

# CHALMERS



## The diffusion of Impact drivers in the Swedish construction industry

*Master of Science Thesis*

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## Abstract

This case study provides a context specific application of the factors affecting diffusion identified by Rogers (2003) to the diffusion of Impact drivers in the Swedish construction industry. These factors are: *Change agent effort*, *Type of innovation decision*, *Perceived attributes of the innovation*, *Communication channels* and *Nature of the social system*. In contrast with most diffusion studies, the study is conducted in an ongoing diffusion process and also contains a supply side perspective on which factors that can be successfully affected in order to increase the diffusion and adoption rate. By using mixed methods research including unstructured and semi-structured interviews together with a self-completion questionnaire and secondary analysis, the context specific factors are described. The data includes questionnaire responses of over 80 adopters and non-adopters in the Swedish construction industry.

The analysis identifies factors inhibiting, neutral and enhancing to the diffusion of Impact drivers in the Swedish construction industry. Interestingly, *Change agent effort* is the factor inhibiting, while *Communication channels* is a neutral factor to the diffusion. Both the *Nature of the social system*, *Type of innovation decision* and *Perceived attributes of the innovation* are factors enhancing the diffusion of the Impact driver. The findings include a surprisingly low focus from possible change agents and show the strength of the internal communication within the Swedish construction industry. The proposed supply side interventions include actions to affect the perceived attributes of Impact drivers through a more consistent message communicated through additional communication channels along with the utilization of opinion leaders. Future research is suggested around the boundaries of the investigated factors, since this study finds many of them overlapping, as well as around methods of identifying opinion leaders.

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# 1 Introduction

*This section functions as an introduction to the research problem along with the purpose of this Master Thesis.*

## **1.1 Background**

The way an innovation spreads on a market has been investigated by several scholars during a long period of time (for example: McVoy, 1940; Rogers, 1962, 1983, 1995, 2003; Ostlund, 1974; Mahajan & Muller, 1979; Tornatzky & Klein, 1982; Valente & Davis, 1999; Scott, et al., 2008). The subject of innovation diffusion has been, and still is, of great interest for academia and span over several research fields. The most prominent scholar on the topic of innovation diffusion is Everett M. Rogers, who synthesized the findings of over 500 diffusion studies in his book *Diffusion of Innovation* from 1962. Rogers presents five factors that determine an innovation's rate of adoption: type of innovation decision, attributes of an innovation, nature of the social system, change agent efforts and communication channels. Each of the five factors has, in its own right, been the subject of numerous research studies regarding the diffusion of an innovation: Moore and Benbasat (1991) investigated the perceived attributes of an IT innovation; Scott, et al. (2008) studied the impact of communication channels on the diffusion of a hygiene innovation in Ghana; and Kelly, et al. (1991) analyzed the use of opinion leaders in the reduction of HIV among gay men in the United States of America. However, few research studies embrace a holistic view where all five factors are being investigated within the same diffusion study and instead often investigate one particular factor more thoroughly. In addition, as noted by Valente (1999), most innovation diffusion studies have been retrospective and therefore neglected to investigate the possibility of accelerating the diffusion of innovations.

The inherent uncertainties of introducing and spreading an innovation in a new market have been the focus and interest of not only academic scholars but naturally also business managers. The commercial success of new products are among the top priorities of firms and crucial for surviving in the business world. The firm in focus of this research is the Swedish branch of the international tool producer Hilti. Hilti Sweden is a premium provider of various hand tools and accessories for the Swedish construction industry. During 2006, Hilti Sweden launched a cordless Impact driver called SID 121-A. This tool was based on a totally different technology than the existing cordless drill drivers that are conventionally used for driving bolts and screws.

The Impact drivers have since reached high market penetration in certain markets, such as the Japanese and North American. However, the progress in the Swedish market has been perceived by Hilti Sweden as relatively slow. This has yielded interest from Hilti Sweden in conducting a more thorough investigation of the factors affecting the diffusion of Impact drivers in Sweden within the frames of a Master Thesis. With a deeper knowledge of the five factors Rogers proposed, the mechanics of the diffusion of a specific innovation can be understood and the adoption rate accelerated by a firm supplying the innovation.

## **1.2 Purpose**

The purpose of this Master Thesis is to describe the major factors that affect the diffusion of Impact drivers in the Swedish construction industry as well as the identification of factors that can effectively be targeted by the supply side in order to increase diffusion.

The intended contribution to academia consists of a context specific application of general diffusion theory in an ongoing diffusion process in order to identify potential limitations of current literature.

### ***1.3 Delimitations***

In order to achieve the purpose in the given time frame, certain delimitations were necessary to apply. Firstly, only the general contractor segment of the construction industry will be investigated. This is done to avoid specialized sub trades such as electricians, masonries or others that are involved in very different application areas than the rest of the industry. Secondly, the study is focused around the professional market, which means that only professional manufacturers, retailers and rental services will be investigated and the private, "do it yourself" segment will be excluded. Thirdly, while there exist variations of Impact drivers, such as pneumatic or corded, the focus is around the cordless, electrical Impact driver since this is the type that has shown the most sales increase in recent years. Therefore, all other Impact drivers will be excluded.

### ***1.4 Disposition***

Since the formulation of the research questions is based on previous literature, the research questions will be presented after the literature section followed by a method section explaining the research methods utilized in achieving the purpose and answering the research questions.

## **2 Literature study**

*This section aims to give an introduction to the diffusion research field as well as the areas relevant to the purpose of this Master Thesis.*

Research concerning the diffusion of innovations started as early as the 1940's (E.g McVoy, 1940). What started as independent clusters of research has over the years emerged as a well established research field spanning over several research traditions such as sociology, marketing and geography to name a few. The most prominent work in the field of diffusion research is the five editions (1962, 1971, 1983, 1995 and 2003) of Everett. M. Rogers' book "Diffusion of innovations" which draws from an enormous amount of various diffusion studies.

### **2.1 The innovation**

Central to the diffusion theories is the innovation. While the popularity of the term innovation has escalated and is used in a vast amount of topics, its definition is somewhat debated and related to what particular research field that defines it (Baregheh et al, 2009). Rogers (2003, pp 12) uses the following definition: "An innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption. It matters little, so far as human behaviour is concerned, whether or not an idea is "objectively" new as measured by the lapse of time since its first use or discovery.". However, several scholars have sought to extend this definition to include a dimension of commercial success (E.g Luecke & Katz, 2003). Since the innovation of study in this Master Thesis is both new to the market and has, at the time of print, sold in reasonable amounts already, the Impact driver technology seems to fit within the frames of both Rogers' and extended definitions.

### **2.2 The diffusion process**

Katz, Levin and Hamilton (1963) define the diffusion process as "the acceptance over time of some specific item (idea or practice) by individuals, groups or other adopting unit linked to specific communication channels, social structure and system of values or culture". As such, the diffusion process refers to the spread of an innovation across a universe of potential adopters. Closely related to the diffusion process is an innovation's rate of adoption, i.e. the relative speed with which an innovation is adopted by members of a social system. The two concepts are somewhat overlapping, but adoption research focuses more on the characteristics and behaviors of the adopter while diffusion research focuses on accelerators and barriers to the spread of an innovation through a population (Rogers, 2003). Within this context rate of adoption and diffusion is seen as interchangeable concepts in the sense that factors affecting the rate of adoption also affects the diffusion of an innovation and vice versa.

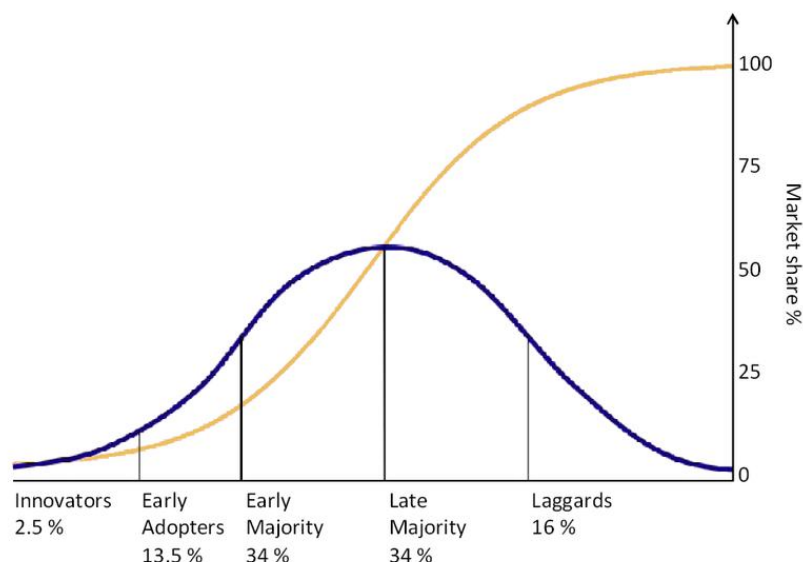
Although the ultimate decision to adopt is made by the demand-side, the benefits and costs can be affected by decision made by the supply-side and therefore the resulting diffusion process is a mixture of both supply-side and demand-side decisions (Hall & Khan, 2003).

### **2.3 Models of diffusion and adoption**

An early observation concerning the diffusion of an innovation was that when plotted against time, the aggregated rate of adoption often formed an "S-shaped curve" (E.g Rogers, 2003; Geroski, 2000). This has been proven valid for so many innovations as it has become a

stylized fact in diffusion theories. The reason, however, is debated. Geroski (2000:pp 615) notes that “there are actually many ways to shape an S-curve”. The most common explanation is found in the epidemic model, which assumes that the only driving factor for diffusion is information, and that this information is transferred in a system only through interpersonal communication (Mahajan & Muller, 1979). While a mathematical formulation of such a system indeed forms an S-curve, the simplicity and drawbacks of the model has yielded competing explanations. Examples of such rival explanatory models are the probit model which focuses on the individual differences of the inhabitants in a system (Geroski, 2000) or more specialized models such as the Technology Acceptance Model (TAM) presented by Davis (1986) which focuses on the individual user acceptance of new information technologies. Rogers (2003) incorporates both individual perceptions and information spread in his model of diffusion.

The same adoption data presented as the frequency of adoption per time unit often forms a “bell shaped curve”. This has been utilized in order to sort the adopters into categories according to relative innovativeness. While there has been some disarray of names of different adopter categories, the dominant categorization is the following: innovators, early adopters, early majority, late majority and laggards. Figure 1 below presents the S-curve and Bell-curve as well as the percentage of the total market each category represents.



**Figure 1. S-curve and Bell-curve (Rogers, 2003)**

While the categories of innovativeness were originally proposed for individuals, research has shown that organizations can be divided into similar categories (Walker, 1969; Fell, 2003). However, the generalizations that can be drawn from the adopter categories differ between individuals and organizations. Rogers (2003:pp 409-413) draws the following generalizations about organizational innovativeness: “Larger organizations are more innovative”, “Degree of centralization is negatively correlated to innovativeness”, “Degree of formalization is negatively related to innovativeness”, “Interconnectedness is positively correlated to innovativeness” and “Organizational slack is positively related to innovativeness”.

### **2.3.1 Categories of innovativeness in the construction industry**

While the previously presented categorizations and generalizations are very broad, there has been specific research within a construction industry context. Pries and Janszen (1994)

investigated the impact of the environment on the innovativeness of firms operating in the construction industry. As an additional finding they note that 75% of the innovations stem from minor companies, which contradicts Rogers' (2003) generalization that larger companies are more innovative. This observation is also made by Kramer et al (2009) who found that smaller companies within the construction sector had a greater tendency to adopt an innovation with ergonomic benefits.

Further investigation of the construction industry context has been conducted by Gore (2010) who tries to develop a framework for categorization of firms in the construction industry related to their innovativeness. Gore notes that the conventional categorizations methods involve very labor intensive data collection and that the reliance on either the adoption of a specific innovation or the accumulated adoption of several innovations is too limiting in order to estimate the innovativeness of a firm.

Concluding the categories of innovativeness is the fact that while an investigation performed post-hoc diffusion of a specific innovation can yield categorization for that specific case, those categories cannot be proven valid externally. Further, while it would be interesting to investigate what categories that have adopted the Impact driver technology, the work of Gore (2010) and others prove that the innovativeness is a multifaceted construct that is not currently understood to such a degree that such an investigation would be feasible within this Master Thesis.

## ***2.4 The innovation decision process***

The diffusion of an innovation can be seen as the cumulative decisions of inhabitants of a system to either adopt or reject an innovation. Because of this, the decision process of an individual or firm is central to properly understand the diffusion process. Rogers (2003: pp 168) describes this process as “the process through which an individual (or other decision-making unit) passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision”. The innovation decision process is modeled by Rogers (2003) as five stages; knowledge, persuasion, decision, implementation and confirmation. This model of the innovation decision process has been utilized in several diffusion studies (E. g Kendall et al, 2001; Halfens et al, 2001) and has been proven useful under very different circumstances.

In the knowledge stage, the individual is exposed to an innovation's existence and gains an understanding of how it functions. This information can either reach the individual passively or he can be actively seeking the information due to a prior need for the innovation. The information processing activity serves the purpose of reduce the uncertainty for a potential adopter towards the innovation. Rogers (2003) labels three types of knowledge of a potential adopter in the initial decision process, *awareness-knowledge*, *“how-to” knowledge* and *principles-knowledge*. The awareness-knowledge is naturally the first type, which is information that the innovation exists. Awareness-knowledge can bring the potential adopter to seeking the two other types of knowledge. “How-to” knowledge is information regarding how to use an innovation properly. The amount of “how-to” knowledge needed prior to trial or adoption is largely due to the complexity of the innovation. Without the required amount of “how-to” knowledge, the potential adopter will likely reject the innovation. Principles-knowledge is information concerning the principles and fundamentals of the innovation. For example, knowledge about microelectronics is crucial in order to understand why a computer

works. Principles-knowledge increases the ability of a potential adopter to judge the effectiveness of an innovation. However, Rogers notes that it most often is possible to adopt an innovation without the principles-knowledge.

In the persuasion stage, the individual forms a favorable or unfavorable attitude toward the innovation. The meaning of the term “persuasion” in this stage is not the induced attitude change by an external part but rather formation of attitude on the part of the individual. In this stage, the individual actively seeks relevant information of the idea and develops its general perceptions of the innovation (Rogers, 2003).

The decision stage takes place when an individual engages in activities that lead to the decision to adopt or reject an innovation. The possible rejection is not always a terminal decision but might rather be the exertion of an “option to wait” and adopt at a later time (Hall & Khan, 2003). Similarly, the decision to adopt might yield a later decision to discontinue the use of the innovation, i.e. moving from adopter to non-adopter. The innovation decision can be authoritative, optional or collective (Rogers, 2003).

Since the purpose of this thesis is to investigate factors that affect the adoption and diffusion of Impact drivers, the two last stages (implementation and confirmation) will not be covered within this literature review.

**2.5 Factors affecting the rate of adoption**

Since the diffusion of an innovation can be seen as the aggregated decisions of individuals to adopt the factors influencing the rate of adoption is also affecting the diffusion of an innovation. Rogers (2003) has compiled a model of the major factors affecting the rate of adoption of innovations based on an enormous amount of diffusion studies. An overview of these factors and the relations between them is found below inFigure 1Figure 2.

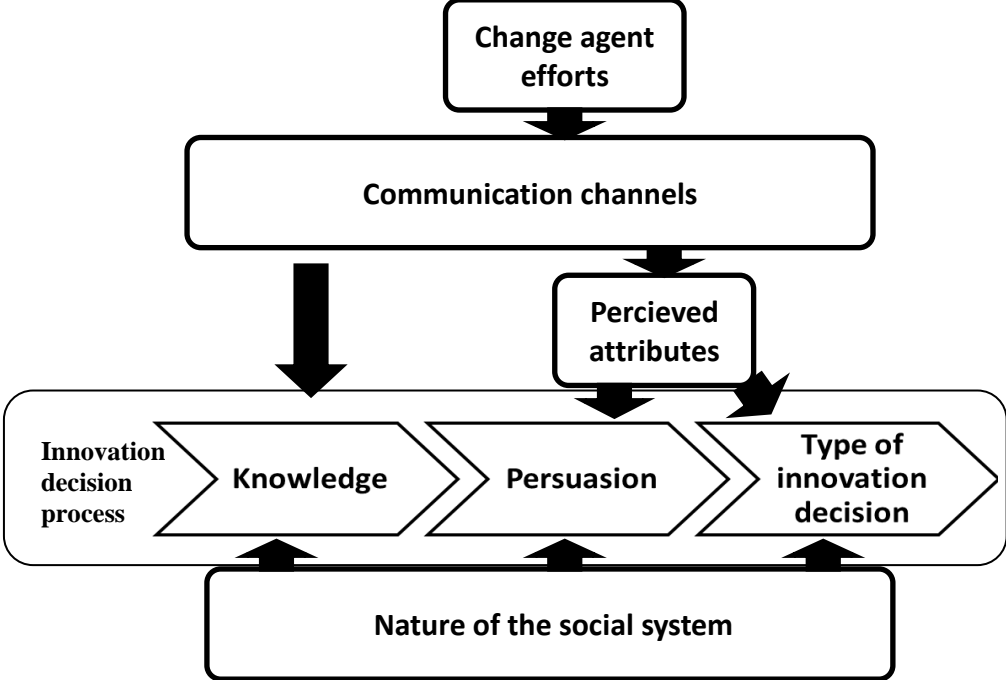


Figure 2. Overview of factors affecting the rate of adoption (Rogers, 1995)



The factors presented in the model are a mixture of both individual-level and system-level factors, thus avoiding focusing solely on either adoption or diffusion. The following sections describe each factor more in-depth and incorporate the views of other scholars in the diffusion field.

### **2.5.1 Perceived attributes of the innovation**

The factor of highest importance to the rate of adoption of innovation has been described by several scholars as the perceived attributes of the innovation (E.g Ostlund, 1974; Rogers, 2003; Moore & Benbasat, 1991). According to Rogers (1995) from 49 to 87 percent of the variation in the rate of adoption is explained by the perceived attributes of the innovation. This is naturally also the factor receiving the most attention from scholars in the past (see for example: Agarwal & Prasad 1997; Tornatzky & Klein, 1982). One of the more influential studies was conducted by Moore & Benbasat (1991), whom developed a rigorous instrument designed to measure the perceived attributes of Personal Work Stations. However, Rogers (2003) argues that the research by Moore & Benbasat can be applied to any particular innovation with the proper adaptation. Flight et. al. (2011) identifies two important practical reasons for measuring the perceived attributes of innovation: to identify problems that may hinder the diffusion and opportunities to solve these problems.

The attributes of an innovation are characteristics inherent to the innovation or the usage of the innovation. A general distinction among attributes is primary and secondary attributes (Moore & Benbasat, 1991). Primary refers to the attributes inherent to the innovations, like size and weight. Secondary attributes are context dependent, complexity being an example of this. However, Downs & Mohr (1976) argue that this distinction creates inconsistencies as primary attributes are in fact also perceptual. Even attributes inherent to the innovation, such as size, cost or weight are perceived in different ways depending on the setting (Downs & Mohr, 1976). For example, cost is perceived differently depending on the financial resources of the potential adopter (Tornatzky & Klein, 1982). Therefore, what ultimately affects the rate of adoption, from an attribute point of view, is the adopter (or non-adopter) perception of attributes and not the attributes classified by change agents or experts (Rogers, 2003).

After analyzing several innovation studies, Rogers (1983) derived five general and conceptually independent attributes of innovations linked to adoption behaviour. The main attributes described by Rogers are: relative advantage, compatibility, complexity, trialability and observability.

#### **Relative advantage**

The relative advantage refers to the perceived value of an innovation relative to the previous idea used to perform the same tasks. Relative advantage is essentially rather broadly based as it covers the perceived values or gains and the cost of adoption. Agarwal & Prasad (1997) break down relative advantage into ease of use, quality improvements, effectiveness and increased control. Flight et al. (2011) on the other hand, refers to Cooper (1979) whom defines relative advantage as uniqueness of features, higher quality, ability to meet needs and reduce cost.

Rogers (2003) research findings shows that the relative advantage dimension is positively related to the rate of adoption of an innovation. Empirical studies also show that relative

advantage is the most significant dimension influencing innovation adoption (Holak & Lehmann, 1990).

### **Compatibility**

The second attribute, compatibility, is defined as the extent to which the innovation is coherent with the adopter's values, past experiences and needs (Moore & Benbasat, 1991). Rogers (2003) identified three areas of compatibility of an innovation, namely: sociocultural values and beliefs; previously introduced ideas; and client needs for the innovation. Compatibility is positively related to the rate of adoption of an innovation, i.e. the more compatible with the values, needs and beliefs the higher likelihood of future adoption (Agarwal & Prasad, 1997; Moore and Benbasat, 1991; Rogers, 2003).

### **Complexity**

Complexity is the degree to which an innovation is perceived as difficult to use and understand (Rogers, 2003). Moore and Benbasat (1991) translate the complexity dimension into a construct called "ease of use", which is measured by source of frustration, degree of mental effort required, degree of learning required and ability to control outcome. Complexity is negatively related to the rate of adoption of an innovation and acts as a barrier to the interaction with the innovation (Rogers, 2003).

### **Trialability**

The definition of trialability as an attribute is the degree to which the potential adopter has an opportunity to try out and experiment with the innovation before the adoption decision (Agarwal & Prasad, 1997). Rogers (2003) states that an innovation that is accessible to the potential adopters for experiments are more rapidly adopted than innovation counterparts. Thus, trialability is positively related to the rate of adoption of an innovation. Moore and Benbasat (1991) measured trialability through the access of the innovation for trial before the adoption decision and the time span of the trial period.

### **Observability**

Observability is the degree to which the results of using an innovation are visible and communicable to other potential adopters. This dimension is positively related to an innovation's rate of adoption. Due to high complexity, Moore and Benbasat (1991) split this dimension into two new items: result demonstrability and visibility.

### **Other attributes**

It is not unusual to add more factors where relevant. E.g Moore and Benbasat (1991) added three more categories while investigating the diffusion of personal working stations. Tornatzky & Klein (1982) found the 10 most prominent attributes from 105 different diffusion studies. Apart from the five abovementioned, the attributes identified were: cost, communicability, divisibility, profitability and social approval. Moore and Benbasat (1991) argue that the attributes chosen should reflect the innovation, the potential adopters and the decision process.

## **2.5.2 Communication channels**

Different communication channels affect the rate of adoption of innovations and are defined as the means by which a message gets from a source to a receiver. According to Rogers (2003) communication channels are present in all stages of the innovation decision process of a potential adopter. Further, various types of communication channels are variously effective

and play different roles in certain stages of the decision process. This is supported by Nilakanta and Scamell (1990) that investigated the effect of communication channels on the diffusion of database development environment and observed that while no single communication channel was significantly affecting the diffusion through the whole process, various channels were important through different stages.

Communication channels can both be used to create knowledge as well as to persuade attitude changes towards an innovation. A useful way of dividing communication channels is into mass media and interpersonal channels. In the awareness phase of the innovation-decision process, i.e. when a potential adopter first learns about the existence of an innovation, mass media channels tend to be more effective in reaching a large audience of potential adopters quickly. These channels generate awareness-knowledge, which is mostly general information about the innovation, however, some weakly held attitudes can be changed using mass media channels (Rogers, 2003).

Interpersonal channels provide a two-way exchange of information between two or more individuals and are thus more specific for the information need of the potential adopter. This is linked to the persuasion and decision phase of the innovation-decision process. Interpersonal channels are more effective in changing strongly held attitudes (Rogers, 2003).

Scott et al (2008) investigates how different communication channels affected the diffusion of hygiene behaviors in Ghana and presents some interesting findings. Firstly, the combined effect of two mass media channels (radio and TV) did not result in an increase of hygiene behaviors compared to being exposed to only one. Secondly, there is a combined effect of community efforts and mass media (which is similar to the interpersonal and mass media channels described by Rogers (2003)). Scott et al (2008) continues to discuss (without reference to Rogers) the fact that the combined effect might be due to the initial awareness created by mass media and the deeper information gained through intrapersonal communication.

### **2.5.3 Nature of the social system**

A social system consists of a set of inhabitants as well as the structures that define the way the inhabitants communicate, with whom they communicate, norms and values. The social structures within a diffusion system have been identified by previous scholars as a contributing factor to the rate of adoption and diffusion of innovations (Rogers, 2003).

#### **Homophily and Heterophily**

In order to understand the nature of communication flows through interpersonal networks it is beneficial to study the concepts of homophily and heterophily. Homophily refers to what extent individuals that are alike communicate with one another while heterophily is to what extent individuals that are different communicate (Rogers, 2003). Since homophilious individuals can communicate in a more effective manner and there is less tendency for misinterpretations, such communication tend to be more common. However, Granovetter (1973) notes that there often exists “weak ties” between homophilious groups and while communication between them might be scarce, that communication is vital for the diffusion of information for the whole population.

Homophily can however, act as a barrier to the diffusion of innovations, in the sense that it creates communication “gaps” between different homogenous groups within a population.

While the “weak ties” observed by Granovetter (1973) may ultimately lead to total diffusion of information, strong homogenous formations within a population will hinder or delay the information spread. Powell (1995) observed this phenomenon when investigating the diffusion of total quality management (TQM); the only U.S. adopters of TQM were the ones most homogenous with the already adopted Japanese companies.

### **Opinion leaders**

Amongst the social structures, it is often interesting to identify “opinion leaders”, i.e. persons or organisation that to greater extent influence the adoption decisions of other inhabitants (Valente, 1999). The way opinion leaders perceives the innovation as well as their adoption or non-adoption decision influence the further diffusion and adoption of the innovation.

The effect of utilizing opinion leaders to speed up the diffusion process has been investigated in numerous studies and has shown a positive correlation between targeting opinion leaders and the rate of adoption (e.g. Castro et al., 1995, Kelly et al 1991). Kramer et al (2009) utilized opinion leaders in order to study the diffusion and adoption of an innovation with ergonomic benefits in the Canadian construction sector and observed that the peer companies expressed appreciation of hearing the experiences and opinions from the selected opinion leaders.

There are several methods of identifying opinion leaders. Rogers (2003) present four different methods: the Sociometric model, the Informants’ ratings model, the Self-designating model and the Observation model. Valente and Pumpuang (2007) expand on these concepts through a categorization of 200 studies that have utilized opinion leaders into 10 different methods of identification. Apart from the methods described by Rogers (2003), Valente and Pumpuang (2007) add the Celebrities method, Staff-selection method, Positional approach and Snowball method. The methods differ widely in time and resource requirements as well as situations where they are applicable. Every method has its certain advantages and drawbacks, but Rogers (2003) argues that the four methods presented by him are equally valid in identifying opinion leaders. However, Valente and Pumpuang (2007) argue that opinion leadership is a function of at least three qualities; the leader’s values and traits, his or her competence and expertise and his or her social position. The various methods differ in capitalizing these concepts and must therefore be carefully selected according to purpose and research method of the study.

### **2.5.4 Change agent efforts**

A change agent is defined as an individual or organization that influences clients’ innovation-decisions in a direction deemed desirable by a change agency (Rogers, 2003). The change agent can either work towards increasing the rate of adoption but also attempt to slow the diffusion process in order to prevent innovations with undesirable effects. Change agent efforts include, but are not limited to, promotion, advertising, pricing and technology simplification (Fichman & Carroll, 2000).

A large part of change agent efforts can therefore be related to marketing efforts of a specific innovation. Marketing efforts are often guided by the marketing mix or “the four p’s” presented by McCarthy (1960). The four p’s stand for product, price, place and promotion. The product aspects of marketing deal with the relation between the specifications of the actual goods or services and the end-user's needs and wants. Price refers to the process of setting a price for a product. The price can also include other aspects than monetary; e.g. time

or energy. Place refers to how the product gets to the customer and is sometimes labeled distribution channels. Place can also refer to the channel by which a product or service is sold, e.g. direct sales or through retailers. Promotion includes advertising, sales promotion, publicity, and personal selling, branding and refers to the various methods of promoting the product. (Perreault, 2006; Kotler et al, 2008 )

The change agent effort factor is closely related to both communication channels and opinion leaders. When dealing with a commercial innovation, a change agent is often the source that initiates both mass media (e.g. commercials) and interpersonal (e.g. through direct sales personnel) communication. There is also a link to opinion leaders as the change agent often tries (or would benefit from trying) to utilize them in order to increase the rate of adoption (Kelly et al, 1991). Chaudhuri (1994) found that change agents do not always have to work through interpersonal networks (i.e. work through an opinion leader) to affect the adoption rate but can instead, foremost in an industrial or B2B setting, work directly with the potential adopters in order affect the diffusion.

The role of the change agent changes over time. Rogers (2003) identifies seven roles in sequential of a change agent when introducing an innovation to a client system:

- To create a need for change
- To establish an information exchange relationship
- To diagnose problems
- To create an intent to change in the client
- To translate an intent into action
- To stabilize adoption and prevent discontinuance
- To achieve a terminal relationship (i.e. shifting the client from relying on the change agent to self-reliance)

Rogers presents this sequence as an ideal and notes that the reality is often quite different.

### **2.5.5 Type of innovation decision**

The final factor affecting the rate of adoption according to Rogers (2003) is the type of innovation decision. The decision phase of the innovation decision process can be divided into three types of innovation decisions; authority, collective and optional.

Optional innovation decisions occur when an inhabitant of a system is free to adopt or reject an innovation independent of the decisions of other members. This is the most common form of adoption decisions. Collective innovation decisions take place when the members of a system reach consensus that a particular innovation is to be adopted or rejected by the whole system. While the process leading up to such a decision might be time consuming, the rate of adoption post decision is rapid and non conformers are usually punished in some sense. Authority innovation decisions are defined as decisions where only one or a few individuals within a system make the decision and the rest of the system has to comply. Companies are often guided by authority innovation decisions, where the CEO makes the decisions and employees must follow. The diffusion after an authority innovation decision is almost imminent. (Rogers, 2003)

### **2.5.6 Critique of diffusion theory**

The most common critique of diffusion research concerns innovation bias. Innovation is a positively loaded word and a majority of the research is aimed at increasing the diffusion rates or investigating the successful diffusion of beneficial ideas. The reason for this is that diffusion researchers often work in retrospective and have the luxury of handpicking innovations that has diffused successfully. Successfully diffused innovations are easier and often more interesting to study as they leave a trace of adoption that are accessible to investigation. Further, the research concerning diffusion of innovation is often founded by change agencies which inherently have a pro-innovation bias since their very purpose is to promote innovation. This further enhances the problem in diffusion research (Rogers, 2003).

Abrahamson (1991) argues that the pro-innovation bias leads to a gap in the research which inhibits a total understanding of the mechanisms that causes superior innovations to be rejected and harmful innovations to be adopted. In order to fully understand the diffusion process of innovations, such areas have to be studied further.

### **2.6 The construction industry**

The construction industry has also been subject to certain research efforts from various angles. This is partly due to certain unique characteristics compared to other industries, mostly relating to complexity of operations (Shamas-Toma et al, 1998). A construction project is inherently uncertain with high interdependence among the tasks, which makes it a highly complex undertaking (Gidado 1996). Dubois and Gadde (2002) identifies that every construction project is unique and thus there is a need for local decision-making and adjustments to the local environment since management is often unaware of local environment and conditions. Therefore it is very difficult to apply centralized decision making and decentralization of authority prevails in the industry. Further, construction projects require expertise from a variety of trades, which has the effect that many tasks are subcontracted by primary contractors to specialized firms (Eccles, 1981).

The inter-firm coordination within a construction project needs to be high because of the complexity and interdependencies between operations. However, there are very few firm adaptations beyond the scope of the individual project since the firms and individuals are rearranged for each new project (Dubois and Gadde, 2002). Eccles (1981) argues that each construction project can be viewed as a quasifirm, which is broken down once the project ends. This implies that each building site is a tight coupled system while the industry as a whole is loosely coupled. This has effects on the information and knowledge spread within the industry and creates what Dubois and Gadde (2002) calls a strong community of practice. This is formed when people work together in tightly closed groups and share experiences and knowledge. This knowledge is then held collectively by the whole industry due to the many inter-firm interactions. Bresnen (2003) also stresses the importance of social interactions at the project site when investigating knowledge spread in the construction industry. Specific for the Swedish construction industry is that collaborations are mainly informal and based on personal relations (Bröchner, Josephson & Kadefors, 2002).

### **2.7 Research Questions**

Following the literature study, theory specific research questions derived from the purpose were formulated. During the initial phase, the research questions were continuously discussed

and slightly revised with both individuals in academia and our employer. The continuous revisions were necessary since the research questions guided the following steps of the research. In line with Bryman and Bell (2007, pp 88), the research questions were framed with the aim to be clear, researchable, connected with literature, linked to each other, neither too narrow or broad and having the potential to make a contribution to knowledge. The following questions will be answered:

1. What is the current status of the factors described by Rogers (2003), in the diffusion of Impact drivers in the Swedish construction industry?
2. Which of these factors, if any, can be affected by the supply side in order to increase the diffusion?

### **3 Research methodology**

*The research methodology section aims to describe and clarify the design, data collection and reliability of the research.*

#### **3.1 Research design**

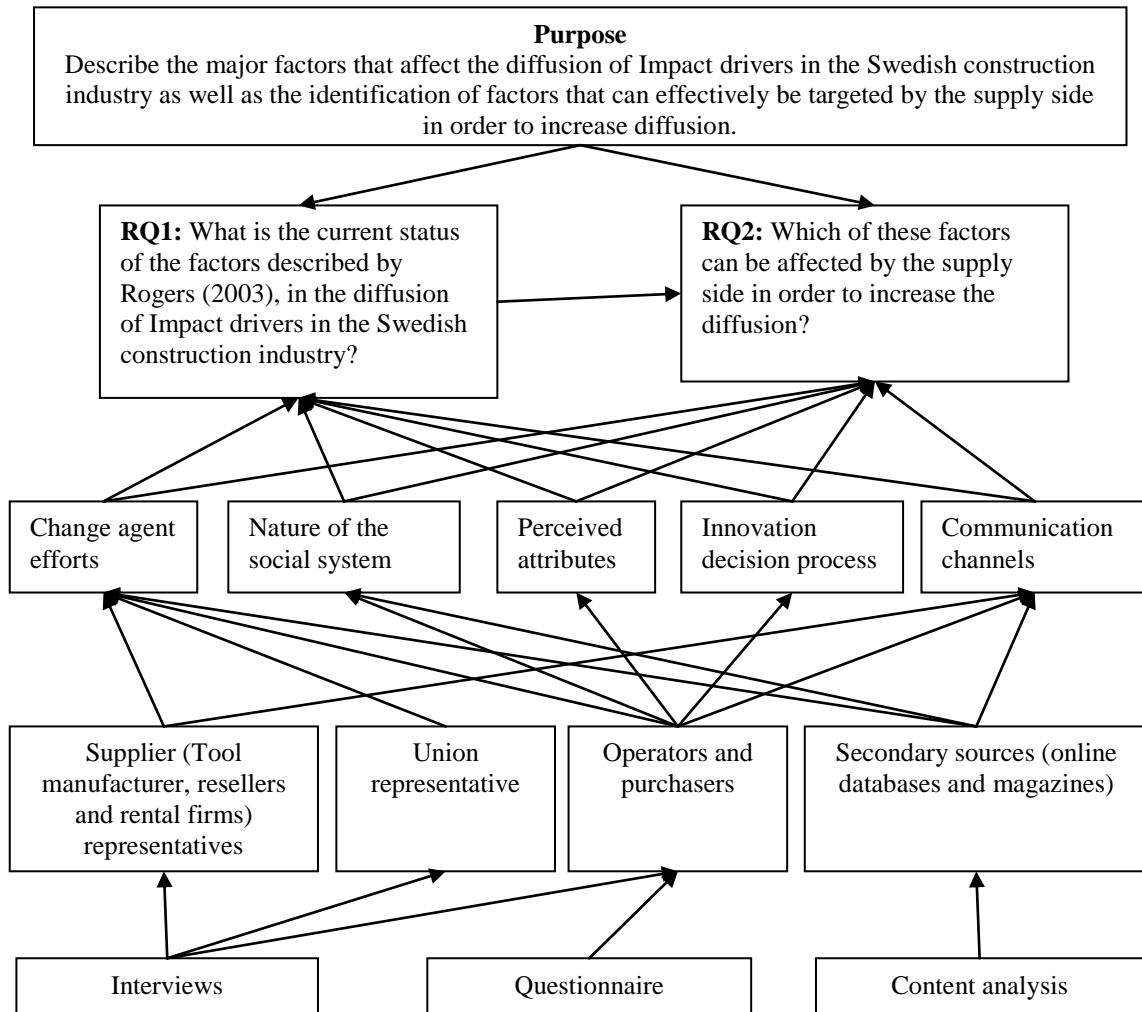
Given the nature of the problem, the resources at hand and the research strategy, a case study design approach is deemed to be appropriate due to the ability to capture in-depth contextual dynamics. According to Yin (1981, p.59), a case study as a research strategy is focusing on understanding “a contemporary phenomenon in its real-life context”. In an experiment design, the focus is on the phenomenon irrespective of its time and place, whereas in case studies the phenomenon and context are intertwined. Yin (1981) presents three distinctions that should be made in order to define the study: type of evidence, data collection methods and research strategy. The aim with a case study in general is either to describe the case, to test theory or to generate theory. Depending on the aim, the relation to previous literature and theories differ. Naturally, in a theory generating case study, the ideal is to have neither theories nor hypotheses under consideration. On the other hand, in theory testing case studies, a literature review is necessary before entering the field.

Reviewing the methodology literature, a dissension is apparent among researches about the appropriateness of the case study as a research strategy. Flyvbjerg (2006) refers to Campbell & Stanley (1996), whom argues that case studies have an absence of control and holds no scientific value. Flyvbjerg (2006) also points out the most common criticism to case studies as it being unable to make any general statements or conclusions from one single case. A common stance from critics of case studies argues that the research design is valid to build theoretical concepts which later have to be tested outside the context of the case using other research designs such as cross-sectional (Darke et. al. 1998). Flyvbjerg (2006) identifies that the general criticism towards case studies is concerning theory, reliability and validity. According to Bryman & Bell (2007), the reason for this criticism is that the case study is viewed as a sample of one; hence no theoretical generalisations can be claimed. In this research study, there are no intentions of making generalisations beyond the context of the case, thus the external validity will be neglected.

Since the purpose of this study is to describe the factors affecting diffusion of a specific innovation in a specific industry, the analysis will take place on two levels: the Swedish construction industry and the Impact technology. The aim of this study is to give an in-depth description of the unique features of the studied case. Due to a constraint in resources and time, the research will be structured with respect to an initial review of the literature in the field of study. Having an inductive approach in this case would be too time-consuming and the access to key actors is not unlimited. Additionally, there are a vast number of factors that potentially affects the diffusion of the innovation in one way or another, but this study seeks to find the most important ones. Therefore, a number of factors affecting the diffusion of innovations in general were used as guidance for this case study research. These general factors will be described and analyzed with respect to the specific case.

Figure 3 illustrates the connection between purpose, research questions, data sources and data collection methods used in this research.





**Figure 3. Overview of connections between data collection methods, data sources, theoretical constructs, research questions and purpose**

### 3.2 Data

Choosing a case-study research strategy does not per se imply the use of qualitative evidence or quantitative data, according to Yin (1981). He also argues that a combination of qualitative evidence and quantitative data has synergies and favours this combination. Eisenhardt (1989) and Mintzberg (1979) points out that quantitative data can indicate relationships that are not easily detected through qualitative evidence and keeps the researcher(s) from getting carried away by false impressions.

In this study, both quantitative data and qualitative data are combined. The reasons for using a combination are to strengthen the analysis (as mentioned by Eisenhardt (1989) and Mintzberg (1979)) and the availability of such data in our case. Since a large proportion of the data from only one actor, not even the biggest actor, is easily available, there is an evident risk of having skewed data points that cannot be certain to reflect the entire market. Therefore, a great emphasis was put on the triangulation of multiple data sources during the data collection period of this research. The triangulation effort is illustrated in Figure 3.

### 3.3 Data collection methods

The following section describes the data collection methods that was utilized in order to investigate the factors proposed by theory regarding diffusion of innovations.

#### 3.3.1 Interviews

Qualitative interviewing was a substantial part of the data collection of this research. Unstructured or semi-structured interviews have a central position in any qualitative research, due to the strive for rich and detailed descriptions (Bryman & Bell, 2003). The general outline for the interview process was initial unstructured interviews in order to reach a holistic understanding of the situation, followed by structured interviews as the research progressed.

#### Unstructured interviews

The unstructured interviews were held in the initial phase of this research. The goal of the interviews was to create an understanding and explore the topic more than actually collecting specific data. The initial interviews were conducted with individuals whom were believed to hold key insights into the context and the innovation. The individuals interviewed are presented in Table 1.

**Table 1. Interviews**

<b>Name</b>	<b>Position</b>
Vivek Sannabhadti	Hilti Global Product Manager Impact drivers
John Gauffin	Hilti Sweden Sales Director
Daniel Kristensson	Hilti Sweden Product Manager Cordless tools
Stefan Tichy	Hilti Business Area Manager Northern Europe (former Global Cordless tools Segment Manager)
David Tunberger	Hilti Sweden PLS Manager
Roger Eriksson	Hilti Sweden Account Manager

The interviews were held at location in Malmö and Göteborg where this was possible and interviews with individuals located outside Sweden were telephone interviews. The interviewee was quickly introduced to the topic of this research beforehand in order to limit the interview to relevant discussion areas. An interview guide was used, however it was limited to a few open and broad questions. Instead, interviewee was allowed to talk openly and follow up questions were posed when needed. In line with Bryman and Bell (2003), the unstructured interviews were similar to a conversation in its openness and the possibility to talk freely.

As Table 1 shows, only Hilti employees were interviewed initially. The reasons for not looking beyond one single firm at that point were two folded. First, these individuals were easily accessed since most of them had their offices in the same building as the authors were located or were easily contacted through the internal network. Second, the interviewees all have vast knowledge about the Swedish construction industry and the Impact driver. The potential bias due to their relation to one actor is not of importance, since the unstructured interview data is not the only source of data used for argumentation.

### Semi-structured interviews

The semi-structured interviews were used in a later stage of the data collection phase. The purpose of the semi-structured interviews was to investigate the representation of theoretical topics in reality. As defined by Bryman and Bell (2003), semi-structured interviews cover predefined specific topics, steered by an interview guide. Bryman and Bell also stress flexibility as part of the semi-structured interviews, where the interviewee should be allowed to express opinions and freely make descriptions.

Interview guides were used for all of the semi-structured interviews presented in Table 2. Questions in the guide were equal for interviews regarding similar positions. For example, all sales personnel were asked the same questions for the sake of comparability. Since the semi-structured interview was applied as a qualitative research method, there were no aggregation of interview data, instead viewpoints were qualitatively compared. Most of the interviews followed the guide roughly regarding the order and the questions posed. Where possible, the interviews were conducted face to face but some interviews had to be held via telephone.

**Table 2. Semi-structured interviews**

<b>Name or function</b>	<b>Position</b>
Daniel Mattinsson	Product Manager, Makita
Jörgen Eriksson	Work health responsible, Byggnads (Union)
Robert Bennerheim	Procurement manager, NCC
Anna Dahl	Work health responsible, NCC
Mirza Palislamovic	Procurement manager south district, Skanska Maskin
Henrik Friman	Depot manager west district, Lambertsson
Helpdesk	Handheld tool expert, Swedish work environment authority
Rental services	Front office sales Göteborg, Tidermans AB
Rental services	Front office sales Göteborg, Ramirent AB
Rental services	Front office sales Göteborg, Cramo AB
Sales	Sales manager Örebro, Bosch
Sales	In store sales Göteborg, Tools
Sales	In store sales Göteborg, Hornbach
Sales	In store sales Göteborg, Beijer bygg
Sales	In store sales Göteborg, Swedol
Roger Eriksson	Account manager Göteborg, Hilti

### 3.3.2 Questionnaire

In order to investigate the demand side within the Swedish construction industry, a questionnaire was used. The reason for choosing a questionnaire was due the need for comparability between respondent. The goal was to aggregate the responses to investigate the perception of Impact drivers of the sample reflecting the Swedish construction industry. More interesting, the difference in perception between adopters and non adopters of the innovation. The questions in the questionnaire was both posed by the authors, theoretically making it a structured interview, and online as a self-completion questionnaire. The complete questionnaire can be found in Appendix III.

## **Development of the questionnaire**

The questionnaire centres around the perception of each of the five independent attributes affecting the adoption of an innovation mentioned by Rogers (2003). The five attributes are: relative advantages, compatibility, complexity, trialability and observability. The attributes suggested by Rogers, are what Bryman and Bell (2003) identifies as multiple-indicators. Indicators are measures of a concept, the concept in this case being the adoption of an innovation. Moore and Benbasat (1991) developed a systematic method for measuring the perception of the attributes of an IT innovation. The attributes were measured by posing a number of statements related to each attribute. However, Moore and Benbasat chose to decompose the observability attribute into two new attributes: result demonstrability and visibility. In addition, the complexity attribute presented by Rogers (2003) was instead called ease of use. The changes successfully increased the construct validity of Moore and Benbasat's attributes. Due to the high construct validity of the measured attributes and their related statements presented in the research of Moore and Benbasat (1991), the basis of statements and attributes was reused in the questionnaire conducted in this research. In line with Moore and Benbasat (1991), the attributes used were:

- Relative advantage
- Compatibility
- Visibility
- Result demonstrability
- Ease of use
- Trialability

Most of the statements from Moore and Benbasat (1991) were reused, however certain context adaptations were necessary. The statements were translated to Swedish in order to simplify the interview process and avoid misinterpretations and misunderstandings. As Moore and Benbasat (1991), a seven point Likert-type scale was used in the questionnaire to be able to investigate the respondent's attitude towards the posed statement . The lowest number, 1, represented "I strongly disagree" and the highest number, 7, represented "I strongly agree".

In addition to the questionnaire section related to the attributes, other questions were posed. First, a range of control questions were asked, such as: "Are you aware of the tool called Impact driver?". At the end of the questionnaire, a range of open ended questions related to the factors *nature of the social system* and *change agent efforts* were asked.

## **Pre-testing the questionnaire**

After completing the first draft of the questionnaire, it was pretested at the Hilti Center opening day in Lund, Sweden. Attending were both individuals employed at construction firms and employees of Hilti Sweden. The intention was to investigate whether the respondents fully understood all questions and statements as well as possible misinterpretations. During the pre-test, 20 individuals were interviewed and asked to provide feedback regarding the questionnaire.

Subsequent to the pre-test, two adjustments were made to the questionnaire. First, one statement connected to the ease-of-use indicator was removed. The removed statement was correctly measuring the indicator, however the statement "Learning to operate an Impact driver is easy for me" was considered "almost insulting" to the construction workers. The decision to remove the statement was taken to minimize the risk of agitating future respondents. The risk of agitation was considered to outweigh the benefits of keeping the

statement. Second, one statement was added to the relative advantage indicator. During the open ended questions, the price of the Impact driver compared to the benefits was discussed with several individuals. Hence, the statement "The benefits of using an Impact driver outweigh the price" was added. The statement was considered by the authors to cover an important aspect of the relative advantage of the innovation. The cost to benefit aspect is in line with Tornatzky and Klein (1982), who identified cost as being one of the 10 most addressed attributes in innovation adoption research.

## **Sampling**

The goal of the sampling plan was to reflect the Swedish construction population. The sampling was conducted in two steps. In the first step, the questionnaire conducted as structured interviews was held at various Hilti Centers in Sweden<sup>1</sup>. The stores were visited during an event where the cordless platform, including the Impact driver, was being shown and visitors had the possibility to test every tool in a competition. Random visitors at the event was being interviewed, however only individuals employed in the Swedish construction industry was selected. Further, it is highly probable that the most of the visitors are also customer of Hilti, since the most respected customer are receiving invitations from sales personnel.

Since Hilti is a manufacturer in the premium segment, there was an apparent risk of only approaching premium customers. It was of importance not to only approach one type of individuals, such as Hilti customers, but to capture a diversity of organisations and individuals to correctly represent the market. Therefore a stratified random sampling approach was utilized, the strata being Hilti or non Hilti customers. In the second step, an online questionnaire was conducted in order to include other individuals in the sample. In total, 451 individuals were contacted with a request to fill out the questionnaire. The sample was generated from two online search engines, Sverige Bygger<sup>2</sup> and Eniro<sup>3</sup>. Sverige Bygger consists of all construction firms with active or completed construction projects in the western region of Sweden. From the total sample, 251 firms were chosen from Sverige Bygger; 50 being large, 100 being medium size firms and 101 being small firms, all with ongoing project the last five years. The split in firm size was due to the market situation, availability of email addresses and the probability of the firm responding. The sample from Eniro was generated by a keyword search<sup>4</sup>. The webpage of every firm in the generated search list was visited in order to ensure the firm carried out construction activities. From the generated search list, 200 firms were chosen. The criterion for choosing firms from Eniro was randomized regarding geographic location and firm size. However, what criteria the generated search list from Eniro is based upon is not known by the authors but most probably it is sorted by some measure of popularity. Regarding which person to contact at each firm, the goal was to reach the employee either taking the buying decision regarding electrical tools or the operation of electrical tools. At firms where contact information was available, the foreman or team leader was contacted. Most of the small companies had only one email address listed and naturally that was chosen.

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<sup>1</sup> The Hilti Centers visited was HC Örebro (2011-05-19) , HC Göteborg (2011-05-24) and HC Västerås (2011-05-18)

<sup>2</sup> [www.sverigebygger.se](http://www.sverigebygger.se) (Accessed 2011-06-13 and 2011-06-14)

<sup>3</sup> [www.eniro.se](http://www.eniro.se) (Accessed 2011-06-13 and 2011-06-14)

<sup>4</sup> Keyword being "byggföretag" (construction firms)

Since an online questionnaire was chosen, firms without existing websites or email addresses were excluded from the sample. Therefore, the sample is somewhat biased towards firms using internet on a daily or weekly basis. Construction firms without websites and email addresses are today largely small firms with one or a few employees. This bias could only be eliminated by using telephone interviews. However, telephone interviews were considered highly inefficient in comparison to email distribution and the bias was assumed to be rather small in this case. Therefore, a larger sample size using an online questionnaire was favored in this research.

### Reliability and validity of the questionnaire

In total, 15 Hilti customers answered the questionnaire in combination with 68 (43 complete and 25 partial) online responses adding up to a sum of 83 responses. While 451 firms were contacted regarding the online questionnaire, 43 of the emails sent did not reach its destination due to inactive email addresses. The response rate of the online questionnaire amounted to 16,7 %. The partial responses were being counted at the respective question were it was being answered. The questionnaire data was analyzed using Statistical Package for the Social Sciences (SPSS).

Regarding the validity and reliability of the constructs used in this questionnaire, Table 3 shows the Cronbach's alpha of the constructs. According to Cronbach (1951), the Cronbach's alpha is an estimate of reliability, i.e. an estimate of how well the items are measuring the same thing (the construct). Moore and Benbasat (1991) refers to Nunally (1967), who points out that alphas between 0,5 and 0,6 is sufficient for basic research and anything above 0,8 is often wasteful. These ranges are therefore considered as limits in this research. Due to low levels of Cronbach's alpha concerning the two items of the Compatibility construct, Compatibility was split into two constructs: Compatibility and Forced changes. The split was done in order to increase the validity of the constructs. Since Compatibility and Forced changes only consist of one item respectively, a Cronbach's alpha measurement is not valid. Other constructs have measured alphas within or above the specified limits. The acceptable levels of alphas together with the support from the rigorous research of Moore and Benbasat (1991), the reliability of the constructs is considered satisfying.

**Table 3. Reliability measures**

<b>Construct (attribute)</b>	<b>Number of items</b>	<b>Cronbach's Alpha</b>
Ease of use (N=52)	2	0,778
Relative advantage (N=51)	6	0,917
Result demonstrability (N=52)	2	0,727
Trialability (N=52)	3	0,777
Visibility (N=52)	3	0,594
Forced changes (N=52)	1	-
Compatibility (N=52)	1	-

### 3.3.3 Secondary data and analyses

Apart from primary data from interviews and a questionnaire, secondary analysis was also included. Secondary analysis was used where high quality data was already available and

considered trustworthy. Bryman and Bell (2003) points out numerous benefits with using secondary analysis as relevant for this research: cost and time efficient; high quality data where sampling procedures and sizes has been rigorous; and the opportunity for longitudinal analysis. Table 4 presents the sources of secondary analysis used in this research.

**Table 4. Sources of secondary analysis**

<b>Title</b>	<b>Data set</b>	<b>Topics</b>
Fakta om byggandet	Sveriges Bygginstrumenter (BI) collects and analyzes data from 3000 construction firms (www.bygg.org)	The economic development of the Swedish construction industry
Indicators of economic development	Statistiska centralbyrån (SCB) collects and analyzes data using telephone interviews with senior management in 323 large firms in 18 industries (www.scb.se)	Perceived economic outlook of large firms in the top industries in Sweden
LEH Sales data	LEH is an industry provider of sales statistics for firms selling electrical handheld tools. LEH collects sales data from 16 members, covering more than 90% of the professional market (www.leh.nu)	Sales of electrical handheld tools for professional users.
Sverige Bygger	Sverige Bygger contains detailed information about the ongoing construction projects in Sweden. (www.sverigebygger.se)	Interactions between construction firms within Swedish construction projects. Contact information of decision makers in each firm.

Other than sources of secondary analysis, secondary data has been collected from a range of Internet websites. The web pages of tool manufacturers have been used for collecting various tool specifications, product launches and so forth. Websites of resellers and rental agencies have been visited to collect information regarding promotions and prices.

### **3.4 Data analysis methods**

This section presents the different analysis methods utilized in the thesis as well as an argument to why they are suitable.

#### **3.4.1 Coding**

The qualitative data from the unstructured and semi-structured interviews were recorded in written interview transcripts in order to make the data more manageable. Data from interviews with individuals in similar positions (e.g. sales representatives) were coded and compared through high and low coding and word count. For example, whether sales representatives were deemed to be actively promoting the Impact driver or not, the interviewee's answer was coded as high or low. Word counting was used in the case of determining the most commonly used application areas for Impact drivers as regarded by sales representatives.

Qualitative data stemming from the open questions in the questionnaire were being analyzed through coding. For example, the answers to the question "What is the advantages with using an Impact driver?" were structured into general codes, such as "ergonomics", "high torque" or "easy to use". The codes were counted based on occurrences and structured in a quantitative form.

### **3.4.2 Statistical analysis**

The statistical tools were utilized in order to interpret the perceived attributes and explain the differences between adopters and non adopters. Apart from comparing absolute mean values for each group a t-test for equality of means and a discriminant function analysis was conducted. All statistical analysis was conducted through using Statistical Package for the Social Sciences (SPSS).

#### **t-Test for equality of means**

The purpose of this process is to determine whether: 1) the differences you observe between two samples represents a real difference between the populations from which the samples were drawn; or 2) the observed difference just happened by chance when, in reality, the two populations don't differ at all. The t-test can either be one-tailed or two-tailed based on which tail of the distributions are to be investigated (tail is referring to the two ends of the distribution curve). Even though a one-tailed t-test more often produces a higher alpha than a two-tailed, a two-tailed t-test is to be preferred when not knowing where the possible difference in means exists.

The t-test was utilized in this study in order to test whether the difference in means was significant between adopters and non adopters. An unpaired, two-sided t-test was selected because of the limited knowledge about the populations previous to the test. SPSS also test for equal variances between the populations through "Levene's Test for Equality of Variances" and adjust for when equal variance can be assumed and not assumed. An alpha of 0.05 was used in all tests as the level of confidence of rejecting the null hypothesis (that the means of each population are equal).

#### **Discriminant function analysis**

Discriminant function analysis is useful in determining whether a set of variables is effective in predicting category membership (Press and Wilson, 1978). The analysis applies a liner function dependent on a set of continuous variables and tries to predict membership in previously set categories based on this function. This procedure fits well into the explaining of belonging to the adopter or non adopter category based on the perceived attributes of Impact drivers. This test was also utilized in a similar setting by Moore and Benbasat (1991).

This analysis is used as a compliment to the comparison of means since it focuses more on explanatory values relating to the categories than the notion that the mean values are different between populations. Whereas the discriminant function analysis is known to be sensitive to non-normality of the data (Press and Wilson, 1978), the t-test is more robust.

### **3.4.4 Content analysis**

Content analysis is essentially a research method used to analyze text data. Initially, it was used quantitatively and objectively: Berelson (1952) systematically analyzed World War II propaganda. Content analysis has a high degree of flexibility, in the sense that it may be applied over a wide range of media (Bryman and Bell, 2007). According to Rosengren (1981) it is also flexible in the use of analytic approaches, from strict and systematic to



impressionistic. When reviewing the literature, this flexibility can seem vague since different authors apply the method in completely different ways.

In this research, the method of content analysis was used to collect data and analyze the occurrences of the Impact driver in printed and online media. The occurrences of drill drivers were also measured in order to have a yard stick for comparison. The Swedish translation for Impact driver and drill driver along other popular names for the tools were used as keywords in the search. The occurrences were counted and the year of publication together with the type of message was registered. Message types were labeled as advertisements, press releases or independent product tests. The sources used in the search were the following industry specific newspapers and websites: Byggnadsarbetaren, Husbyggaren, Gör det själv, [www.byggnyheter.se](http://www.byggnyheter.se) and Den moderna hantverkaren. These sources were chosen due to the high circulation numbers and therefore assumed to be reaching the majority of the organizations and employees in the Swedish construction industry.

## 4 Context

*This section aims at giving an introduction to both the innovation of study as well as the system in which it is diffusing.*

### 4.1 The Impact driver

The Impact technology sprung from the need to loosen rusty or over-torqued bolts and screws. Among the first patents related to the Impact technology was filed in 1951 (US patent 2,543,441) by George F. Crummey. The first generation of the technology was powered by user generated hammer blow to the top of the tool, where the axial force was converted to a tangential force by a pin and cams. In turn, the anvil rotated and eventually also the bolt or screw. Figure 4 is an illustration of the aforementioned invention. The Impact driver descends from the tool type Impact wrenches, which are specialized tools for driving nuts and bolts often used in an industry setting. The tools are essentially identical apart from the connection end; the 1/2" male square anvil for Impact wrenches and the female 1/4" hexagonal anvil connection for Impact drivers. This small distinction allows the tool types to perform very different types of applications.

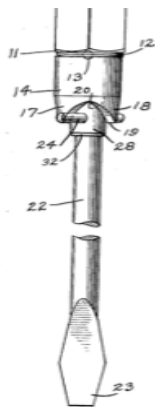


Figure 4. Early Impact driver



Figure 5. A modern Impact driver

The Impact driver available today is working according to similar principles as the earliest Impact driver, but has a rather different appearance (see Figure 5). A modern Impact driver has an electric motor (DC) powered by a battery. The motor transmits energy to a spring, which temporarily stores the energy as it compresses. The stored energy is used to accelerate a rotating mass which hits the anvil and eventually turns the screw or nut (as mentioned in US patent 2,712,254 by Schodeberg). By accelerating the rotating mass, a high torque output is possible, even with a rather small DC motor. The process is repeated up to 3000 times per minute and thus a discontinuous torque is delivered. Since the anvil and hammer is disconnected and torque is not continuous, the user will only experience the reactionary force from the motor accelerating the hammer. Hence, the reactionary torque is practically negligible.

The possible applications for an Impact driver are essentially identical with a conventional Drill driver. However, the no reactionary torque together with the high torque output differentiates the Impact driver from the drill driver regarding optimal applications. Naturally, the Impact driver is excelling in applications where a high torque is needed such as bolting and large diameter screws. Because the Impact driver has a physically small motor and no mechanical gearbox, it has a great power-to-weight and power-to-size ratio over the drill

driver. However, due to the non continuous power of the Impact driver, drilling and small diameter screwing in fragile materials are better suited for the drill driver. The technical differences between an Impact driver and a drill driver are summarized in Table 5 below. The figures are taken from the current 14,4V Hitachi platform and are used to highlight the differences between the tool types.

**Table 5. Impact driver – drill driver comparison<sup>5</sup>**

<b>Dimension</b>	<b>Impact driver</b>	<b>Drill driver</b>
Length	162 mm	234 mm
Weight	1,5 Kilo	2,0 Kilo
Max RPM	2600	1500
Mar Torque	140 Nm	52 Nm
Vibration value	9,1m/s <sup>2</sup>	3,6m/s <sup>2</sup>
Noice	89/100 dB	73/95 dB

The Impact driver is smaller, lighter, produces a higher RPM (rotations per minute) as well as a higher torque output. However, the drill driver produces less vibrations and noise.

#### **4.2 The Swedish construction industry**

In 2008, the investments in construction in Sweden amounted to 250 billion kronor, which corresponds to 8% of the GDP<sup>6</sup> and is one of the largest industries in Sweden. The construction industry in Sweden consists of more than 18000 companies employing in excess of 294000 individuals in 2010 (SCB)<sup>7</sup>. The construction business is heavily reliant on government and private investments and thus dependant on the state of the economy. During the last decades, the construction industry has followed the cyclical recessions in the Swedish economy. During the economic crisis in the early 1990's, the Swedish construction industry suffered along with the Swedish economy. The crisis led to lower governmental support, reduced regulations and higher taxes within the industry (Olsson 2000, BI). Between 1990 and 1997, the investments in construction were reduced by 35 %<sup>8</sup>. Since the crisis in the early 90's, the construction industry slowly recovered and peaked in 2008<sup>9</sup>. However, the positive outlook was only temporary and the global crisis in the end of 2008 and 2009 hit the Swedish construction industry. Figure 6 shows the share of companies in the Swedish construction industry that perceives the economic situation as good minus the share of companies having a negative perception of their economic situation<sup>10</sup>.

<sup>5</sup> The technical specifications are for Hitachi Impact driver WH14DL and drill driver DS14DL ([www.hitachi-powertools.se](http://www.hitachi-powertools.se), accessed 2011-07-28)

<sup>6</sup> Bygg.org: [http://www.bygg.org/fakta\\_statistik.asp](http://www.bygg.org/fakta_statistik.asp), Accessed 2011-07-18

<sup>7</sup> SCB:SNI 2007:41 o 42 (2010)

<sup>8</sup> Bygg.org: [http://publikationer.bygg.org/Images/Info/491/Fakta\\_om\\_byggandet\\_2009.pdf](http://publikationer.bygg.org/Images/Info/491/Fakta_om_byggandet_2009.pdf), Accessed 2011-07-18

<sup>9</sup> SCB: [http://www.scb.se/Pages/PressRelease\\_\\_\\_\\_231249.aspx](http://www.scb.se/Pages/PressRelease____231249.aspx), Accessed 2011-07-18

<sup>10</sup> SCB: [http://www.scb.se/Pages/TableAndChart\\_\\_\\_\\_217150.aspx](http://www.scb.se/Pages/TableAndChart____217150.aspx), Accessed 2011-07-18



Figure 6. Perceived business outlook, Swedish construction industry (SCB)

The construction industry in Sweden is mature, with a few large companies and a lot of small actors. The key players are Skanska Sverige AB, NCC Construction Sverige and PEAB. These large actors are geographically present in all of Sweden and in most of the Nordic countries. The 7 largest construction companies in Sweden currently employ 40 % of the workforce in the industry<sup>11</sup>. However, since the construction industry naturally is a labor intensive industry and the scale advantages are not dominant, a large part of the market is shared by a myriad of small companies (Bröchner et. al. 2002). The smaller players are often specialists or acting on their local market.

The construction industry is subject to many work related accidents and health hazards compared to other industries. Various dangerous work methods and handling of toxic material, such as asbestos, has created a focus on health and safety issues within the industry. The Swedish work environmental agency (SWEA) has issued numerous regulations and guidelines for different working methods within the construction industry. This has in extension created strong unions for construction workers. The largest construction union in Sweden is called Byggnads and currently holds 112000 members<sup>12</sup>.

#### 4.2.1 The suppliers to the Swedish construction industry

The tool suppliers to the construction industry can be divided into three groups; manufacturers, retailers and rental services. All of the tool manufacturers currently distributing Impact drivers in Sweden are global firms with local market organizations. Tools are designed, engineered and manufactured outside of Sweden, at the headquarters of the respective firm. The functions of their Swedish branches are marketing, distributing and selling tools and accessories. Manufacturers rarely supply directly to construction firms but instead often work through retailers. The exception from this is Hilti Sweden, who only supply tools through its own channels; direct sales, customer services, Hilt centers and online store. The largest professional manufacturers are Makita, Hilti, Hitachi, Milwaukee, DeWalt, and Bosh. Due to scale advantages, tool manufacturers are not only selling Impact drivers but an entire portfolio of power tools to their customers. Other power tools include drill drivers, hammer drills, fastening systems and measuring devices, to name a few. Naturally, the tool

<sup>11</sup> SCB: SNI 2007:41 o 42 (2010)

<sup>12</sup> <http://www.byggnads.se>, accessed 2011-07-28

manufacturers are striving for customer loyalty where the customers' entire fleet of tools is from the same manufacturer. This is especially apparent in the cordless segment (tools using batteries as energy source), where a range of tools have the same battery as a common denominator.

Retailers often work through a one-stop-shop concept and aims at supplying everything construction related at one location. There are several large retail chains present in Sweden with large geographical dispersion. The largest professional and semi-professional retail chains include Tools, Ahlsell, Beijer Bygg, Swedol and Dahl.

The rental services also uses a total concept to some extent, but focuses more on heavier machinery that is expensive and only useful during certain projects or specific tasks. The Swedish rental services are considerably stronger than their European counterparts. The largest professional rental services in Sweden include Cramo, RamiRent, Lambertsson and Skanska Maskin. For a detailed overview of the largest actors on the supply side of the construction industry see Appendix V.

### ***4.3 The diffusion of Impact Drivers in Sweden so far***

The first cordless Impact driver was launched in Sweden 2002 by Hitachi (Appendix IX). Between 2002 and 2004 all manufacturers except Bosch and Hilti launched cordless Impact tools, all using the Nickel-metal hybride (NiMH) battery technology. In 2005, Milwaukee introduced Impact tools using the Lithium-ion battery technology, which substantially increased the performance and ergonomics of the tools. The following two years, every manufacturer introduced Li-ion tools in the Swedish market. The second major improvement to the Impact tools was the brushless motor, which was introduced in 2009 by Makita and Hitachi (Appendix IX). Brushless motors are smaller, more energy efficient and more durable compared to conventional brush motors. All manufacturers are expected to introduce Impact tools with brushless motors in the coming years<sup>13</sup>.

The Impact driver has increasingly diffused over the years. Figure 7 show the relational sales of Impact drives between 2006 and 2010, obtained from the industry supplier organization LEH. The y-axis has been removed because of the sensitive nature of the data.

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<sup>13</sup> Vivek Sannabhadti, Hilti Global Product Manager Impact Drivers, 2011-04-12

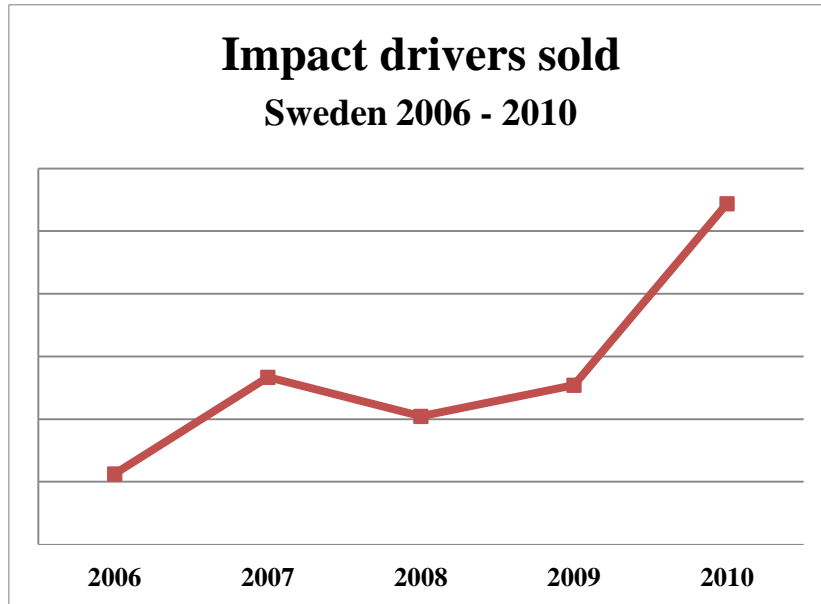


Figure 7. Impact drivers sold in Sweden 2006-2010 (LEH, 2006-2010)

The sales data show an increasing trend in rate of adoption and diffusion. The relatively low increase in 2008 and 2009 can be connected to the economic downturn in the construction industry described in the previous section.

While the sales figures show the relative increase in the rate of adoption, the total diffusion cannot be estimated from this data alone since the total population of potential Impact driver adopters is not known. In order to make an estimation, the Impact driver can be compared to the sales of drill drivers. Drill drivers are considered to have diffused completely and are found in the portfolio of practically every construction firm. The applications that can be performed with the tool types are also very similar. Therefore, drill driver sales figures can be used as a substitute for the total population of possible Impact driver adopters.

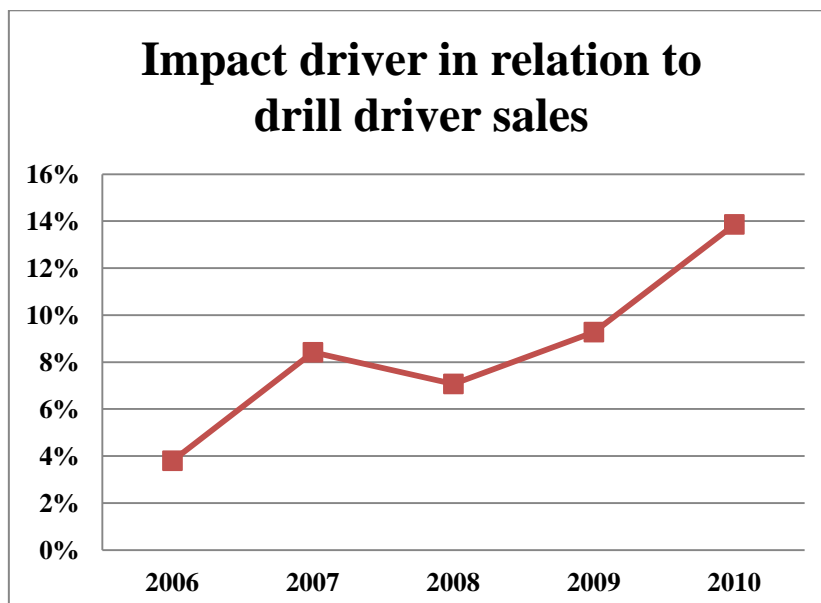


Figure 8. Impact driver sales quantities in relation to drill driver sales quantities (LEH, 2006-2010)

As seen in Figure 8, the relation of Impact drivers sold compared to drill drivers is increasing. While the sales of Impact drivers in 2010 still was only about 14% of the total sales of drill drivers, the trend is increasing. Since this is a comparison, external events such as the economic downturn have been eliminated since it affects the drill drivers' sales figures as well.

While it is hard to predict how the adoption will continue, the sales data suggest that there is very little risk for discontinuance of the innovation and the trend seems to be increased diffusion and rate of adoption.

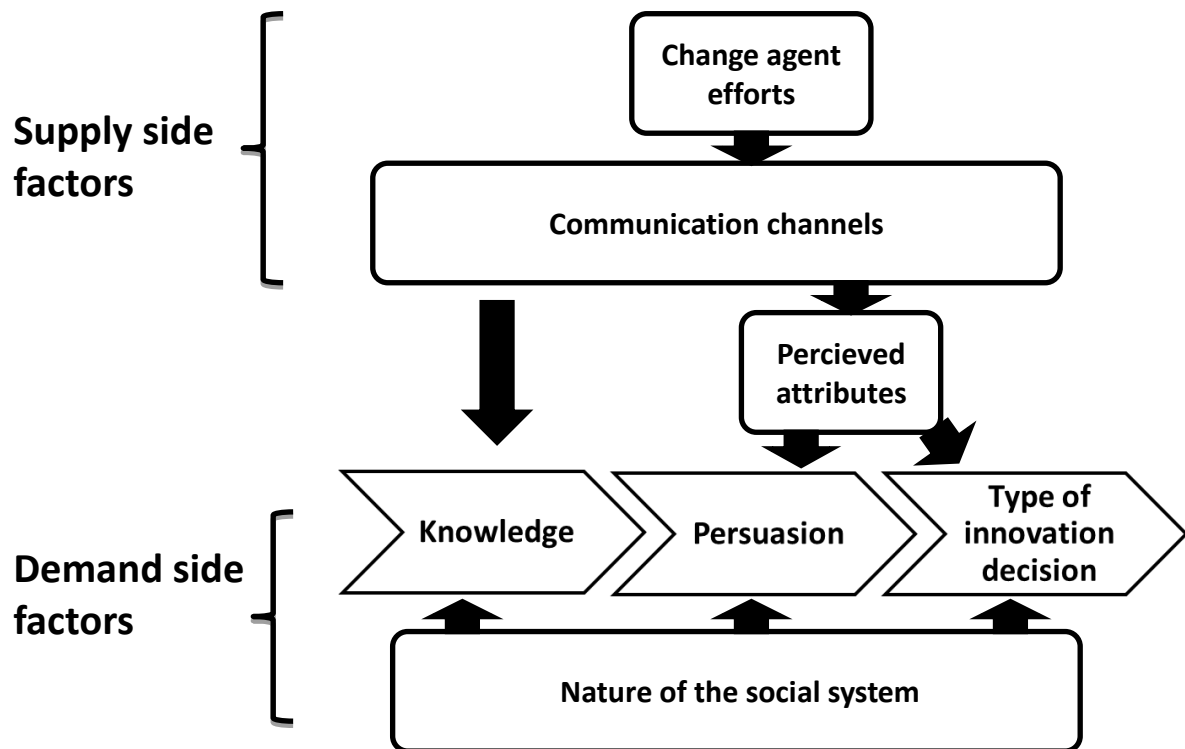
## 5 Analysis of results

*This section provides the results and analysis of the investigated factors described in the literature study section.*

The factors described in the literature section are somewhat interrelated and there exists interdependencies between certain factors. The disposition of this chapter starts with the two factors more relating to the demand side; the type of innovation decision and nature of the social system. The type of innovation decision is closely related to the innovation decision process of the members of the Swedish construction industry. While the innovation decision process is not a factor per se, it contains valuable information about the mechanisms and workings behind a potential adoption. Therefore, the innovation decision process and type of innovation decision is combined in the first section.

The chapter continues with the supply side factors; change agent efforts and communication channels. These two attributes are interrelated in the sense that communication channels are often instigated by change agents. The chapter concludes with the perceived attributes factor, since it is influenced by both supply- and demand side factors.

The categorization of the factors is shown in Figure 9 below.



**Figure 9. The factors affecting rate of adoption and diffusion categorized according to demand- and supply side functions**



## ***5.1 The type of innovation decision and the innovation decision process in the Swedish construction industry***

Since the purpose of this Master Thesis is to investigate the factors affecting the diffusion of Impact drivers in the Swedish construction industry, the focus of this section is around the actual adoption decision, which is considered equal to a purchasing decision.

One important characteristic of the Swedish construction industry is that the firms operating within are of extremely varying sizes. The workforces span from one man companies to 26000 employees in the largest corporations. Naturally, the purchasing decision processes are very different between small and large companies. Therefore, there is a distinction in this analysis between large and small firms.

### **5.1.1 Small firms**

When investigating the responses from the survey, there seemed to be a distinction around when the firm size exceeded 30 employees. When the firm size increased, the purchasing decisions were removed from individuals to functional divisions such as warehouse staff, rental services, etc. Small firms are therefore defined in this analysis as firms with 1-30 employees.

There are 22 companies within the survey that fit this description. They were asked whether they were involved in the purchasing decision and who else were involved. The responses can be categorized in three groups: firms where one person makes the decision on his own, firms where a selected few are allowed to partake in the decision and firms where all employees are allowed to participate. The relation between the groups is shown below.

**Table 6. Decision categories – small firms**

<b>Type of innovation decision</b>	<b>Nr of respondents</b>	<b>Percentage</b>
Single person	11	50%
Selected few	5	23%
Everyone	6	27%

While two of the firms were one-man-companies, and thus naturally the only one involved in the purchasing decision, there is still dominance for single person decisions. These firms have indicated that they make the decision themselves, without input from the rest of the company. The second largest category indicated that they invite a few people in their purchasing decisions. These people were often described in personal terms, as relatives or close colleagues. The final category responded that virtually everyone in the company was allowed to share their opinions during purchase decisions.

These categories can be linked to Rogers' (2003) model of the innovation decision process. In the case where a single person solely makes the purchasing decision, the decision is only reliant on the perceptions of one individual. As the group of people that are involved expands into the other two categories, more persons' interpretations, knowledge and attitudes are present in the process. It is enough that one person has gained awareness about an innovation to pass this on to the other individuals present in the process. Further, there may be a whole new persuasion phase when several individuals with different attitudes and relations towards the tool type are to agree upon a decision. The categories are also consistent with the types of innovation decisions. While the adoption for the whole firm is optional, the internal process and adoption decision seem to span from authority to collective decisions.

### 5.1.2 Large firms

Following the argumentation in the previous paragraph, large firms are defined in this analysis as firms with 30 or more employees.

There were 25 companies in the survey that fit this description. The survey data was also expanded with interviews with representatives from two of the major machine rental providers; Skanska Maskin and Lambertsson. The purchasing decisions of the large firms are more complex compared to smaller firms. The small firms often evaluate relatively small purchasing decisions with clear effects and the owner can decide who he listens to or not. Large firms often have centralized storing for machinery and specialized warehouse staff that supervise stock levels and equipment. Therefore, the purchasing decision categories are not the same for the large firms. The data suggest the following categories: firms that let inventory or logistics department make the decisions, firms that let each site manager decide the purchases for his construction project, or firms that uses a combination of these functions. The relation between the categories is shown below.

**Table 7. Decision categories – large firms**

<b>Function involved in decision</b>	<b>Nr of respondents</b>	<b>Percentage</b>
Inventory staff	5	20%
Site Manager	8	32%
Combination	12	48%

When considering the objectives of Site Managers and Inventory Managers, there may be some differences. Inventory managers are concerned with supplying the demand of the different Site Managers and at the same time keeping a level stock of machinery. A Site Manager might focus only on the current project and not whether to type of machinery he demands is usable in other projects as well. These differences might be an explanation to the large group of firms that uses a combination of the functions. This is also in line with the argument made by Dubois and Gadde (2002) that the application of centralized decision making is very difficult in the construction industry due to the variation between projects.

A typical company that uses the combined method is Skanska Maskin. Skanska Maskin is one of the largest power tools rental companies in Sweden and is owned directly by Skanska. Skanska Maskin rents machinery to all Skanska projects and Skanska Site Managers are directed to primarily order their tools from Skanska Maskin. Even though the Site Managers are in control of what tools they order for their respective project, Skanska Maskin makes their own purchasing decisions and then supplies the Site Managers in the next step. As a centralized function within Skanska, Skanska Maskin has a much broader way of evaluation tool purchases. A tool is evaluated along conditions such as durability and utilization prognoses. Since Skanska is such a large company, Skanska Maskin has restricted its stock to only include certain brands, thus ignoring certain brand specific demands from site managers<sup>14</sup>.

When only a Site Manager is involved in the purchase decision, the project can be compared to a small firm. The Site Manager can chose to what extent he listens to the operators or other persons involved in the project. This is clear for the sales personal at Hilti; sometimes they are not allowed to show tools to the operators in order to keep the decision only to the Site

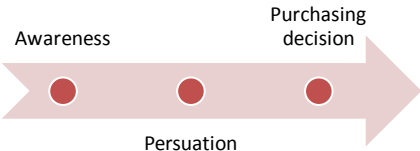
<sup>14</sup> Mirza Palislamovic, Skanska Maskin South District Buyer, 2011-06-15

Manager and other times they are directed to talk solely to an operator<sup>15</sup>. It is therefore safe to assume that within the Site Manager category there exist sub-categories similar to the ones for small companies.

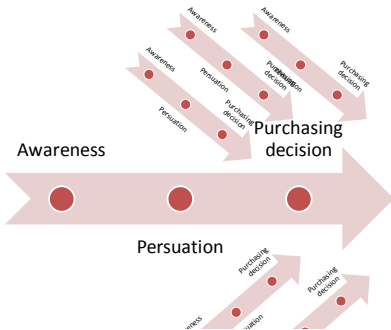
Applying Rogers’ (2003) model to the large firms within the Swedish construction industry, the same consequences for the categories in the small firm section are valid for the Site Manager category. The amount of attitudes and people that affects the purchase decision is dependent on the Site Manager himself. When adding an inventory function, the number of people involved is increasing since the inventory function aggregates the demands of several Site Managers, especially when both functions are involved in the decision. The large firms also have decision categories corresponding to different types of innovation decisions. However, in distinction to small firms, the authority innovation decisions are taken one level higher within the organization and other aspects are taken into account.

**5.1.3 Summary**

The innovation decision process for the firms operation in the Swedish construction industry can differ greatly depending on variables such as firm size, organizational structure and individual decisions of Site Managers and firm owners. Connecting this to Rogers’ (2003) model of the innovation decision process, where an individual moves through the awareness and persuasion phase before making the adoption decision, it shows that a linear model of the process might only be applicable for the firms that have a sole decision maker. Most of the firms have many people involved in the process and the actual decision, all with their own awareness and persuasion phase behind them. This distinction is showed in the figures below.



**Figure 10. Innovation decision process – one decision maker**



**Figure 11. Innovation decision process- many decision makers**

Further, when the process is similar to Figure 11, there may be a new set of persuasion phases for the people involved since they are exposed to the opinions and knowledge from colleagues and friends during the actual decision phase. The involvement of many people from different organizational levels is positive for the diffusion of Impact drivers since it increases the chance that one or more people involved in the purchasing decision are aware of the innovation and thus makes it a part of the purchasing discussion.

While the innovation decision for each firm is optional, there are distinctions between firms regarding internal decision making. For certain firms the decision is collective and for others it is authority based purchasing decisions. For the larger organizations, with centralized

<sup>15</sup> Roger Eriksson, Hilti Account Manager, 2011-04-18

inventory, the collective decisions from a site manager and the operators can be overturned by the decisions of the inventory purchasers.

## **5.2 Nature of the social system**

This section focuses on the interaction, communication and information spread between different actors within the Swedish construction industry. While the previous section investigated the individual decision processes of potential adopters, this section describes the Swedish construction industry on a system level. The concepts of homo- and heterophily are investigated along with the existence, nature and adoption of any possible opinion leaders.

### **5.2.1 Homophily and Heterophily in the Swedish construction industry**

As mentioned in chapter 2.6, the Swedish construction industry has been described as a loosely coupled system without strict barriers or division. This suggests that there are no, or very few, homophilious groups that have little to no interaction with the rest of the industry. A number of empirical data supports this argument.

Firstly, the five largest actors within the geographical area of Västra Götaland was involved in an average of 144,2 projects between 2006-2012. During this time, they were involved with on average 221 different contractors and entrepreneurs. Each entrepreneur was involved in 1-19 projects (Sverige Bygger, 2011). This shows the vast interaction and communication between companies within the building sector. Even though the geographical area of the building projects was limited to Västra Götaland, the companies involved in the projects were from all areas of Sweden, thus supporting the absence of homophilious groups in the Swedish construction industry. The geographical dispersion and other details are shown in Appendix II.

Secondly, the labor turnover and salary dispersion and differences within the Swedish construction industry can be seen as indicators of the existence of elite formations within the sector. A high labor turnover would suggest that staff travel easily between firms and supporting low barriers between firms. Low salary dispersion would also indicate the absence of elite formations since they would earn a distinctively higher salary. The labor turnover between 2007 and 2010 varied between 1,9% and 5,5% and two of these years the construction industry in Sweden accounted for the second highest labor turnover, only surpassed by the service sector (SCB-Kortperiodisk sysselsättningsstatistik, 2007-2010). The dispersion of hourly salaries between 2001 and 2010 varied between the lower and higher quartile from 22,3 SEK in 2001 to 30,63 SEK in 2010 (SCB-Genomsnittlig timlön, lönespridning m.m., arbetare privat sektor (SLP) efter yrkesgrupp, 2001-2010). This is regarded a rather low dispersion between the highest and lowest salaries within a sector. Both these indicators suggest a rather homophilious total market with low barriers between firms and few elite formations.

### **5.2.2 Opinion Leaders**

The investigative work concerning opinion leaders was focused around the hypothesis that certain construction firms were more influential and followed in their decision by the rest of the market. Initial interviews with Hilti sales personal suggested that the largest firms often had a large Impact on the diffusion of different products<sup>16,17</sup>.

In order to further investigate this, respondents were asked to name the companies that was more respected or trend-setters within their sector. However, 52,7% could not name any

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<sup>16</sup> John Gauffin, Hilti Sales Director North, 2011-04-06

<sup>17</sup> Daniel Kristensson, Hilti Product Manager, 2011-04-04

company that would be more of a trend setter than others and only 15,7% named one of the largest firms as the most respected company within the industry. Instead, the opinion leaders seem to exist on a more local, personal level. 28,1% of the respondents indicated that they turn to personal contacts and friends when looking for advice about new tool. The respondents further elaborated that there was very little discrimination between firms and it was common to meet with employees from other companies on a regular basis. This further confirms the argument made earlier about the absence of elite formations in the Swedish construction industry. The determinants of opinion leaders were more related to personal characteristics rather than which firm they belonged to. Most respondents recognized the concept of an individual in their respective social surroundings that had good knowledge about new tools that others trusted and often turned to for guidance.

Further, representatives for the largest construction companies were asked if they perceived themselves as opinion leaders or trend-setters. The responses varied somewhat, since none of the firms had made a deeper analysis of such occurrences. Henrik Friman, Depot Manager Power Tools at Lambertsson believed that they regionally influenced the power tool market regarding brand choices and argued that if they would purchase a certain brand of tools it would increase the sales from other customers as well<sup>18</sup>. Mirza Palislamovic, South District Buyer at Skanska Maskin was unsure about how external companies viewed them, but believed that they had a great influence on the daughter companies of Skanska<sup>19</sup>. Robert Bennerheim, Purchasing and Work Environment Manager at NCC believed that they indirectly did set trends through pressure exerted on suppliers, mostly concerning ergonomics and work environment, which affected the whole industry<sup>20</sup>.

The results differ whether or not the largest construction companies are opinion leaders in the Swedish construction industry. While the informant's ratings method indicated them as opinion leaders, it failed to gain support by the sociometric method and gained inconclusive results from the self designated method. However, the largest construction companies are national actors and present in all parts of Sweden, which make their decisions visible to most other construction firms. Further, all the large firms have adopted Impact drivers to some extent and see an increase in the usage of them.

Further support of the existence of local, personal opinion leaders was gained through interviews with sales representatives at Hilti Sweden. Roger Eriksson, Hilti Account Manager, described a certain customer that influenced other firms in his regional contact network<sup>21</sup>. Roger had even gained indirect sales through recommendations from this particular customer. The customer did not belong to a large firm, it currently employed 8 people, but the person was considered knowledgeable by other construction workers from other firms.

The possible existence of another group of opinion leaders was expressed by sales representatives from two retailers<sup>22</sup>. Both expressed, independently and unprovoked, that an appearance in "Äntligen Hemma" (a famous home improvement television show) through its front figure Martin Timell would increase the sales of Impact drivers, even for the professional segment. This suggests that there may exist celebrity opinion leaders involved in

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<sup>18</sup> Henrik Friman, Lambertsson Depot Manager, 2011-06-17

<sup>19</sup> Mirza Palislamovic, Skanska Maskin South District Buyer, 2011-06-15

<sup>20</sup> Robert Bennerheim, NCC Purchasing and Work Environment Manager, 2011-06-27

<sup>21</sup> Roger Eriksson, Hilti Account Manager, 2011-06-15

<sup>22</sup> Sales representatives from Beijer Bygg and Tools, 2011-04-19

construction related television broadcasts that can work as a trend setter in the Swedish construction industry.

While the largest construction firms, certain local actors and celebrities have attributes related to opinion leadership, none have been directly utilized in the promotion process of Impact drivers. There have been no efforts by change agents to utilize opinion leaders in order to affect the opinions of their followers as presented by theory, at least not in an organized manner.

### **5.2.3 Summary**

There seems to be an absence of elite, homophilious networks within the Swedish construction industry and a rather open information climate with many interactions between firms. This enhances the information spread through personal networks and mouth-to-mouth mechanisms. There seem to be a mixture of opinion leaders present in the Swedish construction industry, the large construction companies present at all parts of Sweden along with the knowledgeable local opinion leaders present in regional networks. While many opinion leaders are currently adopters of Impact drivers, none have been utilized by change agents in the diffusion process.

### 5.3 Change agent efforts

This section analyses the marketing efforts performed by various change agents currently making direct profit from the sales of Impact drivers along with an investigation of other possible change agents. While the two previous sections have described the demand side factors and the system in which the Impact driver is diffusing, this section focuses on the supply side efforts of increasing the diffusion of Impact drivers.

An obvious way a change agent can work to increase the diffusion of an innovation is through marketing. Because of the structure of the supply side of the Swedish construction industry, there are two levels of tool suppliers; manufacturers and retail/rental services. Both these levels have the means of marketing Impact drivers in different ways. The marketing efforts of the change agents will be guided by the concept “marketing mix” and the “four p” classification; product, price, place and promotion.

#### 5.3.1 Product

The core product here is naturally the Impact driver, and the only change agent on the market that can directly affect the product attributes are the tool manufacturers. Since the product dimension deal with the relation between the conformances of product attributes to customer needs, it is interesting to investigate the product launches of Impact drivers. While it will not measure the conformance between the actual product and the needs of adopters, it will serve as an indicator to whether change agents strive to update their respective Impact drivers to the needs of the customers. The number of Impact driver product launches in Sweden is presented in Figure 12 below.

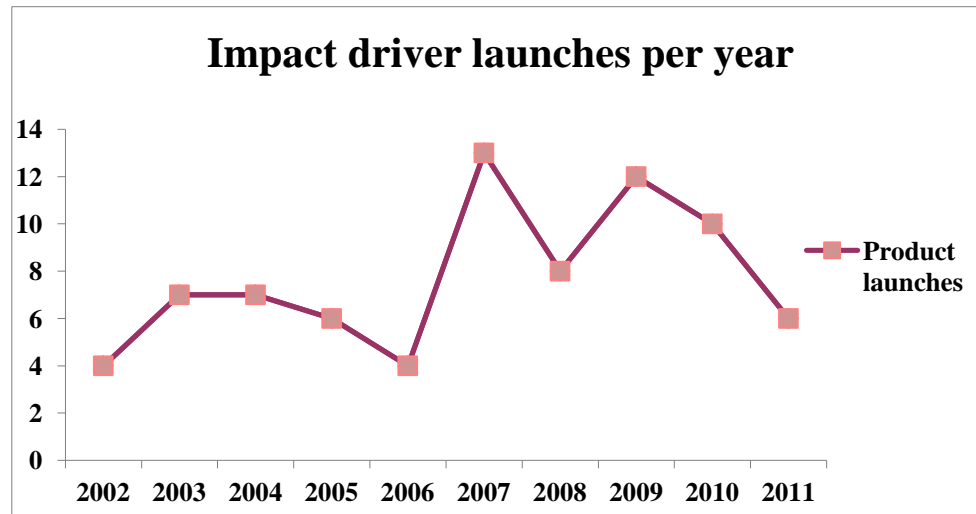


Figure 12. Impact driver launches per year<sup>23</sup>

Figure 12 shows that Impact driver launches are mainly connected to some technology improvement. A greater number of tools were developed and thus introduced along with the Li-ion battery technology improvement in 2007. However, the advantages of Li-ion are applicable for all battery powered tools leading to a similar effect for other tools in the portfolio beside the Impact tool. The brushless motor technology, introduced in 2009 by Hitachi, is also applicable for tools other than the Impact driver since it shares the same DC motor technology.

<sup>23</sup> Hilti, Makita, Hitachi, DeWalt, Bosch and Milwaukee. Details can be found in Appendix IX.



However, all improvements to the Impact drivers are not platform based. In 2007, Makita launched an oil-pulse Impact tool, where the torque is generated by oil pressure. This significantly reduced the inherent noise of the tool, however at the cost of torque. The second Impact specific improvement is the 4-in-1 tool introduced by Makita in 2008. In essence, the Impact driver was combined with a conventional drill driver, making it possible to turn on and off the Impact function.

There does not seem to be a trend of either increasing or decreasing focus from the tool manufacturers in regards to product improvement and development. The Impact driver is frequently updated with features that can be applied through the whole product platform and is not neglected in any way. While most features and updates are not unique to the Impact driver but applied to all products in a manufacturer's portfolio, certain manufacturers have started experimenting with solutions to known drawbacks of the tool, such as Makita's sound dampening oil pulse version.

### **5.3.2 Price**

Since the focus of this study is on the professional customer segment, sales are usually business-to-business. The pricing of Impact drivers includes two dimensions; the price set from manufacturer to retailer/rental service, and the price set from retailer/rental service to the end customer. Because of the secretive nature of the pricing data between manufacturer and retailer, prices have been gathered from popular websites selling professional tools (Appendix VI). This price is adequate in order to give an indication of the current pricing of Impact drivers. In order to give a relation, the Impact driver prices are compared to the price of drill drivers.

In average, Impact drivers are 30 % more expensive than conventional Drill drivers with comparable specifications. Assuming that the resellers are not repositioning the prices from the tool manufacturers, the higher price implies that tool manufacturers are using a skimming price strategy. A skimming price strategy is affecting the diffusion of Impact drivers negatively, since the price becomes a barrier for customers with a low willingness to pay and thus fewer quantities are being sold. This is especially true for an innovation where the uncertainty and perceived risk for the buyer is higher than when dealing with conventional and well known products.

A common way of indirectly discounting tools is through bundling multiple tools together in cases or soft bags, calling them tool kits or combo kits. This is done by the manufacturers who then deliver the tools to retailers in custom designed cases. A tool kit consists of 2-6 tools together with a number of batteries and a charger. The most common tool kit on the Swedish market today is consisting of one Impact driver and one Drill driver, two batteries and a charger. Out of 43 available tool kits on the market, 23 include these two tool types, see Appendix VII for details. For a customer, a tool kit is less expensive than buying the parts individually, in order to invoke an impulse buying behavior. By combining the Impact driver with the traditional Drill driver along with a price discount, tool manufacturers are looking to decrease the resistance to buy a completely new tool type by bundling it with a tool type the customer knows well. Thus, this combination of discount and bundling with known products is affecting the diffusion of Impact drivers positively since a large portion of the Impact drivers are sold as a part of a toolkit<sup>24</sup>.

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<sup>24</sup> Daniel Kristensson, Hilti Product Manager, 2011-04-04

### 5.3.3 Place

The place dimension of the marketing mix refers to how the Impact driver is distributed to the end customer. There are two types of value chains starting from the tool manufacturer. As previously mentioned all manufacturers distribute the Impact driver through retailers. The major retail firms have stores distributed across Sweden which in turn sells Impact tools to construction firms. Hilti Sweden, on the other hand keeps all sales in house through a direct sales force and Hilti shops. The Impact driver is also available to rent from all the major rental services, which like the retail chains are present in all parts of Sweden. In addition, tool manufacturers, retailers and web companies offer Impact drivers in their online stores.

With all suppliers aggregated, the Impact driver is sold in through retail stores, web stores, through direct sales personnel and is additionally available for rent. There is no geographical barriers and all major retailers, rental services and manufacturers have the Impact driver in their product portfolios. Thus, the availability and accessibility of the Impact driver is not a barrier for the diffusion.

### 5.3.4 Promotions

Promotions concern the various methods of promoting the Impact driver utilized by manufacturers, retailers and rental services.

#### **General mass media promotions**

A common way of promoting products is through mass media advertising. However, when investigating written media about Impact drivers in Sweden, it became apparent that any type of communication through mass media about Impact drivers is rather rare. Between 2005 and 2011-05-25, the Impact driver was mentioned 37 times in industry specific newspapers, see Appendix I for details. Of these 37 times, 17 were as a part of information concerning a product platform. Only one of the occurrences was an advertisement while the 19 remaining were press releases from the tool manufacturers. The press releases were seeking to inform potential adopters about a new generation of Impact tools along with its specifications. Since 2005, no effort of explaining neither, the relative advantage, the suitable applications nor the benefits of the Impact technology in mass media has been undertaken. The lack of public knowledge creation is deviating from Rogers (2003) note on the roles of change agents. According to Rogers (2003), the first roles of change agents are to create a need for change and to establish an information exchange relationship. The importance of mass media in conjunction with interpersonal communication is important for enhancing the rate of adoption in the early stages of the diffusion of an innovation. This situation is further cemented by the Product Manager Daniel Mattinson at Makita Sweden: “Marketing through mass media is very inefficient. /.../ demonstrating the tool at construction fairs, where the customer can try out the tool, is what works the best.”<sup>25</sup>

#### **Manufacturers’ promotions**

In order to explore the specific promotions of manufacturers, the product catalogues and Swedish websites of each manufacturer was investigated. Four out of six manufacturers promoted their whole battery platform at the front-page of their respective website. Only Makita included the Impact driver in a slideshow at the front-page with the rather unclear description “Ultimate Impact” written in English. There was no clear promotional effort focusing on Impact drivers on any of the websites investigated; the tools that yielded the most space and recognition on the websites were hammer drills and breakers. Information about

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<sup>25</sup> Daniel Mattinson, Makita Product Manager, 2011-05-09

Impact drivers could only be found on the product page of each model, often with very general descriptions apart from technical data. The Impact driver is described along its physical dimensions, such as small, compact, light and strong. It should be noted that these descriptions are commonly used for all tools; an Impact driver described as small, compact and strong can be placed alongside a drill driver with the exact same description. All in all, the promotional efforts from manufacturers' websites fail to distinguish what makes Impact drivers unique from other tool types.

### **Retailer and rental services promotions**

The retailer promotions were investigated through a combination of visits to seven retailer stores as well as an investigation of the websites of each retailer. Since the rental services do not display tools at their respective locations, only websites were included in the investigation. In six of the seven retail stores visited, the Impact drivers were displayed along drill drivers without any information about the differences between the tool types and in one store the Impact driver was not on display at all. Only one of the retail stores promoted actively a sole Impact driver through an 8% discount. During interviews with sales personal at the retail stores it was clear that the promotion of Impact drivers from the sales staff varied greatly depending on the sales representatives own opinions and beliefs. Only one sales manager indicated that he actively tried to promote Impact drivers to customers while two sales managers focused on the drawbacks of the tool type and indicated that they should be used only when necessary.

When investigating the websites of the same retailers, the Impact driver was only present in the promotions of three current offerings, all times included in a tool kit with a drill driver. All other Impact drivers were hidden deep into the product catalogue and not promoted in any way through the website.

The websites of rental services are a bit different from the retailers'. Since rental services are not selling tools, the focus is on the larger machines that are conventionally rented because of their cost of capital when not utilized. None of the five investigated rental websites contained any information about Impact drivers apart from the fact that they were present in the product catalogue of each rental service. During interviews with four rental services, it was clear that the physical location of the stores served merely as pick-up-points and that very little promotion was done at the site.

### **Promoted application areas**

Interviews with suppliers of Impact drivers showed that the opinions about what applications the tool type is suitable for differs greatly depending on the respondent. While other tool types have distinct application areas, such as hammer drills for drilling in concrete and sticking saws for certain kinds of woodwork, the Impact driver lacks such clear distinctions. This is very interesting from a diffusion perspective since it means that potential adopter may gain very differing information about the functionalities of the tool type.

Hilti described the tools as a specialized tool for a particular screw anchor designed for direct fastening in concrete<sup>26</sup>, Makita described it as the only tool designed only for screwing and applicable for all screwing applications<sup>27</sup>, Ramirent described it as a tool solely for driving bolts and nuts<sup>28</sup> and Tidermans described it as useful during heavier applications such as

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<sup>26</sup> Vivek Sannabhadti, Hilti Global Product Manager Impact Drivers, 2011-04-12

<sup>27</sup> Daniel Mattinsson, Makita Product Manager, 2011-05-09

<sup>28</sup> Ramirent sales representative, 2011-06-22

decking screws<sup>29</sup>. Representatives from Tools and Hornbach connected the tool type to a particular screw for wood called coach screw<sup>30</sup>. It is important to note that special precautions were taken in order not to confuse the tool with others. Several control questions were asked in order to assure that the respondent were discussing the right tool type.

While most of the suppliers agree that the Impact driver cannot be used for drilling and even state this as a drawback of the tool, manufacturers DeWalt and Bosch indicate on their respective websites that this is in fact a suitable application, see Appendix VIII.

The possible and promoted application areas seem to span from all screwing applications to very specialized application areas, which is very interesting since the tool type has been present on the Swedish market for nearly ten years. Even the possibility of drilling is debated. This variation of information inhibits the diffusion of Impact drivers since adopter will gain very different information depending on his/hers information sources. This stalls any collective knowledge (Dubois and Gadde, 2002) about the Impact driver to be created within the industry and varying opinions can prevail.

### **Name of the innovation**

Another factor that increases the confusion about Impact drivers in Sweden is the name of the innovation. Impact drivers descend from the tool type Impact wrenches, which is commonly used in the car industry. The Swedish name for an Impact wrench is “mutterdragare” which translates into “Nut runner” clearly indicating that the application for the tool is to fasten nuts. An Impact driver is called “slagskruvdragare” in Swedish, which translates into something like “Impact screwdriver”. However, as the “slagborr” (hammer drill) and “Skruvdragare med slagfunktion” (Drill driver with hammering function) are also containing the word “slag” (Impact), there is confusion about the tool type. During several interviews with retail store salesmen, the tool type discussed had to be shown and explained to the salesman before the interview began. Further, the name “slagskruvdragare” is not commonly used by either manufacturers or operators. A large variety of nicknames exists, most relating to nut fastening applications. This has led to many misconceptions during the study and answers from the survey such as “You should aim your study at the car industry” and “We only use Impact drivers (mutterdragare) to change the tires on our cars”.

In order to try to create consistency, Bosch has chosen to call both the Impact driver and Impact wrench “mutterdragare”, see Appendix VIII. However, the consistent name is no longer explaining the intended areas of use with the product, since “mutterdragare” only associates with nut- and bolt- running applications. Milwaukee, on the other hand calls the Impact driver both “slagskruvdragare” and “mutterdragare” (Appendix VIII) while Hitachi, Hilti and Makita calls Impact drivers “slagskruvdragare” and Impact wrenches “mutterdragare”. Rogers (2003) notes that the name of an innovation affects the compatibility perceived by potential adopters and thus affects the rate of adoption. A potential adopter of Impact drivers will likely perceive the Impact driver as non-compatible with his or her situation if the name is not reflecting the application areas relevant to him or her. Rogers (2003) concludes that the name should be receiver-oriented and symbolizing the desired meaning for the intended audience.

For a deeper understanding, it is important to relate the promotional efforts of change agent to the stages in the decision process of a potential adopter. As presented previously in this

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<sup>29</sup> Tidermans sales representative, 2011-06-22

<sup>30</sup> Tools sales representative, Hornbach sales representative 2011-04-19

section, little mass media communication has been utilized by change agents. Therefore, the awareness-knowledge mentioned by Rogers (2003) has not been created effectively by change agents on a broad basis among potential adopters in the Swedish construction industry. Instead, much of the awareness-knowledge has been created by interpersonal communication between sales representatives and potential adopters, a rather slow communication channel for creating initial awareness in a social system compared to mass media as noted by Rogers (2003). The second step of the knowledge process, the information regarding “how-to” knowledge, is being communicated to the social system by the change agents. However, the type of information being communicated is rather confusing as mentioned in the previous section dealing with the promoted application areas. No evidence has been found that change agents have initiated any efforts to spread information to create principal-knowledge.

### **5.3.5 Non-supplier change agents**

As Rogers (2003) points out, change agents are individuals or organizations that influence innovation-decisions. Besides the suppliers acting as change agents, there are two major actors with the potential to affect the diffusion of Impact drivers in the Swedish construction industry, the Swedish construction union Byggnads and the Swedish work environment authority (SWEA). Both organizations are involved in preventing injuries and health problems for construction workers. While SWEA is concerned only with safety issues and working across all industries, Byggnads is only concerned with the construction industry but is also involved in other issues, such as salary negotiations and employment issues.

During interviews with representatives from both organizations it was clear that both organizations operated at a more general level than appointing appropriate tool types for certain tasks. SWEA only constructs general guidelines and rules which it is up for each firm to interpret and follow in its own way<sup>31</sup>. Byggnads also operates at a more general level and is trying to change ways of working and educating younger construction workers about potential hazards and long term risks. The representative from Byggnads also expressed criticism of cordless tools in general because of their relatively higher weight compared to corded counterparts<sup>32</sup>.

This suggests that while certain regulations from SWEA or requirements from Byggnads could affect the diffusion of Impact driver either positively or negatively, neither organization is currently working as a change agent.

### **5.3.6 Summary**

While the Impact driver has received certain updates and improvements since its launch in 2002, most improvements have been applicable to all battery tools. There have been some efforts lately from manufacturers to mitigate some of the known drawbacks of the tool type. The pricing of Impact drivers are currently inhibiting the diffusion because of the skimming price strategy utilized by suppliers. However, the effects are somewhat lessened because of the indirect discounting through tool kits. The Impact driver is distributed through all available channels and is present in all supplier product catalogues.

The promotional efforts from change agents are almost nonexistent. There has been close to no mass media marketing and none of the change agents seem to include the Impact driver in their promotional efforts. There does not seem to be any actor on the supply side that actively

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<sup>31</sup> Svarstjänsten, Arbetsmiljöverket, 2011-05-06

<sup>32</sup> Jörgen Eriksson, Work Environment Manager Byggnads, 2011-06-15

drives the diffusion of Impact drivers. Further, the promoted application areas is subjected to debate which creates confusion about what the tool actually can do. This is increased further due to inconsistent naming of the innovation. In summary: the product and the place dimensions are currently increasing the diffusion of Impact driver while the price and promotion dimensions are currently inhibiting the diffusion of Impact drivers.

## 5.4 Communication Channels

This section aims to describe what communication channels that have been utilized in order to spread information about Impact drivers in the Swedish construction industry. There is a clear link to the previously described change agent efforts since change agents often are the ones initializing communication channels. This section is divided between mass media and interpersonal communication channels and is based on the theories of when each channel is most appropriate.

### 5.3.1 Mass media communication channels

In order to investigate to what extent mass media communication channels have been utilized, a content analysis of publications related to the Swedish construction industry was conducted. Even though there exist product placements of power tools in certain Swedish television programs, such placements is focused around displaying the manufacturers brand rather than presenting benefits of certain tool types. Therefore, the focus of this section is on printed publications.

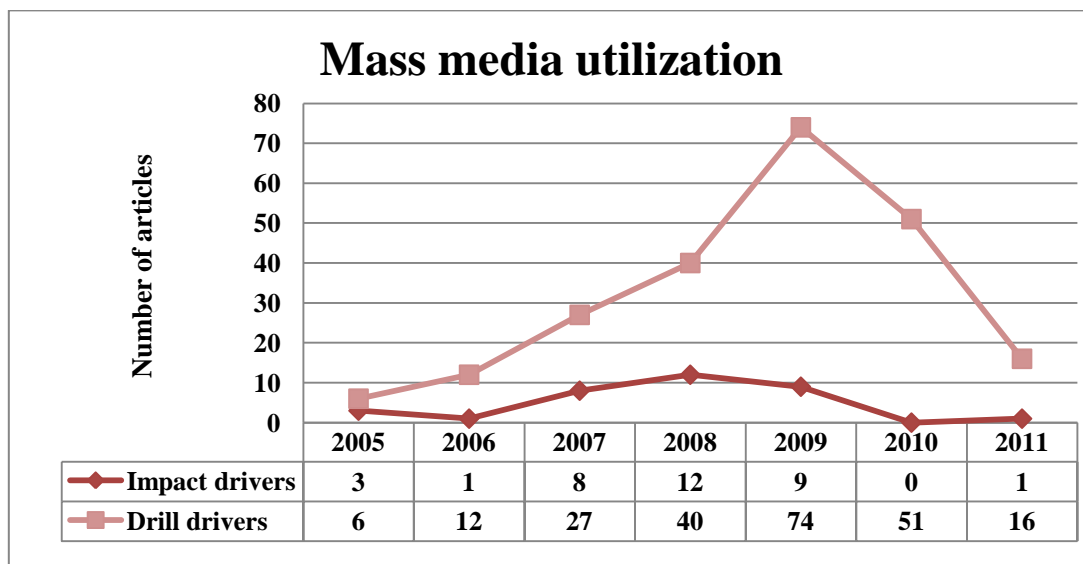


Figure 13. Number of articles per year, Impact versus drill drivers.<sup>33</sup>

There is no clear trend whether the focus from the mass media is increasing or decreasing. The peak in articles about Impact drivers in 2008 correlates well with the introduction of lithium-ion based batteries and the launch of many new products. Looking more closely at the data, there are few articles focused only on Impact drivers. Only 19 of the 37 articles are solely about Impact drivers, while 17 is about new product platforms where the Impact driver is mentioned as a parenthesis. The details of the analysis can be found in Appendix I.

Further, an investigation of a number of other publications was made as well. Since the articles of these publications were not categorized according to time of print, the data shows only how many times Impact drivers are mentioned in each magazine. Again, drill drivers are included for comparison. The results of the investigation are shown in Table 8.

<sup>33</sup> Business Retriever, 2011-06-01; Svensk Rental Tidning, 2011-05-25

**Table 8. Number of articles about Impact and drill drivers.** <sup>34</sup>

Source	Drill drivers	Impact drivers
Byggnadsarbetaren	13	0
Husbyggaren	3	0
Gör det själv	43	0
Byggnyheter	6	4
DMH	3	0

Again, it is a clear focus on drill drivers in comparison with Impact drivers. An interesting point is that “Gör det själv” and “DMH” have made five and three evaluating tests of different drill drivers respectively, but has never written anything about Impact drivers.

The results from the mass media analysis are supported by data gathered from the survey. Only three of a total 59 respondent firms (5%) answered that they had first heard about Impact drivers from mass media. While Rogers (2003) argues that mass media is more effective in spreading awareness knowledge than interpersonal channels it seems that awareness is relatively high regarding Impact drivers; 87% of the respondents declared that they knew what an Impact driver is. However, 13% are still unaware of the technology, nine years after its introduction.

To summarize, the Impact drivers has not been given much room in the mass media spectrum investigated. In the few articles where the Impact driver appears alone, there is not much focus on the technology but instead general press releases about a specific tool from a specific manufacturer. There does not seem to be a trend of increasing focus in mass media, rather the opposite.

### 5.3.2 Interpersonal communication channels

Interpersonal communication channels are persons that are working as a medium to deliver a specific message from a sender to a receiver (Rogers, 2003). Therefore, the interpersonal communication between construction workers is excluded.

While Hilti Sweden has a direct sales force, all the other tool manufacturers are reliant on retailers or rental services for their direct customer interaction and thus also the interpersonal communication. However, at certain construction fairs there are representatives from other tool manufacturers present which gives a certain chance for interpersonal communication. At a construction fair held by the Swedish retailer Tools<sup>35</sup>, hand tool manufacturers Milwaukee, Bosch and Metabo were present, all with a clear focus in their display on battery driven tools for driving and drilling. The intention was clearly to interact with the construction workers and inform about new power tools. There are 14 similar construction fairs with various themes and focus areas planned for 2011 in Sweden<sup>36</sup>. Since these events are virtually the only direct customer interaction the hand tool manufacturers engage in, their overall ability to utilize interpersonal communication channels is very limited.

<sup>34</sup> Byggnadsarbetaren, [www.byggnadsarbetaren.se/](http://www.byggnadsarbetaren.se/), accessed 2011-06-22

DMH, [www.denmodernahantverkaren.se/](http://www.denmodernahantverkaren.se/), accessed 2011-05-29

Gör det själv, [www.gds.se](http://www.gds.se), accessed 2011-06-22

Byggnyheter, [www.byggnyheter.se](http://www.byggnyheter.se), accessed 2011-06-22

Husbyggaren, [www.husbyggaren.se/](http://www.husbyggaren.se/), accessed 2011-06-22

<sup>35</sup> Tools on tour, Örebro, 2011-05-19

<sup>36</sup> Fairlink, [www.fairlink.se/web/Search\\_Trade\\_Fairs\\_in\\_the\\_Nordic\\_Countries.aspx](http://www.fairlink.se/web/Search_Trade_Fairs_in_the_Nordic_Countries.aspx), Accessed 2011-06-28  
Expo Database, [www.expodatabase.com](http://www.expodatabase.com), Accessed in 2011-06-28



The exception from above is Hilti Sweden which uses a direct sales force in combination with 14 retail centers, fully operated by Hilti. Hilti Sweden conducts in over 2000 daily customer interactions and thus has vast opportunities for interpersonal communication. It is difficult to estimate how much of this communication that concerns Impact drivers, since the Hilti staff also manages a rather large product portfolio with over 13 product categories ranging from hand held power tools to fire protection systems.

From the survey it is clear that interpersonal communication channels have played a more important role than its mass media counterpart in creating awareness around Impact drivers. 16 out of 59 respondent firms (27%) indicated that they acquired first knowledge of Impact drivers due to direct interaction with a sales representative. Even though mass media is more effective in creating awareness knowledge (Rogers, 2003) it seems like the tool manufacturers and retailers are focusing on using interpersonal communication channels instead. This is also supported by a Hilti sales representative who experienced often having to take an educational role when meeting new customers regarding Impact drivers<sup>37</sup>.

It is clear that visits to retail stores and rental companies offer construction workers a chance to have an interpersonal exchange about Impact drivers. However, both these types of companies are also acting as interpersonal communication channels for a vast product portfolio that spans from heavy machinery such as trucks to consumption articles such as screws and fixings. During visits and interviews with seven retailers and three rental services, only one sales manager indicated that he actively steered the conversation towards Impact drivers when customers were considering various tools for driving screws.

### **5.3.3 Summary**

Mass media channels have not been utilized to any major extent in order to spread information about Impact drivers. This is in contrast with theory which states that mass media communication channels are most effective in the early stages of the diffusion process in spreading awareness knowledge. This has led to a relatively high unawareness about the technology.

Interpersonal communication channels differ between the different sources of communication. Retailers and rental services have the most opportunity to interact on a personal level with customers, but all have such large product portfolios that very little communication about Impact drivers are performed. Manufacturers all have very limited opportunities to engage through personal channels, with the exception of Hilti Sweden. While Hilti Sweden does engage in a lot of customer interaction, it is very difficult to estimate how much of this communication is concerning Impact drivers.

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<sup>37</sup> Roger Eriksson, Hilti Account Manager, 2011-04-18

## 5.5 Perceived Attributes of Impact Drivers

The perceived attributes is the most influential factor in describing diffusion and rate of adoption of innovations. The factor can be viewed as the sum of all other factors since it all comes down to how the decision maker perceives the innovation in an innovation decision process. This section aims at quantifying as well as giving an overview of general perceptions along with the perceived attributes presented by previous theory of Impact drivers in the Swedish construction industry. An investigation of what perceptions differ most between adopters and non adopters is also included.

### 5.5.1 General perceptions of Impact Drivers

As described in chapter 5.3.4; one thing that has been apparent during this research is that the actual application areas for Impact drivers are somewhat debated. This has obvious ramifications for potential adopters since they will perceive the tool differently depending on what applications they are informed that the tool can be used for.

34 construction firms answered the question regarding what applications they use the Impact driver for. The answers were then divided into four categories. Note that the responses “Everything” and “Heavier applications” may contain applications such as concrete anchors, bolts and nuts along with other applications. The answers are summarized in Table 9 below.

**Table 9. Application areas for Impact drivers**

<b>Application</b>	<b>Nr of answers</b>
Everything	15
Heavier applications	14
Concrete anchor	3
Bolts and nuts	2

Based on this sample, the majority of adopters seem to use the Impact drivers for either all screwing applications or all heavier applications where the strength of the tool is useful. It is very interesting to see the discrepancy between the views of the supply side and demand side.

The respondents were also asked about their perceived advantages and disadvantages of Impact drivers. The answers were categorized and quantified according to number of times mentioned, which means that there may be several answers from the same firm. The advantages are summarized in

Table 10.

**Table 10. General advantages of Impact driver**

<b>Advantages</b>	<b>Nr of answers</b>
Ergonomics	21
Efficiency	15
Torque	12

The ergonomics category includes all aspects of ergonomic advantages such as tool weight, size and the absence of counter torque in the operator’s hand. The efficiency category includes time savings and the ability to do heavier applications with less effort. The torque categories include pure strength perceptions such as high tightening power and high torque. There ergonomic advantages seem to be the foremost appreciated feature of the Impact driver, followed by efficiency and torque. While these are the most appreciated features of the Impact

driver of current adopters, they do not correspond well with the promotions of change agents. Even though high torque is common to promote and somewhat appreciated, it is surpassed by two other beneficiary categories that are not as commonly promoted by change agents.

The disadvantages were measured in a similar way and are summarized in Table 11.

**Table 11. General disadvantages of Impact drivers**

Disadvantage	Nr of answers
Noise	15
Nothing	9
Vibrations	8
Unability to finetune screw	6

The highest noted disadvantage was the noise of the tool. Many respondents indicated that ear muffs were mandatory when using the tool. Vibrations were named a disadvantage eight times, which is something that no suppliers have mentioned as a possible drawback of Impact drivers. Also, while the Impact driver apparently is perceived as having certain ergonomic advantages, it is also perceived as having a disadvantageous ditto within the same category (vibrations). Finally, the inability or difficulty of finer work, such as working with more brittle materials was named six times as a disadvantage. It is also interesting to note that nine respondents did not find any disadvantages with the tool type.

### 5.5.2 Survey results of perceived attributes of Impact Drivers

The total sample size for the investigation of perceived attributes was 52 subjects, with a mixture of both current Hilti customers (27%) and random construction companies (73%). The respondents were divided into adopters or non adopters based on a question about if they were currently using an Impact driver. There are 32 adopters and 20 non adopters in the sample based on this division. Each attribute is measured through a series of statements from which the respondent indicate on a seven point Likert-scale how much they agree with the statement. The answers are then combined in order to create a uniform measurement for each attribute. Table 12 below shows the mean of all respondents and all items for each attribute. The attributes are sorted according to highest difference between adopters and non adopters.

**Table 12. Attribute means and differences between adopters and non adopters**

Attribute	Adopters	Non-Adopters	Difference
Compatibility	5,06	3,85	1,21
Relative advantage	5,16	4,23	0,93
Visibility	5,41	4,72	0,69
Forced changes	4,94	4,35	0,59
Result demonstrability	5,53	5,13	0,41
Ease of use	5,98	5,60	0,38
Trialability	5,26	5,35	-0,09

As seen in Table 12, the results are generally high or neutral amongst both adopters and non adopters. There are very few negative attitudes within a particular attribute apart from “Compatibility” for non adopters, which is slightly below the neutral value. The highest overall rating is the “Ease of use” attribute, which indicates that the tool is both perceived to be and actually is easy to use.

Besides the comparison of total means for each construct, a t-test for Equality of Means was conducted (See Appendix X for details). The results showed that for a confidence interval of 95% only “Relative Advantage” and “Compatibility” showed significantly differing means, with “Visibility” just outside the range (alpha of 0,083). However, "Visibility" has been brought up by experts as an important factor when marketing any tool type and is therefore included as a significant factor<sup>38</sup>. The factor with the largest difference between adopters and non adopters is “Compatibility”, which is based on the statement “I think that using an Impact driver fits well with how I like to work”. Apparently, adopters find the Impact driver more compatible with their working style than non adopters. Further, “Triability” shows the least difference and even signifies a slight negative Impact on adoption. This has several explanations, one being that the interviews with Hilti customers were conducted in direct proximity of Hilti centers, which are equipped with testing facilities. It is also important to remember that adopters are responding to their actual trial experiences and non adopters are responding to their assumed ditto. This may seem trivial but has some consequences; non adopters assume that they would be able to try an Impact driver before purchase and know where they can turn to try various applications for Impact drivers, but the action of actually trying the tools will require some effort from their part, e.g. driving to a Hilti center or visiting a retailer. Therefore, the action of actually trying an Impact driver for a non adopter would have to be triggered by an inherent need, unless it is offered by a change agent.

To further study which perceived attributes that affects adoption, a discriminant function analysis was conducted, see Appendix IV for details. While comparing mean answers only give some insight to the affecting attributes, a discriminant function analysis fits a linear function to the attributes in order to predict if the respondent is an adopter or non adopter. The most interesting aspect of this function is the explanatory values of the attributes, shown in Table 13 below.

**Table 13. Attributes ordered by absolute size of correlation within function**

	Function
	1
Relative Advantage	,766
Compatibility	,725
Visibility	,588
Result Demonstrability	,350
Ease Of Use	,349
Forced Changes	,339
Trialability	-,060

As seen in Table 13, “Relative advantage”, “Compatibility” and “Visibility” are the attributes that best explains if a respondent is an adopter or non adopter. “Result demonstrability”, “Ease of use” and “Forced changes” all show some degree of significance to similar extent, while “Trialability” shows almost no significance at all.

<sup>38</sup> John Gauffin, Hilti Sales Director North, 2011-04-06

Looking more closely at the questions within the “Relative Advantage” category, there are three questions where the answers vary greatly between adopters and non adopters. A summary of these is show below in Table 14.

**Table 14. Questions with the highest difference between adopters and non adopters regarding relative advantage**

<b>Relative advantage</b>	<b>Adopters</b>	<b>Non-Adopters</b>	<b>Difference</b>
Using an Impact driver allows me to accomplish tasks more quickly	5,41	4,00	1,41
Using an Impact driver makes it easier to do my job	5,59	4,25	1,34
Using an Impact driver enhances my effectiveness on the job	5,59	4,30	1,29

It is very interesting to see that adopters find that Impact drivers make work easier, accomplished quicker and more effectively than the perceived ditto of non adopters. Since the tasks performed with Impact drivers are of such a general nature that almost every construction firm perform them, the best explanation cannot be that the firms perform different tasks and therefore perceive the Impact driver differently. The difference in perception might be explained by the differences in opinions by suppliers about what the tool can actually be used for. Non adopters might have gotten information that the Impact driver only can be used for tightening bolts and nuts and thus does not see any relative advantage compared to their current working methods. This may also explain the large difference in compatibility values.

“Visibility” also showed a large explanatory value. This is something general for all tool brands since all tool manufacturers decorate their specific tools in bright colors to increase visibility and recognition at building sites. The largest difference between adopters and non adopters in this category referred to the statement that “I often see Impact drivers at building sites where I work”, which differed by 1,5. This might indicate that the Impact driver spreads through regional networks and building sites where non adopters come into contact with the tool type. This is also in line with the arguments made in chapter 5.2 as well as the observations made by Bresnen (2003) and Dubois and Gadde (2002).

Since “Trialability” showed such a surprisingly low significance for adoption and the suppliers had indicated the importance of demonstrations when selling Impact drivers<sup>39,40</sup>, this attribute was further investigated through the use of a prototype of a new generation of Impact drivers from Hilti Sweden. The prototype was handed out to a previous Hilti customer for two weeks during which he and his firm were encouraged to try various applications that they usually did not conduct with an Impact driver. Interviews were held both before and after the trial period. The pre-test interview included general questions about trialability of hand held power tools. The respondent indicated that it was only Hilti Sweden that allowed its customers to try tools in their daily work. Other, less satisfactory, opportunities to try tools included very limited applications at retailers or to actually rent the tool from a rental service. Such differences between trial opportunities can shed some light into the low significance for

<sup>39</sup> Daniel Mattinsson, Makita Product Manager, 2011-05-09

<sup>40</sup> Daniel Kristensson, Hilti Product Manager, 2011-04-04

trialability from the survey results. There is no way of knowing what type of trial opportunity the respondents in the survey are referring to. The post-test interview indicated that the attitude to the tool type had increased positively and that the respondents had tried new applications that they previously had used a drill driver for with satisfactory results. All in all, the investigation of “Trialability” showed that the low significance from the survey results might be misleading and that it actually does have an effect on adoption.

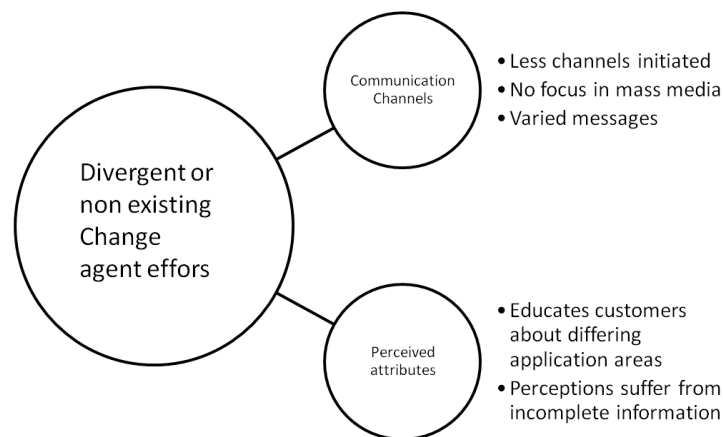
### **5.5.3 Summary**

To summarize the perceived attributes; the three attributes that most significantly affects the adoption of Impact drivers are “Relative advantage”, “Compatibility” and “Visibility”. The differences in perception of “Relative advantage” and “Compatibility” between adopters and non adopters might be explained by differing information from change agents, while “Visibility” may indicate that the technology spreads through regional networks such as building sites, which would fit with the observations made about the nature of the social system. Further, “Trialability” showed a low significance from the survey results but might be higher in reality due to a large variance in trial opportunities.

## 6 Discussion and conclusions

*This section summarizes and discusses the most important aspects of the analysis along with concluding remarks and answers to the research questions. A section about which factors that can successfully be affected by the supply side in order to increase diffusion is also included.*

The most notable aspect of this diffusion study is the change agent efforts. In the ideal case an innovation is driven by clear change agents that work towards increasing the adoption and diffusion rates. However, in the case of Impact drivers, the change agents all have large product portfolios to consider which makes focusing on only one product problematic. The change agents are all profit maximizing firms, and an effort to increase the diffusion of Impact drivers might not be the best use of resources for each firm. This has led to the absence of any “true” change agent for Impact drivers which has effects on other factors affecting the diffusion process, most clearly on “Communication channels” and “Perceived attributes”.



**Figure 14. Change agent efforts effects on other factors**

The communication channels are negatively affected by the lack of focus from change agents. The use of mass media has been very limited when spreading information about Impact drivers which has led to relatively low awareness about the innovation. Although the interpersonal channels have helped to spread some awareness, they are not utilized to change the attitudes of potential adopters to a large extent. As long as the customer buys any item from the product portfolio, the change agent is usually content and does not actively attempt to promote particular products. This is in great contrast with theory which states that mass media channels are most efficient in spreading awareness and interpersonal channels most efficient in changing strongly held attitudes (Rogers, 2003).

The perceived attributes of Impact drivers are affected by the message that change agents deliver about the application areas and benefits of the tool type. The analysis has shown that there is large disarray between different change agents about what the application areas for Impact drivers actually are. Since a large proportion of the adopters use sales people from the manufacturers or retailers as information sources and for advice, they presumably get very different information. Attributes such as “Relative advantage” and “Compatibility” (which are the most important in explaining adoption of Impact drivers) are highly dependent on information gained from change agents. Since there are great differences between the suitable application areas named by change agents and the applications adopters actually used the Impact driver for, certain change agents promote applications that are neither seen as

compatible nor as a relative advantage by the bulk of the market. A more unified message including the applications where the current adopters have found the most benefits would positively affect the total diffusion of Impact drivers in the Swedish construction industry.

Another factor that affects the perceptions about “Relative advantage” and “Compatibility” is the name of the innovation. It is not hard to understand that a tool named about driving nuts is not seen as compatible or beneficial for the average construction firm. The disarray of names for Impact drivers enhances the misconceptions about the application areas the tool can be used for. Further, the “correct” name is easily confused with other tools with totally different application areas.

Both the varied messages from change agents and the name confusion can explain the low effect from “Trialability” derived from the survey. It does not matter if a non adopter knows where he or she can try application areas of Impact drivers as long as he or she thinks it is a tool that has no benefits nor is compatible with his or hers working methods. There is no incentive to actually try a tool that apparently is for driving nuts, even though the potential adopter knows where it can be done.

There are certain actions performed by change agents that have a positive effect on the diffusion. The vast use of combining the Impact driver with another tool in a tool kit at a reduced price is a way of reducing uncertainty for the adopter and thus increasing the spread of the tool type. However, it is very interesting that the most common tool used in tool kits with Impact drivers is the drill driver. Even though drill drivers are very familiar to all construction workers, the tool can be seen as somewhat a substitute to Impact drivers. This may be a strategy towards decreasing the threat of cannibalization within the product platform and selling two tools at a reduced price instead of just one. Further, the Impact driver is present in all manufacturers’ product portfolios and also through the vast majority of retail stores and rental services. The Impact driver is thus present at all locations where tool purchases are performed, which is positive from a diffusion perspective.

Although the change agent efforts have not been in line with the theoretic ideal for increasing diffusion and adoption, the Impact driver has already diffused to a certain extent. The explanation for this lies in the nature of the social system. Information seems to spread easily through the Swedish construction industry because of the absence of strong, homophilious formations and the many interactions between firms. This is also supported by the fact that most adopters had first heard about Impact drivers from colleagues. Another explanation lies in the innovation- or purchasing decision process. Since a large percentage of firms involve many people from several organizational levels in the decision process, there is a greater chance that someone involved has come into contact with Impact drivers and includes them in the discussion.

The factors presented affecting the diffusion of Impact drivers can be divided according to the effect they currently have on the diffusion process.



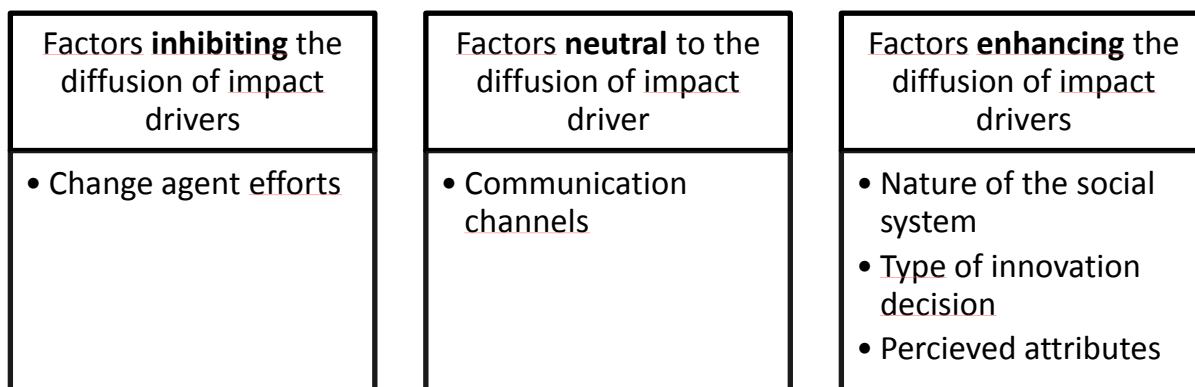


Figure 15. Factors categorized according to effect on diffusion

The inhibiting factor is currently creating misunderstandings about the innovation and thus is damaging the potential diffusion. Though not all change agent efforts are bad for the diffusion process, the factor as a whole is considered to belong in the inhibiting category. While the perceived attributes are affected by several of the other factors, adopters rate the Impact driver very high along the most important dimensions and therefore the factor can be seen as enhancing the diffusion.

### ***6.1 Factors that can be affected by suppliers***

Since one of the research questions in this Master Thesis is to identify the factors that can be successfully affected by suppliers in order to increase the diffusion of Impact drivers in the Swedish construction industry, this section will discuss such factors and the effects alternative ways of intervention will have.

A factor that clearly can be affected by suppliers is the change agent efforts. The lack of a true change agent has negative effects on the diffusion and adoption rate of Impact drivers. While there may be a natural focus on product platforms rather than individual products from the manufacturers, new tool types needs special attention in order to inform potential adopters of their advantages. Since the adopters of Impact drivers are using it mostly for all screwing application or heavier screwing applications, there needs to be a change agent promoting this message. This change agent can be either a manufacturer promoting the message through mass media communication channels or a retailer promoting it through intrapersonal channels when interacting with customers. While there may be certain cannibalization aspects to consider in relation to drill drivers, the positive perceptions from adopters of Impact drivers show that there may be much to gain when promoting it before the competition. The important thing is to have a clear message that is related to the benefits and application current users have found.

The name of the innovation might be hard to affect as a supplier but it is important to steer away from any nut or bolt insinuating name combinations and focus on screw applications in general. To at least be clear in written communications, such as home pages and product catalogues is a start but might not be enough to entirely change the name, now that it has festered amongst adopters. The goal for suppliers must be a clear name of the innovation that reflects the applications and benefits of the tool and that cannot be confused with other tool types.

While the perceptions of “Relative advantage” and “Compatibility” of non adopters will be positively affected by the above presented measures, the third most important factor

“Visibility” will not. One way suppliers can affect visibility is through offering the tool on a trial basis. This means that potential adopters should be offered to try the tool at their respective building sites for a limited time in order to discover what the tool actually can do. This enhances visibility on building sites where often a large amount of firms are present while at the same time leveraging on the fact the when potential adopters gets the opportunity to try the tool, the results are often positive.

Currently, there is no organized effort from suppliers in utilizing opinion leaders in the diffusion process. While the largest firms are all adopters in some sense, their status as opinion leaders were questioned from the survey results. Regional, smaller opinion leaders should be sought out and presented with Impact drivers. If the results are positive, these regional opinion leaders will spread their perceptions of Impact drivers throughout their networks and thus increasing the diffusion. The use of celebrities could be another way of utilizing opinion leaders and at the same time increasing the use of mass media communication channels. If representatives of the most suitable television programs could be persuaded into promoting the Impact driver during a show, it would both increase awareness and act as an opinion leader affecting its followers.

Different suppliers work under different conditions and are thus differently equipped to pursue the interactions described above. However, all actions are valid in order to increase the diffusion of Impact drivers in the Swedish construction industry.

## ***6.2 Theoretical implications***

While applying the theoretical framework used in this diffusion study, several limitations were identified. Rogers (2003) presents the factors as mutually exclusive whereas this study has shown several connections between the factors. Foremost the perceived attributes of the innovation show connections with primarily communication channels and change agent efforts but is also indirectly affected by the nature of the social system. Where other scholars have sought to expand Rogers’ factors in other dimensions (E.g. Chaudhuri, 1994), none have, to our knowledge, criticized the factors for not being mutually exclusive or investigated the connections between the factors. A reason for this may be the commonality of only studying one factor in depth in each study and thus the absence of a holistic study of all factors. Such behavior may indeed find other factors critical to explaining diffusion but will fail to create a total understanding of the connections between different factors.

Further, while Rogers (2003) argues that his four methods of identifying opinion leaders are equally valid; this study gained varying results from all of them. This calls for future research about which method that is most suitable at what time.

## ***6.3 Limitations***

Since this study was conducted in collaboration with Hilti Sweden, a certain bias towards their opinions and customers has been impossible to avoid. While certain measures has been taken, such as including a large random sample in the survey and not presenting the sponsoring manufacturer to interview subjects until after interviews, it might have had an effect on some aspects of the thesis.

The sample from the survey is not relationally representative of the Swedish construction industry in terms of Impact driver adoption. However, since the adopters and non adopters

were treated as different categories, the effects on the results should be minimal. However, the proportion that indicated that they had no knowledge about Impact drivers is probably higher in reality, since respondents without prior knowledge would have a higher tendency not to answer the survey.

The discriminant function analysis is relatively sensitive to non-normality of the data. Since the responses do not show perfectly normal distributions (see Appendix X), the results of the analysis may not be valid. However, the t-test shows the same categories as the most differing ones in mean values. Since this test is more robust to non-normality and the results are consistent with the discriminant function analysis, the focused attributes are considered valid. However the order of significance may differ from the results.

While mass media communication channels are often both traceable and quantifiable, the opposite holds true for interpersonal communication channels. A more complete investigation and tracing of the interpersonal communication is desirable, however very difficult to achieve. Interpersonal communications in this context is very connected to the individuals in contact with customers and strategic goals of competing firms and is thus of a secretive nature.

Although Rogers (2003) is the most prominent work in diffusion literature, other factors have been identified by other scholars and may therefore play important roles in this particular diffusion case without being mentioned here. However, the purpose of this Master Thesis is not to completely explain the diffusion of Impact drivers but rather to apply all of Rogers' factors to this ongoing diffusion.

Despite these limitations, it is the firm beliefs of the authors that the results of this thesis are valid and that the answers to the research questions presented is of value both to practitioners and academia.

#### ***6.4 Future research***

As shown in chapter 6.2 there is a apparently an overlap between the factors presented by Rogers (2003). This phenomenon has been given little attention in academia and has not been present in the body of knowledge included in this Master Thesis. Such studies are vital since they are necessary to fully understand the diffusion of innovations. There is also a danger that new factors will be presented without knowledge of the relation or overlap with other findings and factors.

There is also a need to investigate the usefulness in different situations of the different methods of investigating opinion leadership. Since this study has shown that different methods arrive at various results, it is important to fully understand what inherent implications the use of each method involves.

#### ***6.5 Conclusions***

In order to summarize the answer to the first research question posed in this Master Thesis; "What is the current status of the factors described by Rogers (2003), in the diffusion of Impact drivers in the Swedish construction industry?", Table 15 presents the status of each factor affecting the diffusion of Impact drivers in the Swedish construction industry.

**Table 15. Overview of the status of factors affecting the diffusion of Impact drivers**

<b>Factor</b>	<b>Status</b>
Innovation decision process	Differs depending on firm size  Many people involved from many organizational levels
Nature of the social system	None or very few homophilious groups present  Many interfirm interactions which enhances information spread  A mixture of opinion leaders present of which none have been utilized in the diffusion process
Change agent efforts	No change agent actively driving the diffusion  Divergent efforts which creates confusion about application areas and is further enhanced by the name of the innovation  The product and the place dimensions are positive for the diffusion of Impact driver while the price and promotion dimensions are negative
Communication channels	Little to no mass media utilized which has led to suffering awareness  Focus on interpersonal channels in order to create awareness
Perceived attributes	Relative advantage, Compatibility and Visibility showed most importance explaining adoption  Triability showed almost no significance but might be misleading due to the variance in trial opportunities

The peculiar fact about this particular case is the lack of change agent effort and utilization of communication channels. The diffusion so far seems to have been driven by the demand side through the strength of communication within the social system. Change agents have actually inhibited the diffusion through certain actions such as diverging information and promotion of substituting products. This has effects on other factors, primarily on perceived attributes. Additionally, the Swedish translation of the name of the innovation seems to further increase the confusion about suitable application areas for the tool type.

The answer to the second research question; "Which of these factors, if any, can be affected by the supply side in order to increase the diffusion?", includes an increased focus on the product and the utilization of mass media communication channels. A communicated message corresponding to the actual use by current adopters of the tool type would spread the correct information about the Impact driver and increase the effectiveness of interpersonal communication. Connected to this is the utilization of different opinion leaders; the use of celebrity opinion leaders could be done through mass media communication channels and the organized identification and utilization of regional opinion leaders would further enhance the interpersonal promotion of Impact drivers. This would positively affect the perceived attributes of the innovation, primarily "Relative advantage" and "Compatibility", which currently best explains adoption or non adoption. While suppliers work under different

conditions and pursue differing strategic goals, not all interventions described in this Master Thesis might be suitable, but all would positively affect the diffusion.

The most prominent theoretical implication concerns the connections between the different factors affecting the diffusion of innovations as well as inconclusive results from methods identifying opinion leaders.

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## Appendix I – Mass media investigation

### *Business Retriever*

URL:

Date of access: 2011-06-01

Related magazines:

### Impact drivers

**Keywords used:** slagskruvdragare OR mutterdragare OR mutterknack

**Results:**

Year	2007	2008	2009	2010	2011
Nr of articles	4	4	6	0	1

	2005	2006	2007	2008	2009	2010	2011
Commercial				1			
News		4	4				
Mentioned related to product platform				5		1	
Test							

### Drill drivers

**Keywords used:** borrar-skruvdragare OR skruvdragare

**Results:**

Year	2005	2006	2007	2008	2009	2010	2011
Nr of articles	1	5	22	33	67	47	14

### *Svensk Rental Tidning*

URL: <http://www.svenskrental.se/>

Date of access: 2011-05-25

### Impact drivers

**Keywords used:** slagskruvdragare OR mutterdragare OR mutterknack

**Results:**

Year	2005	2006	2007	2008	2009	2010	2011
Nr of articles	3	1	4	8	3	0	3

	2005	2006	2007	2008	2009	2010	2011
Commercial							
News	2		1	5	3		
Mentioned related to product platform	1	1	3	3			3
Test							

### Drill drivers

**Keywords used:** borrar-skruvdragare OR skruvdragare

**Results:**

Year	2005	2006	2007	2008	2009	2010	2011
Nr of articles	5	7	5	7	7	4	2

## *Byggnadsarbetaren, DMH, GDS, Byggnyheter and Husbyggaren*

### **Byggnadsarbetaren**

URL: [www.byggnadsarbetaren.se/](http://www.byggnadsarbetaren.se/)

Access date: 2011-06-22

### **DMH**

URL: [www.denmodernahantverkaren.se/](http://www.denmodernahantverkaren.se/)

Access date: 2011-05-29

### **Gör det själv**

URL: [www.gds.se/](http://www.gds.se/)

Access date: 2011-06-22

### **Byggnyheter**

URL: [www.byggnyheter.se/](http://www.byggnyheter.se/)

Access date: 2011-06-22

### **Husbyggaren**

URL: [www.husbyggaren.se/](http://www.husbyggaren.se/)

Access date: 2011-06-22

### **Keywords used:**

**Impact driver:** slagskruvdragare OR mutterdragare OR mutterknack

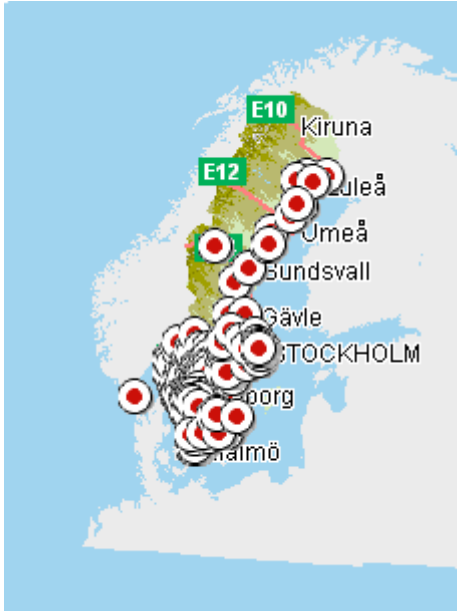
**Drill Driver:** borrar-skruvdragare OR skruvdragare

### **Results:**

Source	Circulation	Drill drivers	Impact drivers	Notables
Byggnadsarbetaren	114900	13	0	
Husbyggaren	11200	3	0	
Gör det själv	41200	43	0	5 tests of drilldrivers
Byggnyheter.se	-	6	4	
DMH	40000	3	0	Only tests searchable

## Appendix II – Interactions in the Swedish construction industry

Locations of headquarters of companies involved in construction projects in Västra Götaland with starting dates between 2006 and 2012.



Number of subcontractors of the top five firms involved in the most projects:

**NCC Construction Sverige:** 232 projects, 254 subcontractors, same subcontractor involved in 1-28 projects.

**Nya BBM i Göteborg AB:** 128 projects, 333 subcontractors, same subcontractor involved in 1-15 projects.

**Skanska Sverige AB:** 121 projects, 195 subcontractors, same subcontractor involved in 1-16 projects.

**PEAB region Göteborg:** 152 projects, 211 subcontractors, same subcontractor involved in 1-16 projects.

**Backgårdens bygg:** 88 projects, 112 subcontractors, same subcontractor involved in 1-21 projects.

Source: Sverige Bygger, [www.sverigebygger.se](http://www.sverigebygger.se), accessed in 2011-06-08

## Appendix III – Questionnaire

**Känner du till slagskruvdragare eller mutterdragare?**

**Hur fick du höra talas om tekniken?**

1. Genom kollegor
2. Genom massmedia
3. Genom säljare
4. Såg den hos en återförsäljare
5. Annat \_\_\_\_\_

**Använder du för närvarande slagskruvdragare?**

**Arbetar du inom byggsektorn?**

**Vilket företag jobbar du på idag?**

**Ungefär hur många är anställda i ditt företag?**

**Är du inblandad vid köpbeslut om nya verktyg?**

**Vilka övriga personer är inblandade vid inköpsbeslut om verktyg?**

### Relative advantage

**1. Att använda en slagskruvdragare gör att jag kan utföra mina arbetsuppgifter snabbare**

1            2            3            4            5            6            7

**2. Att använda en slagskruvdragare förbättrar kvaliteten på det arbete jag gör**

1            2            3            4            5            6            7

**3. Att använda en slagskruvdragare gör det enklare att utföra mitt jobb**

1            2            3            4            5            6            7

**4. Att använda en slagskruvdragare ökar min effektivitet på jobbet**

1            2            3            4            5            6            7

**5. Fördelarna med att använda en slagskruvdragare uppväger priset**

1            2            3            4            5            6            7

Vet ej priset

**6. Att använda en slagskruvdragare minskar fysisk belastning under arbete**

1            2            3            4            5            6            7

## **Compatibility**

**1. Att använda en slagskruvdragare passar bra med hur jag vill arbeta**

1            2            3            4            5            6            7

**2. Att använda slagskruvdragare medför inte några påtvingade förändringar i mitt arbetssätt**

1            2            3            4            5            6            7

## **Ease of use**

**1. Jag anser att det är lätt att få en slagskruvdragare att göra vad jag vill att den ska göra**

1            2            3            4            5            6            7

**2. Sammantaget tycker jag att en slagskruvdragare är lätt att använda**

1            2            3            4            5            6            7

## ***Result demonstrability***

**1. Resultaten av att använda en slagskruvdragare är tydliga för mig**

1            2            3            4            5            6            7

**2. Jag kan förklara för andra vad resultaten av att använda en slagskruvdragare är**

1            2            3            4            5            6            7

## Visibility

**1. Jag har lätt att se vilka applikationer andra använder sina slagskruvdragare till**

1            2            3            4            5            6            7

**2. Jag har lätt att urskilja en slagskruvdragare från andra verktyg**

1            2            3            4            5            6            7

**3. Jag ser ofta slagskruvdragare vid byggarbetsplatser där jag jobbar**

1            2            3            4            5            6            7

## Trialability

**1. Innan en slagskruvdragare köptes hade jag möjlighet att prova den**

1            2            3            4            5            6            7

**2. Jag var tillåten att prova en slagskruvdragare tillräckligt länge för att se vad den kunde göra**

1            2            3            4            5            6            7

**3. Jag vet vart jag kan vända mig för att få prova olika användningsområden för slagskruvdragare**

1            2            3            4            5            6            7

**Vart vänder du dig för att få information om nya verktyg?**

**Vart går du för att få råd om inköp av verktyg?**

**Vilka företag sätter trender i din sektor?**

**Vilket företag är det mest respekterade inom din sektor?**

**Vad använder du en slagskruvdragare till?**

**Vilka är fördelarna med att använda en slagskruvdragare?**



**Vilka är nackdelarna med att använda en slagskruvdragare?**

## Appendix IV – Discriminant function analysis

**Group Statistics**

Adopter		Valid N (listwise)	
		Unweighted	Weighted
1	RelativeAdvantage	32	32,000
	Compatibility	32	32,000
	EaseOfUse	32	32,000
	ResultDemon	32	32,000
	Visibility	32	32,000
	Trialability	32	32,000
	ForcedChanges	32	32,000
2	RelativeAdvantage	20	20,000
	Compatibility	20	20,000
	EaseOfUse	20	20,000
	ResultDemon	20	20,000
	Visibility	20	20,000
	Trialability	20	20,000
	ForcedChanges	20	20,000
Total	RelativeAdvantage	52	52,000
	Compatibility	52	52,000
	EaseOfUse	52	52,000
	ResultDemon	52	52,000
	Visibility	52	52,000
	Trialability	52	52,000
	ForcedChanges	52	52,000

### Analysis 1

### Summary of Canonical Discriminant Functions

#### Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	,181 <sup>a</sup>	100,0	100,0	,391

a. First 1 canonical discriminant functions were used in the analysis.

**Wilks' Lambda**

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	,847	7,726	7	,357

**Standardized Canonical Discriminant Function Coefficients**

	Function
	1
RelativeAdvantage	,735
Compatibility	,378
EaseOfUse	,072
ResultDemon	-,550
Visibility	,266
Trialability	-,181
ForcedChanges	,478

**Structure Matrix**

	Function
	1
Relative Advantage	,766
Compatibility	,725
Visibility	,588
Result Demonstrability	,350
Ease Of Use	,349
Forced Changes	,339
Trialability	-,060

**Structure Matrix**

	Function
	1
Relative Advantage	,766
Compatibility	,725
Visibility	,588
Result Demonstrability	,350
Ease Of Use	,349
Forced Changes	,339
Triability	-,060

Pooled within-groups correlations  
between discriminating variables and  
standardized canonical discriminant  
functions

Variables ordered by absolute size of  
correlation within function.

**Functions at Group**

**Centroids**

Adopter	Function
	1
1	,330
2	-,527

Unstandardized canonical  
discriminant functions  
evaluated at group means

## Classification Statistics

**Classification Processing Summary**

	Processed	52
Excluded	Missing or out-of-range group codes	0
	At least one missing discriminating variable	0
	Used in Output	52

**Prior Probabilities for Groups**

Adopter	Prior	Cases Used in Analysis	
		Unweighted	Weighted
1	,500	32	32,000
2	,500	20	20,000
Total	1,000	52	52,000

**Casewise Statistics**

Case Number	Actual Group	Highest Group						Second Highest Group			Discriminant Scores Function 1
		Predicted Group	P(D>d   G=g)				Squared Mahalanobis Distance to Centroid	Group	P(G=g   D=d)	Squared Mahalanobis Distance to Centroid	
			p	df	P(G=g   D=d)	Squared Mahalanobis Distance to Centroid					
Original 1	1	2**	,115	1	,848	2,488	1	,152	5,926	-2,105	
2	1	1	,710	1	,665	,138	2	,335	1,510	,702	
3	1	1	,673	1	,501	,178	2	,499	,189	-,093	
4	1	2**	,682	1	,672	,167	1	,328	1,603	-,936	
5	1	1	,175	1	,822	1,843	2	,178	4,903	1,687	
6	1	1	,052	1	,884	3,790	2	,116	7,861	2,276	
7	1	2**	,778	1	,531	,079	1	,469	,331	-,245	
8	1	1	,374	1	,756	,789	2	,244	3,046	1,218	

9	1	1	,598	1	,694	,278	2	,306	1,917	,857
10	1	1	,595	1	,695	,283	2	,305	1,929	,862
11	1	1	,813	1	,639	,056	2	,361	1,197	,567
12	1	1	,795	1	,643	,067	2	,357	1,246	,589
13	1	2**	,321	1	,772	,984	1	,228	3,418	-1,519
14	1	2**	,721	1	,515	,128	1	,485	,249	-,170
15	1	1	,506	1	,718	,442	2	,282	2,315	,994
16	1	1	,801	1	,538	,063	2	,462	,366	,078
17	1	1	,996	1	,590	,000	2	,410	,726	,325
18	1	1	,927	1	,610	,008	2	,390	,899	,421
19	1	1	,777	1	,648	,080	2	,352	1,300	,613
20	1	1	,841	1	,549	,040	2	,451	,430	,129
21	1	1	,604	1	,692	,269	2	,308	1,892	,848
22	1	1	,514	1	,716	,425	2	,284	2,276	,981
23	1	2**	,736	1	,658	,114	1	,342	1,427	-,865
24	1	1	,682	1	,504	,168	2	,496	,200	-,080
25	1	1	,537	1	,710	,382	2	,290	2,174	,947
26	1	1	,416	1	,744	,663	2	,256	2,792	1,144
27	1	1	,986	1	,587	,000	2	,413	,705	,313
28	1	2**	,335	1	,767	,929	1	,233	3,315	-1,491
29	1	1	,714	1	,513	,134	2	,487	,241	-,037
30	1	2**	,669	1	,500	,183	1	,500	,184	-,100
31	1	1	,332	1	,768	,940	2	,232	3,335	1,299
32	1	1	,313	1	,774	1,018	2	,226	3,481	1,338
33	2	2	,304	1	,777	1,058	1	,223	3,556	-1,556
34	2	2	,090	1	,861	2,883	1	,139	6,527	-2,225
35	2	2	,813	1	,541	,056	1	,459	,386	-,291
36	2	1**	,450	1	,734	,570	2	,266	2,598	1,085
37	2	1**	,954	1	,579	,003	2	,421	,639	,272
38	2	2	,947	1	,577	,004	1	,423	,626	-,461
39	2	2	,584	1	,698	,299	1	,302	1,971	-1,074
40	2	2	,951	1	,603	,004	1	,397	,843	-,589
41	2	2	,076	1	,868	3,144	1	,132	6,917	-2,300

	42	2	2	,717	1	,514	,131	1	,486	,245	-,165
	43	2	2	,810	1	,540	,058	1	,460	,380	-,287
	44	2	1**	,917	1	,569	,011	2	,431	,566	,225
	45	2	1**	,349	1	,763	,877	2	,237	3,216	1,266
	46	2	1**	,890	1	,619	,019	2	,381	,991	,468
	47	2	1**	,957	1	,580	,003	2	,420	,646	,276
	48	2	2	,327	1	,770	,960	1	,230	3,374	-1,507
	49	2	2	,329	1	,769	,951	1	,231	3,357	-1,503
	50	2	2	,355	1	,761	,857	1	,239	3,178	-1,453
	51	2	2	,355	1	,761	,857	1	,239	3,178	-1,453
	52	2	1**	,691	1	,670	,158	2	,330	1,573	,727
Cross-validated <sup>a</sup>	1	1	2**	,484	7	,920	6,485	1	,080	11,364	
	2	1	1	,996	7	,657	,935	2	,343	2,235	
	3	1	2**	,545	7	,559	5,957	1	,441	6,430	
	4	1	2**	,345	7	,773	7,859	1	,227	10,305	
	5	1	1	,845	7	,816	3,409	2	,184	6,382	
	6	1	1	,019	7	,887	16,765	2	,113	20,881	
	7	1	2**	,902	7	,563	2,812	1	,437	3,320	
	8	1	1	,906	7	,744	2,768	2	,256	4,904	
	9	1	1	,000	7	,545	28,426	2	,455	28,788	
	10	1	1	,967	7	,683	1,856	2	,317	3,392	
	11	1	1	,948	7	,623	2,204	2	,377	3,204	
	12	1	1	,856	7	,620	3,296	2	,380	4,278	
	13	1	2**	,101	7	,897	11,982	1	,103	16,305	
	14	1	2**	,013	7	,692	17,702	1	,308	19,325	
	15	1	1	,962	7	,707	1,967	2	,293	3,732	
	16	1	2**	,215	7	,549	9,553	1	,451	9,950	
	17	1	1	,799	7	,559	3,828	2	,441	4,303	
	18	1	1	,692	7	,574	4,738	2	,426	5,334	
	19	1	1	,305	7	,594	8,327	2	,406	9,090	
	20	1	2**	,149	7	,547	10,773	1	,453	11,151	
	21	1	1	,983	7	,682	1,478	2	,318	3,008	
	22	1	1	,028	7	,645	15,720	2	,355	16,915	
	23	1	2**	,688	7	,725	4,773	1	,275	6,715	

24	1	2**	,558	7	,554	5,845	1	,446	6,283
25	1	1	,924	7	,696	2,538	2	,304	4,197
26	1	1	,811	7	,728	3,721	2	,272	5,691
27	1	2**	,039	7	,530	14,806	1	,470	15,049
28	1	2**	,388	7	,860	7,404	1	,140	11,028
29	1	2**	,121	7	,598	11,432	1	,402	12,226
30	1	2**	,685	7	,549	4,795	1	,451	5,186
31	1	1	,649	7	,752	5,087	2	,248	7,301
32	1	1	,130	7	,743	11,204	2	,257	13,323
33	2	2	,204	7	,715	9,732	1	,285	11,576
34	2	2	,000	7	,781	26,041	1	,219	28,579
35	2	1**	,468	7	,552	6,634	2	,448	7,052
36	2	1**	,951	7	,792	2,159	2	,208	4,828
37	2	1**	,722	7	,661	4,490	2	,339	5,821
38	2	2	,542	7	,502	5,980	1	,498	5,993
39	2	2	,084	7	,580	12,550	1	,420	13,194
40	2	2	,938	7	,574	2,350	1	,426	2,948
41	2	2	,039	7	,830	14,749	1	,170	17,922
42	2	1**	,837	7	,537	3,484	2	,463	3,784
43	2	1**	,510	7	,548	6,258	2	,452	6,640
44	2	1**	,461	7	,683	6,697	2	,317	8,235
45	2	1**	,517	7	,869	6,193	2	,131	9,983
46	2	1**	,607	7	,720	5,436	2	,280	7,323
47	2	1**	,895	7	,636	2,889	2	,364	4,003
48	2	2	,198	7	,704	9,840	1	,296	11,577
49	2	2	,001	7	,587	25,553	1	,413	26,252
50	2	2	,114	7	,680	11,604	1	,320	13,113
51	2	2	,114	7	,680	11,604	1	,320	13,113
52	2	1**	,221	7	,825	9,466	2	,175	12,560

For the original data, squared Mahalanobis distance is based on canonical functions.

For the cross-validated data, squared Mahalanobis distance is based on observations.

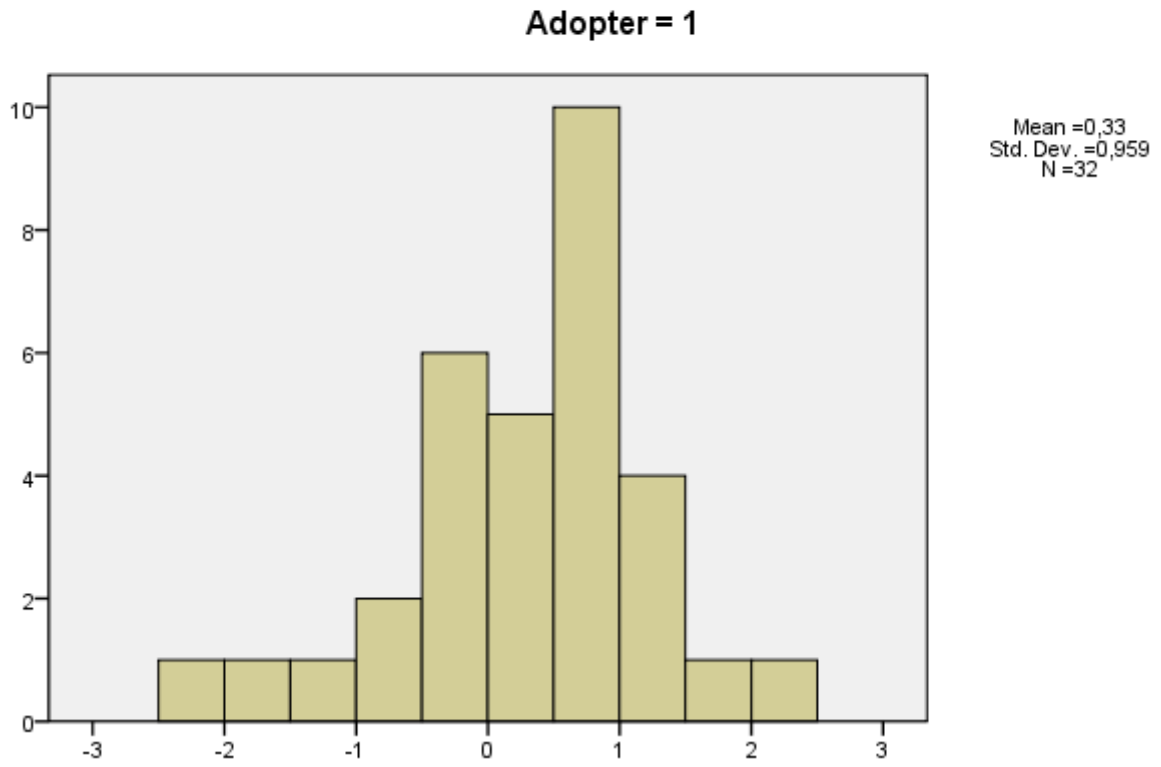
\*\* . Misclassified case

a. Cross validation is done only for those cases in the analysis. In cross validation, each case is classified by the functions derived from all cases other than that case.



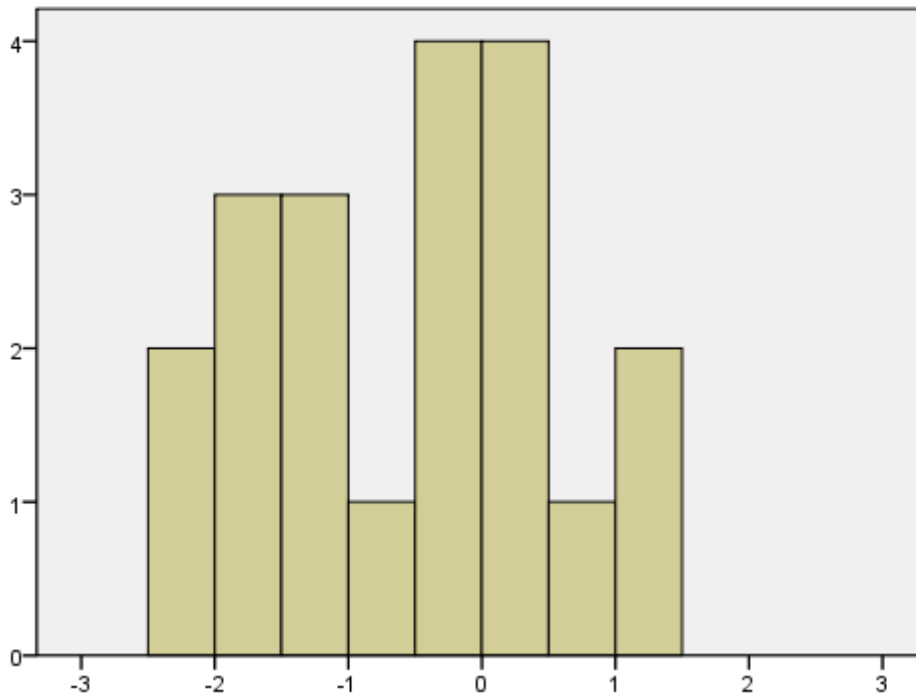
## Separate-Groups Graphs

### Canonical Discriminant Function 1



## Canonical Discriminant Function 1

Adopter = 2



Mean = -0,53  
Std. Dev. = 1,064  
N = 20

Classification Results<sup>b,c</sup>

		Adopter	Predicted Group Membership		Total
			1	2	
Original	Count	1	24	8	32
		2	7	13	20
	%	1	75,0	25,0	100,0
		2	35,0	65,0	100,0
Cross-validated <sup>a</sup>	Count	1	18	14	32
		2	10	10	20
	%	1	56,3	43,8	100,0
		2	50,0	50,0	100,0

a. Cross validation is done only for those cases in the analysis. In cross validation, each case is classified by the functions derived from all cases other than that case.

b. 71,2% of original grouped cases correctly classified.

c. 53,8% of cross-validated grouped cases correctly classified.

## Appendix V – Supplier overview

### *Manufacturers, professional hand tools*

Manufacturers	Employees	Number of products	Revenue (M SEK)	Gross Profit (M SEK)
Makita	10400 (28 in Sweden)	900+	50 - 499	Not Listed
Milwaukee	3000 (Industry group)	500+	111	-1 (2009)
Bosch	100-199	Not Listed	31500 (industry group)	Not Listed
Hitachi	20-49	Not Listed	182	-0,357
DeWalt	50-99	Not Listed	271 (Black & Decker)	-19 (Black & Decker)
Hilti	100-199	Not Listed	653	25

Sources: Accessed 2011-08-08

<a href="http://www.makita.se">http://www.makita.se</a>
<a href="http://www.milwaukeetool.se">http://www.milwaukeetool.se</a>
<a href="http://www.bosch-pt.se/">http://www.bosch-pt.se/</a>
<a href="http://www.hitachi-powertools.se/">http://www.hitachi-powertools.se/</a>
<a href="http://www.blackanddecker.se/">http://www.blackanddecker.se/</a>
<a href="http://www.hilti.se/">http://www.hilti.se/</a>
For all: <a href="http://www.proff.se/foretag">http://www.proff.se/foretag</a>

***Retailers with product segments aimed at professional construction firms***

<b>Retailers</b>	<b>Employees</b>	<b>Number of products</b>	<b>Revenue</b>	<b>Gross Profit</b>	<b>Number of stores</b>
Tools	1000	500 000	2,5 billion SEK	Not Listed	100
Ahlsell	4300	100 000	19 billion SEK (Ahlsell Group)	Not Listed	85
Beijer Bygg	1400	500 000	5 billion SEK	Not Listed	63
Swedol	366	20 000	1,378 billion SEK	127 million SEK	33
Dahl	1000	65 000	5 billion SEK	Not Listed	62
Hornbach	13000 (Europe)	60 000	1 billion SEK	36 million SEK	130 (in Europe)
Bauhause	Not listed	150 000	Not listed	Not Listed	15
Hilti	100-199	Not Listed	653 million SEK	25 million SEK	14

Sources: accessed in 2011-08-08

<b>Source</b>
<a href="http://www.tools.se">www.tools.se</a>
<a href="http://www.ahlsell.com/">www.ahlsell.com/</a>
<a href="http://www.beijerbygg.se">www.beijerbygg.se</a>
<a href="http://www.swedol.se">www.swedol.se</a>
<a href="http://www.dahl.se">www.dahl.se</a>
<a href="http://www.hornbach.se">www.hornbach.se</a>
<a href="http://www.bauhause.se">www.bauhause.se</a>
<a href="http://www.hilti.se">www.hilti.se</a>
For all: <a href="http://www.proff.se/foretag">http://www.proff.se/foretag</a>

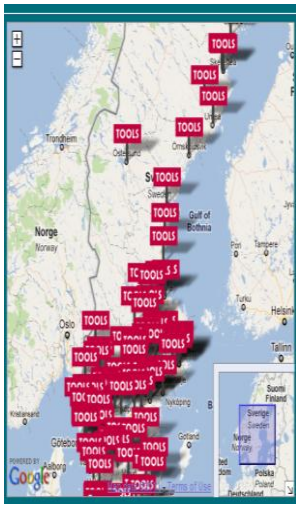
### *Rental services aimed at professional construction firms*

<b>Rental services</b>	<b>Revenue M SEK</b>	<b>Gross profit M SEK</b>	<b>Number of products</b>	<b>Number of stores</b>
Cramo	2050	156	130 000 (construction machines)	100
RamiRent	1300	107	Several thousands	70
Tidermans	104	11	Not listed	3
Lambertsson	951	114	Not listed	25

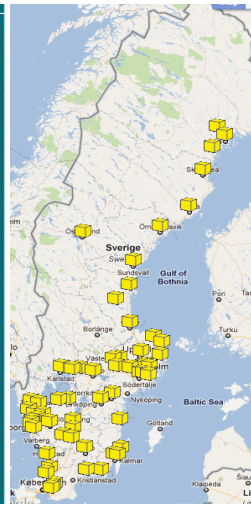
Sources: accessed in 2011-08-08

<b>Source</b>
<a href="http://www.cramo.se">www.cramo.se</a>
<a href="http://www.ramirent.se">www.ramirent.se</a>
<a href="http://www.tidermans.se">www.tidermans.se</a>
<a href="http://www.lambertsson.se">www.lambertsson.se</a>
For all: <a href="http://www.proff.se/foretag">http://www.proff.se/foretag</a>

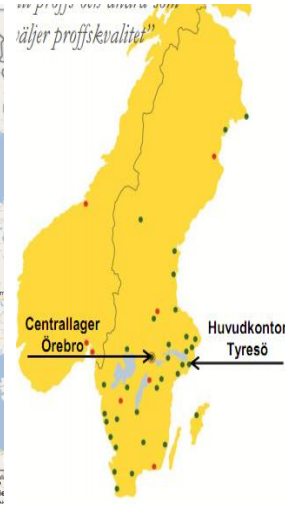
*Geographical dispersion for certain retailers and rental services*



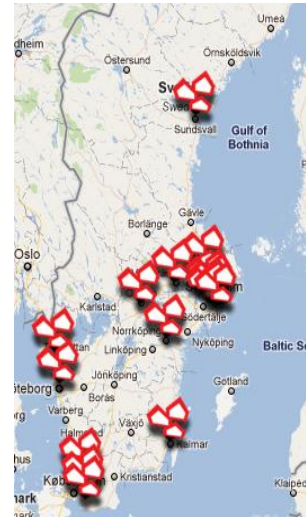
Tools



Beijer Bygg



Swedol



Bauhaus



Lambertsson

## Appendix VI – Prices

Sources	www.verktygsladan.se
	www.verktygsproffsen.se
	www.proffsmagasinet.se
	www.verktygsbutiken.se

### *Impact driver prices*

<b>Impact drivers</b>		
<b>Brand</b>	<b>Voltage</b>	<b>Price SEK</b>
Makita	14,4	4650
Makita	14,4	7250
Makita	14,4	5000
Makita	14,4	5000
Makita	14,4	4875
Makita	14,4	4375
Makita	18	3990
Makita	18	6100
Makita	18	5740
Makita	18	5740
Makita	18	5300
Makita	18	5900
Bosch	10,8	1750
Bosch	14,4	3590
Bosch	14,4	4450
Bosch	18	3990
Bosch	18	4600
Hitachi	10,8	2390
Hitachi	10,8	2550
Hitachi	14,4	4240
Hitachi	18	4494
Makita	10,8	1590
Makita	14,4	3990
Makita	14,4	3990
Makita	14,4	5800
Makita	18	3800
Makita	14,4	4090
Milwaukee	12	1890
Makita	10,8	1590
Makita	14,4	3990
Makita	14,4	3500
Makita	18	3490
Makita	18	4870
Makita	18	4870
Makita	18	4990



### *Drill driver prices*

<b>Drill drivers</b>		
<b>Brand</b>	<b>Voltage</b>	<b>Price</b>
Makita	14,4	2275
Makita	14,4	4250
Makita	14,4	3975
Makita	14,4	3975
Makita	14,4	2325
Makita	14,4	4540
Makita	18	4600
Makita	18	3975
Makita	18	3700
Makita	18	4000
Makita	18	2500
Makita	18	4850
Makita	18	5250
Makita	18	4900
Makita	18	2550
Makita	18	4800
Makita	18	4800
Bosch	10,8	1650
Bosch	10,8	1990
Bosch	10,8	1490
Bosch	14,4	2990
Bosch	14,4	3690
Bosch	18	3450
Bosch	18	3990
Dewalt	18	3195
Hitachi	10,8	1690
Hitachi	10,8	1545
Hitachi	14,4	3940
Hitachi	14,4	1940
Hitachi	14,4	2790
Hitachi	14,4	3580
Hitachi	18	4390
Hitachi	18	3740
Hitachi	18	4190
Makita	10,8	1290
Makita	10,8	1390
Makita	12	1750
Makita	12	2600
Makita	14,4	1650
Makita	14,4	2650
Makita	14,4	3480
Makita	14,4	3490
Makita	18	3739
Makita	18	2900
Makita	18	1750
Makita	18	4190
Makita	18	4250
Milwaukee	14,4	2940
Milwaukee	18	3100

Milwaukee	18	3800
Makita	10,8	1195
Makita	10,8	1595
Makita	14,4	2980
Makita	14,4	3360
Makita	18	3860
Makita	18	3990
Makita	18	3990
Makita	18	3600
Makita	18	1920
Bosch	10,8	1295
Bosch	10,8	1695
Bosch	14,4	3695
Bosch	14,4	1950
Bosch	14,4	2990
Bosch	18	3595
Bosch	14,4	3195
Bosch	18	3795
Hitachi	14,4	5073
Hitachi	14,4	3135

## Appendix VII – Toolkits

Toolkits	Name	Voltage	Impact driver	Drill driver	# of batteries	Total # of tools
Makita	LXT 600	18	1	1	3	6
Makita	LCT 203	10,8	1	1	2	2
Makita	LCT 303X	10,8	1	1	2	3
Makita	LXT 418K	18	0	1	2	4
Makita	DK 1445	14,4	1	1	2	2
Dewalt	DCK235L2	14,4	1	1	2	2
Dewalt	DCK235C2	14,4	1	1	2	2
Dewalt	DCK285L2	18	1	1	2	2
Dewalt	DCK285C2	18	1	1	2	2
Dewalt	DCK290L2	18	1	1	2	2
Dewalt	DCK296CS	10,8 + 18	0	2	4	2
Dewalt	DCK282C2	18	0	1	2	2
Dewalt	DCK232C2	14,4	0	1	2	2
Dewalt	DCK591L3	18	1	1	3	5
Milwaukee	PP2A	12	0	1	2	2
Milwaukee	PP2B	12	0	1	2	2
Milwaukee	PP2C	12	0	1	2	2
Milwaukee	PP3A	12	0	1	2	3
Milwaukee	PP3B	12	1	1	2	3
Milwaukee	PP4A	12	0	1	2	4
Milwaukee	PP4B	12	1	1	2	4
Milwaukee	PP4D	12	0	1	2	4
Milwaukee	PP4F	12	0	2	2	4
Milwaukee	PP2A	18	1	1	2	2
Milwaukee	PP2B	18	1	1	2	2
Milwaukee	PP2C	18	1	1	2	2
Milwaukee	PP4A	18	0	1	2	4
Milwaukee	PP4B	18	1	1	2	4
Milwaukee	PP5A	18	0	1	2	5
Milwaukee	PP6A	18	1	1	2	6
Milwaukee	PP6B	18	1	1	2	6
Milwaukee	M28B	28	0	1	2	4
Milwaukee	M28D	28	0	1	2	3
Milwaukee	M28G	28	0	1	2	3
Milwaukee	M28H	28	0	1	2	2
Milwaukee	PP2A	28	0	1	2	2
Milwaukee	PP2B	28	0	1	2	2
Bosch	Twin set 1	10,8	0	1	2	2
Bosch	Twin set 2	10,8	1	1	2	3
Hilti	Kit1	14,4	1	1	2	2
Hilti	Kit2	14,4	1	1	2	2
Hilti	Kit3	14,4	1	1	2	2
Hilti	Kit4	14,4	1	1	2	2

**Other tools appearing in the toolkits:** Recip saw, Angle grinder, Circular saw, Lamp, Inspection camera, Laser, Pipe cutter, Multicutter, Jig saw and Hammer drill<sup>41</sup>

<sup>41</sup> <http://www.makita.se>, <http://www.milwaukeeetool.se>, <http://bosch-pt.se>, <http://www.hitachipowertools.se>, <http://www.hilti.se>, <http://www.dewalt.se>. All accessed in 2011-07-01

## Appendix VIII – Manufacturers promotions

This picture is from the website of Bosch power tools (2011-08-08), with the name “mutterdragare” (Nut runner) while at the same time promoting drilling applications.

Sladdlös mutterdragare GDR 18 V-LI MF Professional



This picture is from the website of Milwaukee power tools (2011-08-08), where the Impact driver is called “mutterdragare” in the heading and “slagskruvdragare” in the details section.

SLADDLÖS MUTTERDRAGARE C12 ID



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Egenskaper

> Kompakt **slagskruvdragare** som mäter endast 165 mm i längd, vilket gör den perfekt för arbeten i smala och trånga arbeten

This picture is from the website of DeWalt (2011-08-08), clearly indicating that the Impact driver can be used for drilling.



## Appendix IX – Product Launches

Year	DeWalt	Hitachi	Makia	Milwaukee	Bosch	Hilti
2002	DW977K DW967K	WH9DM WH12DM				
2003	DW050K-2 DW052K-2 DW054K-2 DW056K-2	WH14DM		PIW14.4HEX		
2004		WH9DM2 WH12DAF WH12DM2	6916 6935			
2005		WH9DMR WH12DMR WH12DAF2 WH14DMR WH18DMR	BTD200SH			
2006		WH14DAF2			GDR 10,8V LI	SID 121 SID 144
2007	DC855KA DC845KA DC835KA DC825KA DC827KL	WH14DL WH18DL	BTD130FRFE BTS130RFE BTD140RFE		GDR 9,6 GDR 12 GDR 14,4	
2008	DC822KL		TD090DWE 6980FDWAE BTD130FRFE 6935FDWAE BTD140RFE BTD142RHE BTP140RFE (Hybrid tool)	2650		
2009		WH14DBL	TD090 BTD144	2662 2451 2450 2663	GDR9,6V GDR10,8V- LI GDR12V GDR14,4V GDR18V	
2010	DC837C2 DCF815S2		TD021DSE BTD133 BTD145	C12ID C18ID	GDR 14,4 V-LI MF GDR 18V-LI MF	
2011	DCF826KL	WH10DFL WH18DFL WH18DSAL				SID14 SID22

**Sources:** The investigation was conducted through a search of both product catalogues for each firm as well as an investigation of cached web pages of each manufacturer.

**Cached websites investigated:**

<a href="http://www.makita.se">http://www.makita.se</a>
<a href="http://www.milwaukeetool.se">http://www.milwaukeetool.se</a>
<a href="http://www.bosch-pt.se/">http://www.bosch-pt.se/</a>
<a href="http://www.hitachi-powertools.se/">http://www.hitachi-powertools.se/</a>
<a href="http://www.dewalt.se/">http://www.dewalt.se/</a>
<a href="http://www.hilti.se/">http://www.hilti.se/</a>

## Appendix X – t-test for Equality of Means

Group Statistics

	Adopter	N	Mean	Std. Deviation	Std. Error Mean
RelativeAdvantage	1	32	5,1667	1,37567	,24319
	2	20	4,1500	1,79416	,40119
Compatibility	1	32	5,0625	1,62516	,28729
	2	20	3,8500	2,39022	,53447
ForcedChanges	1	32	4,9375	1,94998	,34471
	2	20	4,3500	2,13431	,47725
EaseOfUse	1	32	5,9844	1,16040	,20513
	2	20	5,6000	1,46539	,32767
ResultDemon	1	32	5,5313	1,22433	,21643
	2	20	5,1250	1,54643	,34579
Visibility	1	32	5,4063	1,29164	,22833
	2	20	4,7167	1,48787	,33270
Triability	1	32	5,2604	1,84086	,32542
	2	20	5,3500	1,58382	,35415

Independent Samples Test

		Levene's Test for Equality of Variances	
		F	Sig.
RelativeAdvantage	Equal variances assumed	2,081	,155
	Equal variances not assumed		
Compatibility	Equal variances assumed	7,355	,009
	Equal variances not assumed		
ForcedChanges	Equal variances assumed	,196	,660
	Equal variances not assumed		
EaseOfUse	Equal variances assumed	1,200	,279
	Equal variances not assumed		
ResultDemon	Equal variances assumed	1,491	,228
	Equal variances not assumed		
Visibility	Equal variances assumed	,484	,490
	Equal variances not assumed		



Triability	Equal variances assumed	,737	,395
	Equal variances not assumed		

### Independent Samples Test

		t-test for Equality of Means		
		t	df	Sig. (2-tailed)
RelativeAdvantage	Equal variances assumed	2,304	50	,025
	Equal variances not assumed	2,167	32,813	,038
Compatibility	Equal variances assumed	2,180	50	,034
	Equal variances not assumed	1,998	30,029	,055
ForcedChanges	Equal variances assumed	1,019	50	,313
	Equal variances not assumed	,998	37,706	,325
EaseOfUse	Equal variances assumed	1,050	50	,299
	Equal variances not assumed	,994	33,644	,327
ResultDemon	Equal variances assumed	1,051	50	,298
	Equal variances not assumed	,996	33,639	,326
Visibility	Equal variances assumed	1,766	50	,083
	Equal variances not assumed	1,709	36,193	,096
Triability	Equal variances assumed	-,180	50	,858
	Equal variances not assumed	-,186	44,977	,853

### Independent Samples Test

		t-test for Equality of Means	
		Mean Difference	Std. Error Difference
RelativeAdvantage	Equal variances assumed	1,01667	,44127
	Equal variances not assumed	1,01667	,46914
Compatibility	Equal variances assumed	1,21250	,55627
	Equal variances not assumed	1,21250	,60679
ForcedChanges	Equal variances assumed	,58750	,57636
	Equal variances not assumed	,58750	,58872
EaseOfUse	Equal variances assumed	,38438	,36624
	Equal variances not assumed	,38438	,38658
ResultDemon	Equal variances assumed	,40625	,38646
	Equal variances not assumed	,40625	,40794

Visibility	Equal variances assumed	,68958	,39037
	Equal variances not assumed	,68958	,40351
Triability	Equal variances assumed	-,08958	,49816
	Equal variances not assumed	-,08958	,48096

#### Independent Samples Test

		t-test for Equality of Means	
		95% Confidence Interval of the Difference	
		Lower	Upper
RelativeAdvantage	Equal variances assumed	,13035	1,90299
	Equal variances not assumed	,06199	1,97134
Compatibility	Equal variances assumed	,09519	2,32981
	Equal variances not assumed	-,02668	2,45168
ForcedChanges	Equal variances assumed	-,57015	1,74515
	Equal variances not assumed	-,60460	1,77960
EaseOfUse	Equal variances assumed	-,35124	1,11999
	Equal variances not assumed	-,40156	1,17031
ResultDemon	Equal variances assumed	-,36997	1,18247
	Equal variances not assumed	-,42311	1,23561
Visibility	Equal variances assumed	-,09451	1,47367
	Equal variances not assumed	-,12863	1,50779
Triability	Equal variances assumed	-1,09016	,91099
	Equal variances not assumed	-1,05830	,87913

### Histograms of adopter and non adopter means

