Monkey, the website used to manage the survey tool. Using the coding scheme detailed in Chapter 3, my co-investigator and I labeled each response with a measure. I analyzed the results to best interpret their relationship to the original hypothesis using the following categories:

- Engagement
- Status
- Power: Impact on Process
- Power: Influence on Others
- Conflict
- External Factors
- Normative Values
- Closure

These categories help to organize the data into themes and create a clearer picture of the results. The original hypothesis states the Social Construction of Technology model for product development cannot fully address the decision-making process in hierarchical organizations; in particular, the hypothesis indicates a need to understand the roles of power and normative values in the decision-making process. As such, the results of the survey were organized to evaluate the SCOT model as well as the hypothesized importance of power, values, and other external factors.
The Research Findings

The results of the survey revealed a variety of key takeaways regarding the product development process. Though the results certainly provide insight into the product development processes at a variety of firms, the results of the survey do not demonstrate consistent support for or denial of the hypothesis. Rather, the results indicate that the product development process is much more complex than this thesis anticipated, and the process cannot be understood with one set of survey responses alone. In effect, the research shows that select parts of the SCOT model, such as the inclusion of all relevant social groups in the process and reaching consensus as a decision-making method, are applicable to the product development process in hierarchical firms. However, as the hypothesis states, other external factors, such as time, money, and normative values, do play an important role in the process and cannot be excluded from the product development process.

A set of important findings was gathered from the data. Below is a brief list of the key points from the research, and each point is explicated in the remaining sections of this Chapter.

• Important stakeholders in a new project are actively involved in the decision-making process, not merely corporate leaders or small teams alone.
• Hierarchy (role/status) does impact how decisions are made and the ultimate outcomes of products.
• Product development teams demonstrate high regard for those workers with functional expertise; often, these people’s opinions carry more weight than even a superior’s opinions.
• Product development teams attempt to find consensus within the team when conflicts arise; in the event no consensus can be reached, power associated with hierarchy takes command.

• Time, money, and corporate policy are external factors that impact the decision-making process.

• Individuals do not explicitly identify a normative environment or social relationships as valuable, but respondents indirectly indicate a strong reliance on such norms and workplace relationships.

• Trust among colleagues is a highly valued quality within product development teams.

An in-depth researcher’s analysis is provided in the following sections of this Chapter. The anomalies of the research were not only interesting, but deserve further attention and may serve as an impetus for future research.

The Roles of Normative Values, Workplace Relationships, and Trust

Perhaps the most significant finding of the survey was not an issue directly addressed in the original hypothesis. Under the categories/measures of normative values and external factors, respondents were asked to provide information about their decision-making habits and processes. The questions focused on the importance of normative values; the effect that workplace relationships (such as friendships) had on the respondents’ decisions; and whether or not trust was an important aspect of the decision-making process and team dynamic.
A majority of the respondents answered that social relationships do not serve as the basis of workplace decisions, and that normative values are either “somewhat important” or “not at all important” to the decision-making process in their company. In contrast, 100% of those respondents who answered the question “When making a decision, is trusting teammates an important factor to you” indicated that trust was “very important” in making decisions.

These responses raise a number of questions. First, how does one explain the apparent contradiction between those respondents who felt that workplace relationships do not affect their decisions, but who find trust among teammates centrally important? Second, it begs the question of why respondents feel that social norms are not important in their workplace. The responses to these questions indicate that participants had negative feelings associated with maintaining workplace relationships, and allowing those relationships to affect one’s business related decisions. Based on analysis of the responses, this type of behavior was considered to be unprofessional. Instead, respondents believed it was appropriate to focus exclusively towards monetary success and business advancement. Little thought was given to how social relations and business success might be related. Hence the preferred environment was one in which workers make decisions based solely on the bottom line, budgetary concerns, or successful product launches. For example, one respondent stated, “While we have a collaborative, friendly team (we are friends outside of work), everyone understands that the bottom line is creating an excellent product. I feel that decisions must be based in logic and fit the vision and mission of the department. I expect my subordinates to at least understand that concept.” Given this preference for strict business relationships, the responses to the question about trust are quite curious, insofar as everyone—without exception—reiterated its utmost value. The question of
how trust was to be maintained in the absence of social relationships was not taken into account. Nor did respondents associate the establishment of trust relationships with workplace norms.

Such answers neither support nor deny the hypothesis of this thesis. Although respondents do not believe workplace relationships and norms affect their decisions, they do place a high amount of dependency upon trust within teams and groups. This thesis attempts to understand the roles of factors, such as a normative environment, on the development of products. The responses indicate that further research is necessary to truly understand the environments (both corporate and social) that exist for those people involved in the product development process, and how such environments positively and negatively affect the decisions regarding a product’s final design. Further detail regarding the implications for future research is provided in Chapter 5.

The Roles of Power and Status

To test the hypothesis that power plays an important role in the product development process at hierarchical firms, respondents were asked a series of questions regarding status, power, and hierarchy and the impact of such factors on the process. The findings with respect to this part of the research were not only unanticipated; they were also suggestive of a level of fluidity within the product development process that was not incorporated into the research design.

First, the SCOT model of product development suggests that all relevant stakeholders are included in the decision-making process. To find out whether this is applicable in hierarchical
firms, respondents were asked about who participates in product development meetings and how such participants are selected. The results indicate that the SCOT model indeed applies to the product development process in the workplaces of the survey participants. For example, a majority of respondents indicated that, on average, all relevant stakeholders participate in meetings regarding new products. The responses indicate that meeting participants include not only management, but also the functional team, clients, consultants, designers, and so on. Such diversity in roles and status suggest that all relevant groups that were deemed important to the product’s final outcome are included in the process.

Notwithstanding this tendency towards inclusiveness, respondents were sensitive to the status of actors in the corporate hierarchy. For example, when asked if a superior’s presence within a meeting affects the way decisions are made, a majority of respondents indicated that a superior’s presence does affect the dynamic of a group meeting. The survey did not aim to address whether this presence was positive or negative, but rather whether the roles of different leaders within a hierarchy are associated with certain levels of power and influence. Managers reported that they believed their own presence within a group meeting with subordinates also affected the way the team made decisions. Such influence over a process is important to note, particularly given that people representing a variety of roles are included in product development meetings. Further research on how status influences team meetings and product development decisions would be an important and worthwhile addition to this research.

The impact of hierarchy on the decision making process is not, however, consistent over time; at a minimum in the early stages, it increases as the process comes to a closes. For example, when respondents were asked about how decisions regarding a new product or
technology are made within a team, they said that teams generally work towards finding consensus on an issue. Moreover, managers reported that they encourage teams to gather all possible information, work together to address problems and issues in the product’s design, and come to an agreement regarding the final outcome. In addition, many noted that functional expertise often trumps hierarchical status, so that experts tend to be among the most highly valued members of the product development team. For example, if a team agrees that one member has worked on the product for a long time, knows the product and is invested in the design implications, that team member may gain more power and influence than another team member of equal or greater hierarchical ranking.

At the same time, roles within teams may adjust as the product development process continues. The survey results indicate that time and budgetary concerns have a huge impact on how decisions are made. Thus, as time becomes much more constrained and the budget is tighter, there is a shift back to a reliance on hierarchy. For example, if a team is struggling with moving forward with a design and time is limited, even those with functional expertise fall back into a subordinate role and a superior’s decision will ultimately determine the outcome of that particular aspect of the design. The respondents indicated that time is an important factor in the development process, thus affecting the amount of time a team has to come to a consensus. In the event a consensus cannot be reached within the timeframe allotted or within the budget constraints, a superior’s decision will be final.

Again, the results of the survey do not demonstrate consistent support for, or denial of, the hypothesis. Though hierarchy and power do play a role, they are not consistently the “iron hand” of hierarchical organizations, as evidenced by the reliance upon those team members with
functional expertise. However, the results are not conclusive. They suggest that the approach to examining the product development process cannot be viewed as one consistent process. Rather, it must be viewed in stages, allowing the fluidity of power and status to shift as other factors, such as time and money, impact the process.

**External Factors and Closure**

In order to best understand the decisions that are made in the product development process, it was important to gather information regarding those factors that impact such decisions. Respondents were asked to name factors that affected their decisions, such as time, money, corporate policy, and workplace relationships. The factors with the largest impacts on the most respondents were budget and time. Many respondents also named factors such as product quality, corporate protocol, and client requests. Such factors were categorized and coded as “Corporate Policy.”

Interestingly, but not so much surprising given the other results of the survey, workplace relationships were not included as a factor that impacts respondents’ workplace decisions. However, as a researcher, I cannot conclude that such relationships do not impact respondents’ decisions based on the contradictions described above. Further research focused on the impact of workplace relationships on decisions would provide more concrete evidence on this matter. However, this survey clearly indicated that time, money, and corporate policies are all external factors that impact the product development process.
The responses from this section of the survey directly support the hypothesis that such external factors exist and must be considered when examining the product development process. The SCOT model, as previously noted, does not take such factors into account, suggesting that teams would have an unending amount of time to make decisions and reach consensus (as evidenced in the 19-year bicycle account). However, external factors do indeed create situations where developers feel pressured. Such factors thus create the scenario in which hierarchy matters, such as when a team cannot reach consensus within the allotted time, requiring a superior to move the project along to the next stage in the process.

It is these same factors, time, money and corporate policy, which are also help determine a project’s closure. Thus, respondents indicated that they knew a project was complete when they successfully completed all of the steps in the corporate policy regarding product development, when money ran out, or when they were forced to complete a product because of deadlines. The most-cited reason for acknowledging the completion of a product’s design was the successful completion of protocols. Respondents provided the following answers regarding the acceptance of closure of a product’s development: “We document and mark a product as complete on our task & timeline tracking document,” and “We regularly review our acceptance criteria. It is when our acceptance criteria are met that we know we are done,” and “We have met all of the success criteria targets established, or have provided valid justification for any that were not met.”

Such reliance on corporate policy again demonstrates the influence of external factors in determining when a product is complete. This finding supports the hypothesis, and shows that the SCOT model, wherein relevant stakeholders know a product is complete when all problems
have been solved and there is consensus among the team, would not be a realistic model for product development in hierarchical firms that face pressure to produce.

**Concluding Analysis of Results**

The results of this survey neither support nor deny the hypothesis at-large. Rather, the results indicate that the product development process is much more complex than this thesis anticipated, and the process cannot be understood with one set of survey responses alone. However, the results demonstrate important findings about the perceived influence of workplace relationships, how such relationships are understood, and the need to further investigate the role of social relationships within the corporate environment. The findings also have important implications for the understanding of hierarchy and power and the non-static nature of these characteristics in organizational structures. As noted previously, this research suggests that power and influence are fluid and change as individuals’ role in the product development process changes.

This chapter has presented the results of the survey. Chapter 5 will elaborate on the implications for further research. In that chapter, I will also address the challenges associated with this research and suggest best practices for future product development research.
Chapter V: Conclusion

Importance of Research Findings

In an effort to evaluate the SCOT model of product development, this thesis has examined the design and development of products in hierarchical organizations. Building on survey data, the research reached a number of interesting conclusions about the influence of hierarchical power and status within teams, as well as provided new insight on decision-making methods within the product development process. The research question asked how individuals and teams in vertically structured organizations handle such issues as team member selection, debate, conflict, and external pressures such as time and money. The thesis addressed the seeming paradox between the consensus-based SCOT model of product development and the needs of hierarchical organizations to come to rapid development decisions in today’s complex economy. This research not only sheds light on the applicability and relevancy of the social construction of technology model; it also enhances our understanding of the process by which firms create new products and artifacts.

This kind of insight into the product development process is becoming increasingly important in today’s highly competitive global economy, where first movers reign and speed of delivery is often the key to success. To understand how individuals within the process make decisions, come to conclusions, debate and decide on a final outcomes may provide a foundation on which further discussions and research can refine and enhance the process. This thesis research also provides a better understanding of how modern firms behave.
As a researcher, I began this process with many assumptions about the ways hierarchical firms operated, as well as about the behavior of individuals within those firms. By pursuing this thesis, I was able to get a more nuanced perspective about how firms operate, even under duress. The results show an unanticipated emphasis on group dynamics, on trust, and on finding consensus.

In terms of the theoretic framework employed in this thesis, the conclusions of the research both affirms and critiques the use of the SCOT model for product development. As previously expressed, the research shows that specific portions of the model are indeed still applicable in large-scale firms, and in fact some parts of SCOT are already functioning within firms’ processes. However, other parts of the SCOT model, such as the presumption of limitless time and lack of budget constraints, proved contrary to the experiences of modern firms that face significant external pressures.

Limitations of the Research

Despite such interesting results, this research has its limitations. A major problem was the limited time and resources available to pursue the research question in considerable depth. Without institutional support, it was difficult for me, a sole researcher, to gain access to the firms, organizations, and individuals who might be willing to participate in the survey research. Often, the product development process is closely guarded in an attempt to protect new ideas, developments, and technologies. In my case, I was unable to collect as many surveys as I had hoped. When coupled with a small window of time in which to distribute, gather, and analyze the
results, survey research of this kind is a limited resource. Nonetheless, I do feel that the final the findings are significant and can serve as a basis for more long-term detailed research.

Were I given the opportunity, I would take a new approach to understanding the product development process. For instance, rather than looking at the entire scope of the process, I would divide the range of the project into smaller, compartmentalized portions of research, such as initial product brainstorming, product design, evaluation of design, functional testing, and so on. This would track my finding that while consensus played an important role in the initial product development stages, hierarchy took over as pressures mounted to complete the projects.

Similarly, after finding that trust was highly valued, while norms and interpersonal relationships were not, I would to delve more into the behavioral aspects of the development process. In particular, I would try to follow up the survey process with a number of interviews and/or focus groups to assess why the participants discounted the social aspects of coordination.

**Implications and suggestions for further research**

Research focused on these issues might provide the firms and individuals involved in the product development process new insights about how to improve their final products. For example, if—as I found—the individuals on a team shift their behaviors when managers or superiors are present, firms might be inclined to reconsider how participants for team meetings are selected. Further research on the how status influences team meetings and product development decisions would also be an important and worthwhile addition to this research. As well, there might be further research exploring in depth how workplace relationships affect team
decisions. In particular, the reticence of the participants in my survey to discuss interpersonal relationships in the business environment suggests the need to explore the reasons behind it. Equally beneficial would be inquiries into the way that power and influence is employed, and by whom, at different stages of the development process.

**Final Notes**

As indicated by the vast number of new technologies and products produced by modern firms and organizations, the product development process will certainly continue to adapt and adjust to new developments and further research findings. It is my hope that this thesis might serve as a catalyst for further investigation into how to improve this process. Value must be assigned to the social aspect of such technologies, as Pinch and Bijker express in their literature, and understanding the process by which new products are designed and constructed for the society in which they’re adopted is a critical piece of successful product design.

It is equally important to highlight this research’s findings regarding the use of teams, consensus, and functional expertise within the process. This insight suggests that there is a return to small, close-knit networks within firms. Such close-knit networks have been researched in other areas of economics and technology, and research on these networks of individuals may also indicate the direction in which product development is heading. As the modern economy continues to shift, uncovering the black box of product development and the elaboration of the process will continue to pose important questions regarding organizational culture, society-at-large, and the behavior of individuals within networks of development.
APPENDIX A: The Survey (print version)

This survey seeks to examine the decision-making process about the development of products and services within hierarchical firms. You have been selected for this survey because of your position within a product-development firm.

There are 15 open-ended questions that ask you to reflect upon the ways in which you, as an individual, make a decision about products and the factors that you consider important when making such decisions. Please answer honestly and openly, and I thank you for your participation. Your input is important to my research.

Survey Questions:

1. On average, how many team meetings (a team meeting is defined in this research as a group of employees who are working on a specific product or service) do you attend during one business week?

2. Within these team meetings, how are the participants chosen?

3. Does your input have greater, equal, or less impact on a final decision than your subordinates’ input? Please explain.

4. Does your input have greater, equal, or less impact on a final decision than your superior’s input? Please explain.
5. As a manager, do you feel your presence in meetings affects the way those team members who report to you make decisions?

6. If your superior is present in your team meeting, does his/her presence affect the way your team makes decisions?

7. How, as a manager, do you encourage your team to make decisions?

8. How does your superior encourage you to make decisions?

9. What happens on your team if not all members agree on a proposed issue? For example, if your superior defines a product in one way, but your team defines it in another, what is the process by which a decision about this product will be made?

10. How much leeway is there to extend the decision-making timeframe in order to reach closure?

11. What factors most affect your workplace decisions? (time, money, workplace relationships, corporate policy, etc)
12. Have you ever made a workplace decision based mainly on a social relationship, such as friendship or peer pressure?

13. How important are workplace norms in your office? Norms are those workplace behaviors that employees generally adhere to, though the behaviors are not corporate policy. For example, agreeing with superiors’ decisions when faced with them in a meeting, a shared understanding about attending office functions, sharing information in the break room, etc.

14. Is trust an important factor in your decision-making process?

15. How do you know when your team has reached closure regarding a product’s development?
<table>
<thead>
<tr>
<th>QUESTION</th>
<th>MEASURE</th>
<th>SCALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>On average, how many team meetings do you attend during one business week?</td>
<td>Stakeholders</td>
<td>1 = Management Only</td>
</tr>
<tr>
<td></td>
<td>Impact (Superior)</td>
<td>2 = All Stakeholders</td>
</tr>
<tr>
<td></td>
<td>Influence (Others)</td>
<td>3 = Everyone</td>
</tr>
<tr>
<td>Does your input have a greater, equal, or less impact on a final decision than your subordinates' input? Please explain.</td>
<td>Engagement</td>
<td>1 = Less Impact</td>
</tr>
<tr>
<td></td>
<td>Impact (Subordinate)</td>
<td>2 = Equal</td>
</tr>
<tr>
<td></td>
<td>Influence (on Self)</td>
<td>3 = Greater</td>
</tr>
<tr>
<td>Does your manager's presence in meetings affect the way your team members value you? Please explain.</td>
<td>Influence (on Self)</td>
<td>1 = No Influence</td>
</tr>
<tr>
<td></td>
<td>Influence (Others)</td>
<td>2 = Indecisive</td>
</tr>
<tr>
<td></td>
<td>3 = Influence</td>
<td></td>
</tr>
<tr>
<td>APPENDIX B: The Coding Scheme</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If your superior is present in your team meeting, does his/her presence affect the way your team makes decisions? | Influence (on Self) | 1 = No Influence |
|                                                                 | 2 = Indecisive |
|                                                                 | 3 = Influence  |

As a manager, do you feel your presence in meetings affects the way those team members who report to you make decisions? | Influence (on Self) | 1 = No Influence |
|                                                                 | 2 = Indecisive |
|                                                                 | 3 = Influence  |

Does your input have greater, equal, or less impact on a final decision than your superiors' input? Please explain. | Impact (Superior) | 1 = Less Impact |
|                                                                 | 2 = Equal |
|                                                                 | 3 = Greater |

Within these team meetings, how are the participants chosen? | Stakeholders  | 1 = Management Only |
|                                                             | Impact (Superior) | 2 = All Stakeholders |
|                                                             | Influence (Others) | 3 = Everyone    |

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<table>
<thead>
<tr>
<th>How, as a manager, do you encourage your team to make decisions?</th>
<th>How does your superior encourage you to make decisions?</th>
<th>What happens on your team if not all members agree on a proposed issue?</th>
<th>How much leeway is there to extend the decision-making timeframe in order to reach closure?</th>
<th>What factors most affect your workplace decisions? (time, money, workplace relationships, corporate policy, etc)</th>
<th>Have you ever made a workplace decision based mainly on a social relationship, such as friendship or peer pressure? Please explain.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process (Superior)</td>
<td>Process (Subordinate)</td>
<td>Conflict</td>
<td>External Factors</td>
<td>External Factors</td>
<td>Normative Values</td>
</tr>
<tr>
<td>1 = Find Consensus</td>
<td>1 = Find Consensus</td>
<td>1 = Find Consensus</td>
<td>1 = A Lot</td>
<td>1 = No</td>
<td>1 = Budget/Time</td>
</tr>
<tr>
<td>2 = Rely on Expertise</td>
<td>2 = Rely on Expertise</td>
<td>2 = Majority Opinion</td>
<td>2 = Some</td>
<td>2 = Indecisive</td>
<td>2 = Workspace Relationships</td>
</tr>
<tr>
<td>3 = Default to Superior (self)</td>
<td>3 = Default to Superior (self)</td>
<td>3 = Default to Superior</td>
<td>3 = None</td>
<td>3 = Yes</td>
<td>3 = Corporate Policy</td>
</tr>
<tr>
<td>Normative Values</td>
<td>External Factors</td>
<td>Closure</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>------------------</td>
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<tr>
<td><strong>How important are workplace norms in your office?</strong></td>
<td><strong>When making a decision, is trusting teammates an important factor to you?</strong></td>
<td><strong>How do you know when your team has reached closure regarding a product’s development?</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 = Not Important  
2 = Somewhat  
3 = Very Important

1 = Not Important  
2 = Somewhat  
3 = Very Important

**NON-EXCLUSIVE**  
1 = Budget/Time  
2 = Workplace Relationships (Consensus)  
3 = Corporate Policy
Bibliography


