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Tomi Haapaniemi

Adoption of Innovations in Cross-National Settings
Do Cultural Dimensions Have an Influence on Takeoff Point?

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Thesis for the degree of Doctor of Technology to be presented with due permission for public examination and criticism in Festia Building, Auditorium Pieni Sali 1, at Tampere University of Technology, on the 12th of June 2007, at 12 noon.

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ABSTRACT

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Keywords: takeoff point, adoption of innovations, cultural dimensions, national attributes, cross-national.

Despite the claim that the phenomenon of globalization causes convergence of national markets, contradictory evidence suggests that cultural differences persist. Indeed, there are other national attributes which affect the adoption dynamics of innovation. Companies can, therefore, enhance their competitive position by taking account of this reality in their operations. In addition, determining accurately both adoption trajectories and turning points is essential for a better understanding of the process of diffusion. Especially important is the intermediate takeoff point between introductory and growth phases, because it is here that a complete change in dynamics takes place. The current thesis focuses on the adoption dynamics of cross-national innovation adoption takeoff and the evolution of innovation adoption in different cultures.

This research explores the determination of takeoff point from a cross-national perspective and considers the influence of culture on the dynamics of takeoff. The objective is to discover if innovation adoption takeoff point can be determined, and if so, how this can be determined reliably. A further objective is to ascertain if cultural dimensions influence the occurrence of takeoff. The thesis is based on five separate studies that investigate the domain from different perspectives. Three of these studies deal with the determination of takeoff point and two with the influence of cultural dimensions on the occurrence of takeoff.

The results show that there are various ways to determine takeoff point but the way in which it can be reliably and coherently determined is by employing the method of content analysis. This requires at least two expert analysts, thorough preparation and procedure follow-up. The results also produced clear evidence for the cross-national influence of cultural dimensions on the occurrence of takeoff at a global level. The findings of this research highlight the challenges associated with the commercialization of innovation and with the early phase of innovation adoption. Further, the outcomes of this study can be utilized extensively by companies in meeting the challenges of international scope of operations.

TIIVISTELMÄ

Kulttuurierojen on osoitettu säilyvän huolimatta globalisaation yhtenäistävästä vaikutuksesta kansallisiin markkinoihin. Todellisuudessa myös moni muu kansallisen tason ominaisuus vaikuttaa innovaatioiden omaksumisen dynamiikkaan. Niinpä yritys voi pyrkiä parantamaan kilpailullista asemaansa huomioimalla tämän toiminnassaan. Lisäksi keskeistä diffuusioprosessin ymmärtämisen kannalta on diffuusioon liittyvien kehityskaarten ja niiden käännekohtien määrittäminen. Erityisen tärkeä on omaksumisen tutustumis- ja kasvuvaiheen välissä oleva kasvun lähtöpiste (engl. takeoff point), koska koko innovaatioiden omaksumisen dynamiikka muuttuu tässä pisteessä. Tämä tutkimus keskittyy tämän lähtöpisteen poikkikansalliseen dynamiikkaan ja innovaatioiden omaksumisen kehittymiseen eri kulttuureissa.

Väitöskirjassa tutkitaan poikkikansallisesti kasvun lähtöpisteen määrittämistä ja kulttuurin vaikutusta dynamiikkaan tässä pisteessä. Tutkimuksen tavoitteena on selvittää, voidaanko kasvun lähtöpiste määrittää ja miten se voidaan tehdä luotettavasti. Lisäksi selvitetään, vaikuttavatko kulttuuriulottuvuudet kasvun lähtöpisteen tapahtumiseen. Väitöskirja rakentuu viidestä yksittäisestä tutkimuksesta, jotka lähestyvät aihealuetta eri näkökulmista. Kolme näistä kartoittaa kasvun lähtöpisteen määrittämistä ja loput kaksi tarkastelevat kulttuuriulottuvuuksien vaikutusta kasvun lähtöpisteen tapahtumiseen.

Tutkimuksen perusteella on olemassa useita tapoja kasvun lähtöpisteen määrittämiseen, mutta sisältöanalyysin avulla se voidaan tehdä luotettavasti ja johdonmukaisesti. Menetelmän käyttö edellyttää vähintään kahta asiantuntija-analyytikkoa sekä huolellista valmistautumista ja prosessin seurantaa. Lisäksi tulokset osoittavat selkeästi, että kulttuuriulottuvuuksilla on vaikutusta kasvun lähtöpisteen tapahtumiseen globaalilla tarkastelutasolla. Päätelmissä pohditaan innovaatioiden kaupallistamiseen ja innovaatioiden omaksumisen alkuvaiheeseen liittyviä haasteita sekä havainnollistetaan tulosten laajoja hyödyntämismahdollisuuksia kansainvälisesti toimivan yrityksen näkökulmasta.

ACKNOWLEDGEMENTS

As I now put the final words to this thesis the spring sunshine outside beckons me to take to the road on my motorcycle. This project has been an exhilarating journey and now, when viewed in retrospect, everything at last makes sense. However, as the layers of coffee grounds in my mug might attest, many stones have had to be turned before its completion. However, even as this study nears its end, the zest for learning continues undiminished.

Before taking any steps into the future, I would like to express my thanks to several people, to whom I owe a debt of gratitude for many different reasons. First and foremost, I would like to thank my supervisor, Professor Saku Mäkinen, who at the end of 2003 gave me the opportunity to join his newly-formed research group. Saku's infectious enthusiasm and his ability to inspire have been important in this and other projects we have undertaken.

It has been an honor to have had Professor Jaideep Prabhu, Tanaka Business School, Imperial College London, UK, and Professor Marko Torkkeli, Lappeenranta University of Technology as pre-examiners for my dissertation. I am grateful for their constructive feedback and their much valued help in developing the manuscript during the final stages.

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Tampere, April 2007

Tomi Haapaniemi

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I Haapaniemi, Tomi and Mäkinen, Saku. 2006. An empirical study of the determination of innovation adoption takeoff point by using content analysis. Proceedings of 2006 IEEE International Conference on Management of Innovation and Technology, Singapore, Singapore, June 21–23, 2006.

II Haapaniemi, Tomi and Mäkinen, Saku. 2007. Determining the takeoff point in adoption of innovations: a comparison of content and discrimination analysis. *International Journal of Technology Marketing*, Vol. 2, No. 1, pp. 65–80.

III Haapaniemi, Tomi and Mäkinen, Saku. 2006. Determining Takeoff Point of Innovation Adoption in International Setting: An Analysis of Three Methods. Proceedings of 15th International Conference on Management of Technology, Beijing, China, May 22–26, 2006.

IV Haapaniemi, Tomi. 2006. An International Study of the Adoption of Innovations: The Effects of National Attributes on Takeoff Timing. Proceedings of 2006 Australasian Business and Behavioural Sciences Association International Conference, Adelaide, Australia, September 29–October 1, 2006.

V Haapaniemi, Tomi. 2006. Cross-national adoption of innovations: the effects of cultural dimensions on the number of adopters at takeoff. *International Journal of Technology Intelligence and Planning*, Vol. 2, No. 3, pp. 263–274.

The names of the authors in the original co-authored publications are in alphabetical order, reflecting the equal status of the contributions.

PART I: INTRODUCTORY ESSAY

1 INTRODUCTION

1.1 Background and motivation

It is often claimed in existing studies and popular accounts that convergence in national markets is a result of the widely-discussed phenomenon of globalization (e.g. Levitt 1983; Kustin 1994; Sanz and Velázquez 2006). However, despite the phenomenon, there is contradictory evidence that suggests the cultural value systems of different markets are not converging (e.g. Mahajan and Muller 1994; de Mooij and Hofstede 2002). Even in cases where convergence might be demonstrated empirically, people from the same cultural reference group may buy the same product for different reasons, depending on their status within the culture (de Mooij 2004). Therefore, companies can achieve an improved competitive position by taking this into account in their operations.

Various factors affect the adoption of innovations. In addition to the elements of innovation itself, companies seeking international expansion must also give consideration to a number of other issues. These include the selection of entry timing, the geographic scope of their operations and identification of the similarities and differences that exist within national markets. These factors also influence the entire adoption dynamics of innovations on a national and international level. (e.g. Douglas and Craig 1995; Ganesh and Kumar 1996; Ganesh, Kumar et al. 1997; Tellefsen and Takada 1999; Tellis, Stremersch et al. 2003) It follows, therefore, that the dynamics of adoption must be analyzed not only as a technological phenomenon but also as a socio-cultural issue.

Previous research has largely focused on comparing estimates of diffusion parameters cross-nationally. (e.g. Gatignon and Robertson 1985; Helsen, Jedidi et al. 1993; Talukdar, Sudhir et al. 2002) Such studies report that adoption is both country and product specific, and that cross-national influences affect adoption. However, the diffusion models have been widely criticized. The criticism has focused on the difficulties of applying

diffusion models in an international setting, and also the historical perspective adopted by such models (Heeler and Hustad 1980; Mahajan, Muller et al. 1990a). In addition, the reliability of the diffusion models has been called into question because a requirement of reliable estimation is that data span widely across the point of examination of innovation or product life cycle (Schmittlein and Mahajan 1982; Dekimpe, Parker et al. 1998). Despite these reservations, the dynamics of cross-national adoption of different segments remains a largely unexplored field. There is little research which explicitly considers the phenomenon in an international setting (e.g. Mäkinen 2002; Tellis, Stremersch et al. 2003).

Turning points have only recently received the attention of researchers, even though they play a vital role in the adoption of innovation. In particular, few studies have been carried out into the intermediate point between the introductory and growth phases (i.e. takeoff point) of innovation adoption. Nonetheless, determination of adoption trajectories is crucial for a better understanding of the process of diffusion and for evaluating the possible need for change in competitive strategy. This is because of the total change in dynamics after takeoff.

In *ex post* consideration, the challenge is to determine takeoff point consistently and reliably. For the practicing community, quick determination – as early as possible after it has occurred – is also particularly important for new-to-the-world innovations and for heterogeneous international markets. Accordingly, procedures have been developed to determine takeoff point. However, there is so far no uniform manner to determine the point and existing studies do not compare or evaluate their identification methods.

1.2 Key concept definitions

1.2.1 Innovation

At this point, there is a need to define the basic concepts employed in the research field. The concept of innovation as defined in MOT Collins English Dictionary (MOT 2005) is as follows:

> **1)** something newly introduced, such as a new method or device.
> **2)** the act of innovating.

Most definitions of innovation date back to studies undertaken decades ago whereas the contemporary literature only makes mention of the concept. Bass (1969) defines innovations as *"distinctive 'new' generic classes of products"*. He draws a distinction between new classes of product categories as opposed to new brands or new models of older products. Rogers (1995) characterizes innovation as an idea, practice or object that is perceived as new. Newness in Roger's definition of innovation is a broad concept, which need not just involve new knowledge. Innovation can also be considered as *"unprogrammed activity…directed toward the creation of new programs"* (March and Simon 1958).

Innovation is often associated with concepts of change, invention, creative behavior, and adaptation (Pierce and Delbecq 1977). Innovation can be viewed as the invention of something new (Barnett 1953). Carroll (1967) sees innovation as a social process of organizational adoption in contrast to scientific discovery. In this view, organizational innovation represents a major change in the structure and procedures of an operating system. Mansfield (1963) refines the notion of incorporation of an idea within an organization and distinguishes between innovation and imitation. Innovation represents an organization's *"first use ever"* of a new product, service, process, or idea whereas imitation is a subsequent usage.

Becker and Whisler (1967) also focus on innovation as an organizational or social process. They see innovation as a process that follows invention; as separate from invention in time. Invention is the creative act, while innovation is the first or early employment of an idea by one organization or a set of organizations with similar goals. Mohr (1969) concurs with Becker and Whisler's distinction between invention and innovation, where *"…innovation is the successful introduction into an applied situation of means or ends that are new to that situation"*. Evan and Black (1967) and Knight (1967) have also suggested that innovation represents the implementation of something new into the organizational context.

Some studies have treated innovation as a series of events wherein something new is incorporated into the organization. Carroll (1967) defines innovation as a social process. Becker and Whisler (1967) identify the sequence of innovation events as ranging from inputs to outputs. Wilson (1966) proposes the idea that innovation in organizations occurs in three stages: conception, proposing, and adoption and implementation of

the change. All these definitions share the concept of the newness of an idea.

Rogers (1995) holds that most of the new ideas whose diffusion has been analyzed are technological innovations, and that the word innovation and technology are often used as synonyms. MOT Collins English Dictionary (MOT 2005) defines the word technology as:

> **1)** the application of practical sciences to industry or commerce. **2)** the methods, theory, and practices governing such application: *a highly developed technology*. **3)** the total knowledge and skills available to any human society for industry, art, science, etc.

A technological innovation usually has at least some degree of benefit for its potential adopters, as implicitly also expressed in the definitions of technology above. Rogers (1995) notes that the advantage is not always clearly evident to the intended adopters. Tushman and Anderson (1997) argue that technological innovation is a key factor in raising the economic well-being of a people. Horowitz and Lai (1996) also see innovation in similar terms; as leading a firm up a *"product quality ladder"*.

There are also various types of innovation (e.g. technical and administrative, product and process, radical and incremental, product and category) (e.g. March and Simon 1958; Kessler 2004; Moore 2006). Innovation has also been studied at the level of the industry, the firm, or the individual (Damanpour 1996). An innovation can also be a physical device (hardware) or an idea (software). The above definitions are summarized in Table 1.1 below:

Table 1.1. Various definitions of innovation.

Author	Definition of innovation
Barnett (1953)	Invention of something new
March and Simon (1958)	*"Unprogrammed activity…directed toward the creation of new programs"*
March and Simon (1958) Kessler (2004) Moore (2006)	Different types of innovation (e.g. technical and administrative, product and process, radical and incremental, product and category)
Mansfield (1963)	An organization's *"first use ever"* of a new product, service, process, or idea
Wilson (1966)	Innovation in organizations occurs in three stages: conception, proposing, and adoption and implementation of the change
Becker and Whisler (1967)	A process that follows invention; as separate from invention in time
	Invention is the creative act, while innovation is the first or early employment of an idea by one organization or a set of organizations with similar goals
Carroll (1967)	A social process of organizational adoption, in contrast to scientific discovery
Evan and Black (1967) and Knight (1967)	The implementation of something new into the organizational context
Bass (1969)	*"Distinctive 'new' generic classes of products"*
Mohr (1969)	*"…innovation is the successful introduction into an applied situation of means or ends that are new to that situation"*
Pierce and Delbecq (1977)	Associated with concepts of change, invention, creative behavior, and adaptation
Rogers (1995)	An idea, practice or object that is perceived as new
	A technological innovation usually has at least some degree of benefit for its potential adopters
Damanpour (1996)	Different levels of innovation (e.g. industry, firm, or individual; physical device (hardware) or idea (software))
Horowitz and Lai (1996)	Innovation is leading a firm up a *"product quality ladder"*
Tushman and Anderson (1997)	Technological innovation is a key factor in raising the economic well-being of a people

In this research, innovation is considered as being the category level introduction of new practices and methods or devices. This includes either hardware or software type of innovation; the emphasis is on its novelty in markets. Here an innovation is seen as something radically new.

Innovations that merely replace something less efficient lie outside the scope of the present study.

This definition shares much in common with the definition of technology. However, here innovation is regarded as more complex than one single technology. An innovation is seen as a complete system, which may consist of multiple technologies. According to this definition, personal computers or motorcycles, for example, were innovations when they were first launched commercially because previously nothing similar existed.

1.2.2 Adoption of innovations

Adoption of innovation is a procedure, where consumers purchase the innovation. Adoption traverses five different customer segments (e.g. Rogers 1995; Moore 1999) as illustrated in Figure 1.1:

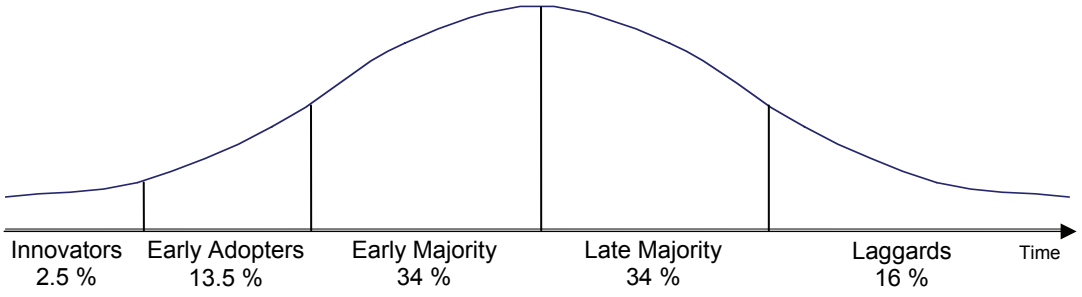

Figure 1.1. Non-cumulative adoption pattern and customer segments with percentages (Rogers 1995).

As Figure 1.1 shows, the evolution of innovation adoption can be divided into phases from initial slow growth to accelerating growth and finally to maturity and decline. The initial slow growth phase represents the innovators' segment and innovators account for some 2.5 % of the total market potential. Innovators are crucial in terms of the success of innovation adoption because they validate the functionality and basic existence of product or innovation. Other segments are early adopters, 13.5 %; early majority, 34 %; late majority, 34 %; and laggards, 16 % of the total market potential. (Rogers 1995)

However, the percentages presented above are averages, and the exact percentages vary between innovations (Mahajan, Muller et al. 1990b). For example, innovators represent some 0.2 to 2.8 % of market potential, depending on the innovation under study. Further, segments differ

dramatically in their characteristics and consumers in these segments have different needs.

The evolution of innovation adoption is traditionally considered as a smooth process (e.g. Mahajan, Muller et al. 1990a). However, there is contradicting evidence that adopting innovations does not always follow the traditional smooth adoption trajectory, but rather consists of specific turning points, deviating significantly from a smooth trajectory (e.g. Agarwal and Bayus 2002). In the present work, the overall adoption of innovation is assumed to occur as a smooth process, where specific turning points can be detected by detailed analysis.

1.2.3 Takeoff point

As mentioned in section 1.2.2, the early market evolution of successful innovations is generally characterized by an initial period of slow growth immediately after commercialization that is eventually followed by a sharp increase (e.g. Mahajan, Muller et al. 1990a; Rogers 1995; Golder and Tellis 1997; Klepper 1997; Agarwal and Bayus 2002). Takeoff point is the intermediate point between slow growth and rapid growth phases. For most new products takeoff is clear because it corresponds to the first large increase in adoption (e.g. Tellis 1994; Agarwal and Bayus 2002).

Golder and Tellis (1997) observed in their study on household consumer durables that takeoff tends to appear as a curve showing an average sales increase of over 400 %. However, they also found that when the base level of sales is small, a relatively large percentage increase could occur without signaling takeoff. Conversely, they found that when the base level of sales is large, takeoff sometimes occurs with a relatively small percentage increase in sales.

Agarwal and Bayus (2002) illustrate takeoff as the *"hockey-stick"* or *"elbow shape"* pattern shown in the adoption diagram. Tellis et al. (2003) define that new product takeoff is a transition from the introduction to the growth stage and undergoes a rapid growth in product sales. Golder and Tellis (2004) later proposed that takeoff is followed by the *first dramatic and sustained* increase in innovation adoption.

The shift across this point poses a substantial challenge for companies. The dynamics changes after takeoff, and customer requirements and preferences change from technical functionality to usability and

reliability (Rogers 1995; Moore 1999; Golder and Tellis 2004; Stremersch and Tellis 2004). In consequence, companies developing innovations and products must adjust their competitive strategies and change their competitive basis from technical functionality to market oriented factors such as reliability and usability. After takeoff, companies should change the focus from innovation and technology development to product development and incremental improvement.

The definition of takeoff point used in the present work follows the definitions of both Agarwal and Bayus (2002) and Golder and Tellis (2004). In other words, takeoff is assumed to form an *"elbow shape"* pattern and takeoff is followed by the *first dramatic and sustained* increase in innovation adoption. Not only can the time from launch to takeoff be measured but also the penetration at takeoff However, in practice, the adoption does not always follow an *"elbow shape"* pattern and so it is not always possible to determine takeoff point.

1.2.4 Cultural dimensions

Culture is a relatively unified set of shared everyday practices, rituals, and symbolic ideas associated with societal patterns of cultural environment (Gudykunst and Kim 1984; Schwartz 1997). It is a system of inherited conceptions expressed in symbolic form by means of which people communicate, perpetuate, and develop their knowledge about and attitudes towards life (Geertz 1974; Hammel 1990). According to Hofstede (1997) culture can be regarded as *"the collective programming of the mind which distinguishes the members of one group or category of people from another"* and that values form the core of culture and define tendencies to prefer certain states of affairs over others. Another well-known consensus definition runs as follows:

> Culture consists in patterned ways of thinking, feeling and reacting, acquired and transmitted mainly by symbols, constituting the distinctive achievements of human groups, including their embodiments in artifacts; the essential core of culture consists of traditional (i.e. historically derived and selected) ideas and especially their attached values. (Kluckhohn 1951)

In cross-disciplinary terms culture can also be defined as *"transmitted and created content and patterns of values, ideas, and other symbolic-meaningful systems as factors in the shaping of human behavior and the*

artifacts produced through behavior" (Kroeber and Parsons 1958). Values as a part of culture can be defined to be expressing a person's beliefs about ideal modes of conduct and ideal terminal goals (Kluckhohn 1951; Rokeach 1970). Both values and culture are based upon what is said and done by individuals and a value is abstracted from verbal and nonverbal behavioral events (Kluckhohn 1951).

National culture is a fundamental factor that distinguishes adopters of one country from those of another and also a factor that influences adopter behavior (Sommers and Kernan 1967; Roth 1995). Culture is a multifaceted construct that can not be easily simplified into a unidimensional construct in which countries are grouped into two or three categories (i.e., high-low or high-medium-low) (e.g. Kluckhohn 1951; Hall 1976). However in practice, to be able to operationalize culture, simplified models are used.

There exist several systems of cultural dimensions to illustrate the differences between cultures. One such system is Inglehart's World Value Survey (Inglehart, Basanez et al. 1998) describing individuals' norms, opinions and attitudes. Another is Schwartz's seven dimensional system demonstrating differences between the meaning of values across countries (Schwartz 1994). The GLOBE project (House, Hanges et al. 2004) is measuring both cultural practices and cultural values. Further, Hofstede's five dimensional system describes everyday practices, symbols, and rituals shared by the members of a society (Hofstede 1980; Hofstede and Hofstede 2005).

The present study follows the tradition of Hofstede (1997) and defines culture as the collective programming of the mind, taking into account the differences of one group or category of people from another. This definition recognizes that culture is based on collective values and paradigms, and groups of people with differing values and paradigms differ from each other. Following a generally accepted principle in the cultural discussion (Ganesh and Kumar 1996), culture and nation are used as synonyms in the current research. Here, cultural dimensions are operationalized by employing Hofstede's empirically derived national index scores.

1.3 Research objectives and questions

The study focuses on innovation adoption takeoff in a cross-national setting, and the evolution of innovation adoption in national markets. The aim is to explore cross-nationally the determination of takeoff point and the influence of cultural dimensions on the occurrence of takeoff. The detailed research questions are presented in Figure 1.2:

1. Can the takeoff point in the adoption of innovations be determined?

2. If so, how can it be determined reliably?

3. Do cultural dimensions influence the occurrence of takeoff of adoption in cross-national settings?

Figure 1.2. Primary research questions of the study.

As Figure 1.2 indicates, the primary objective of this study is to discover if the innovation adoption takeoff point can be determined. The focus is, therefore, on the selected alternatives for determining takeoff point. And if takeoff can be determined, the second objective is to investigate how the determination can be made reliably. Thus this objective addresses the evaluation of reliability and validity of the methods. On the basis of this investigation, the third objective of the study is to examine if cultural dimensions influence the occurrence of takeoff. In other words, in what ways do national cultural dimensions influence takeoff time and volume? Figure 1.3 illustrates the relationship of the original publications to the current dissertation in terms of these research questions:

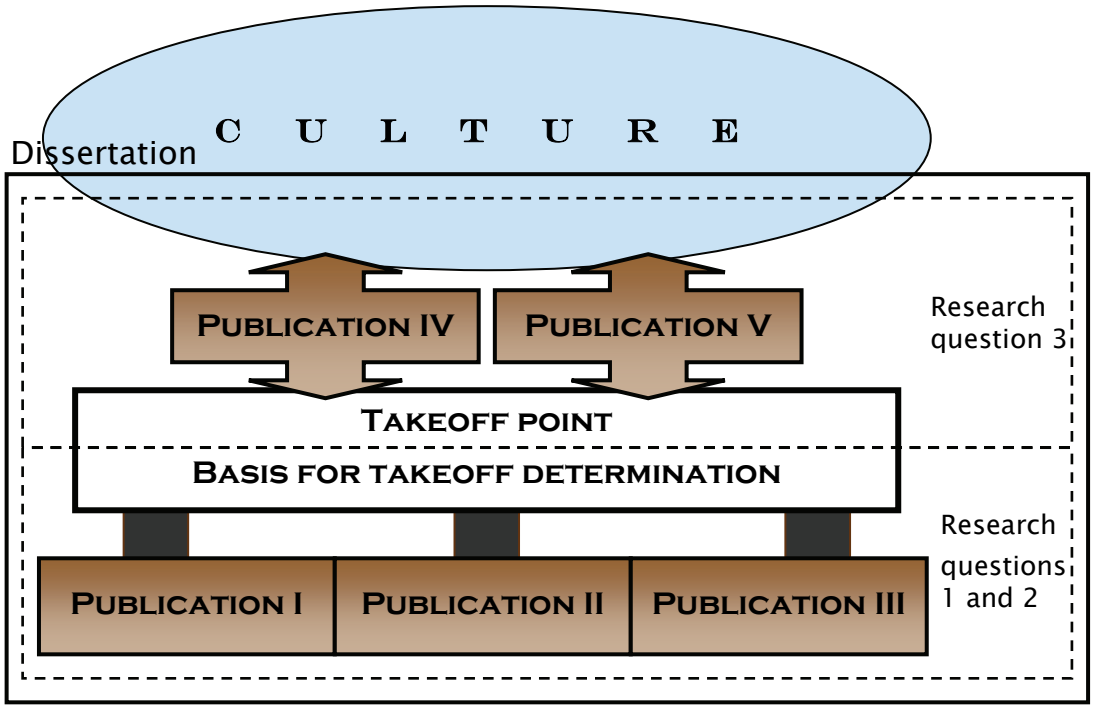

Figure 1.3. The relationship of the original publications in terms of the research questions. The dissertation itself is represented by the rectangular area bordered with a solid line. Culture is considered as an underlying aspect which is discussed in publications IV and V.

It can be seen from Figure 1.3 that the study begins with three publications which establish the basis for the further research carried out in the two subsequent publications. The first paper is entitled "*An empirical study of the determination of innovation adoption takeoff point by using content analysis"*. This analyses one innovation adoption takeoff point determination method and evaluates its reliability as a method. The second article, *"Determining the takeoff point in adoption of innovations: a comparison of content and discrimination analysis"*, investigates two innovation adoption determination methods. This is studied further in the third paper, entitled *"Determining Takeoff Point of Innovation Adoption in International Setting: An Analysis of Three Methods"*. The third publication further considers different determination methods, and explores three methods – content analysis, discrimination analysis and diffusion analysis – evaluating further the reliability of the methods from different perspectives. These first three publications, therefore, provide answers to the first and second research questions, and form the basis for the research on innovation adoption itself, as illustrated in Figure 1.3.

The fourth and fifth publications continue with an examination of the influence of cultural dimensions on the occurrence of takeoff point. The fourth paper is entitled *"An International Study of the Adoption of*

Innovations: The Effects of National Attributes on Takeoff Timing". This explores the influence of cultural dimensions and national attributes on the takeoff occurrence in terms of time. The fifth article, *"Cross-national adoption of innovations: the effects of cultural dimensions on the number of adopters at takeoff"*, focuses on the takeoff occurrence from a different viewpoint. That is, the paper investigates the influence of cultural dimensions and national attributes on the takeoff occurrence in terms of the number of adopters. Thus, the fourth and fifth paper respond to the third research question presented in Figure 1.2 and completes this dissertation.

1.4 Scope and limitations

First, the evaluation of the takeoff determination methods is made for three methods, which are widely recognized in the current literature. Reliability and validity are evaluated for content analysis, partial mathematical discrimination analysis, and pure mathematical diffusion analysis. Thus, the analyses involve the various types of determination method.

The methods, however, have certain limitations. For example, these include the need for an understanding of the underlying assumptions of adoption dynamics in content and discrimination analyses, and also the need for several data points in time series before takeoff in diffusion analysis. However, since these limitations are considered within the analyses of the original publications, they are not discussed in detail here.

There are multiple turning points in the evolution of innovation adoption. However, this study focuses only on the first of these, i.e. takeoff point. This is of special interest because of its exceptional characteristics as well as its influence on the further evolution of innovation adoption.

Further, many individual variables also change before takeoff. For example, Agarwal and Bayus (2002) report that the number of firms in the industry increases before takeoff. Such variables can be considered weak signals, which are followed by a discontinuity in the pattern of adoption (e.g. Ansoff 1975). However, these signals lie outside the scope of the present study.

Takeoff is investigated cross-nationally without restriction to continent or country. Further, the study is conducted as an *ex post* consideration. This means that this study makes no attempt at creating forecasting models for takeoff, but instead, sets out to explain the phenomenon of takeoff and adoption of innovation.

Similarly, even though there are various kinds of innovations, the focus here is on a few similar types of radical new innovations involving a variety of technologies. The focus is on the early evolution of certain types of innovation because, at this stage, the adoption dynamics may not differ significantly between innovations.

This study adopts Hofstede's cultural dimensions as a system for describing culture. These consist of a reduced set of the multidimensional cultural attributes affecting individual behavior in a researchable construct. It is considered as a coherent theory to explain variation between national cultures (Søndergaard 1994; Sivakumar and Nakata 2001; Hofstede, Wedel et al. 2002; McSweeney 2002b; McSweeney 2002a; Yeniyurt and Townsend 2003; Earley 2006; Hofstede 2006; Javidan, House et al. 2006; Smith 2006) and the reason for its extensive usage lies in its clarity, parsimony and resonance with managers (e.g. Kirkman, Lowe et al. 2006).

1.5 Research strategy and methodological setting

Each study has its own particular assumptions about the nature of the social world and how it can be investigated. According to Burrell and Morgan (1979), in management and organizational research, the assumptions can be classified according to four paradigms: radical humanist, radical structuralist, interpretive and functionalist. Radical humanism emphasizes subjectivism and understanding. In radical structuralism, the starting point is change, which is attained, for example, by organizational restructuring. The interpretive paradigm focuses on individual experience and seeks explanations through an understanding of such experience. The fourth paradigm, functionalism, is based on realism and positivism, and aims at rational explanation.

The present work is based on the ontological and epistemological assumptions that there is an actual context wherein culture and innovation adoption takeoff exist, and which can be expressed in

quantifiable terms. Culture and takeoff are assumed to be related, and culture is assumed to have an influence on takeoff, not vice versa. The intention here is to explain this relationship between culture and takeoff and, thus, explore the determination of takeoff point. This makes it necessary to analyze and compare long quantitative time series. Thus, in the classification of Burrell and Morgan (1979), this study falls within the paradigm of functionalism, where the goal is rational explanation.

In the management literature, all research strategies conform in their approaches to either of the two main traditions in scientific thinking: positivism and hermeneutics (von Wright 1970). In a hermeneutic approach, research focuses on understanding and interpretation (Olkkonen 1994; Gummesson 2003). However, research employing a hermeneutic approach rarely proceeds in a direct and straightforward way, but is allowed to *"float"* more widely (Gummesson 2000). Moreover, data in research adopting such an approach are primarily non-quantitative.

The aim in this dissertation is to examine the determination of takeoff point and the influence of culture on takeoff by means of quantitative data. Therefore, a positivistic approach, in which a quantitative data is typical, is considered more appropriate in the current research. In this approach, data consist of facts, which can be observed and are measurable. The data can also be modeled and processed by using mathematical or statistical methods. (Kakkuri-Knuuttila 1998) Typical of a positivistic approach and functionalism is the rational and objective explanation of facts, based on empirical evidence (Burrell and Morgan 1979; Easterby-Smith, Thorpe et al. 1991; Olkkonen 1994; Raatikainen 2004). The objective is to demonstrate correlations and causal relationships in the data.

Though the objective of this study is to explain causalities, and further, to understand the phenomenon of innovation adoption and takeoff, a nomothetic-positivistic approach can be adopted. Such an approach treats reality as objectively observable and independent of the observer. The researcher's role is to gather and systematize the facts. Emphasis is placed on explanation and the empirical aspect of research. Results are generalized from data by using, for example, statistical methods. (cf. Easterby-Smith, Thorpe et al. 1991; Guba and Lincoln 1994; Olkkonen 1994)

In addition, a number of commonly accepted methodologies exist in this approach. In the original publications of the current research, various statistical measures are employed to determine the relationships between research objects. Common to all the publications is that they are based on quantitative longitudinal time series and employ statistical analysis of the empirical evidence.

1.6 Organization of the thesis

The current thesis is organized as follows. Part I provides an introductory essay, which introduces the domain, summarizes the key findings and synthesizes them. Chapter 2 in Part I contains an overview of the domain by presenting the relevant earlier research. Chapter 3 summarizes the dissertation findings from the original publications and synthesizes these findings with a discussion of the theoretical and practical contributions. Finally, Chapter 4 of Part I presents concluding remarks concerning the evaluation of the study, limitations and avenues for further research. The original publications are presented in Part II, at the end of the thesis.

2 LITERATURE REVIEW AND THEORETICAL PERSPECTIVES

2.1 Adoption of innovations and takeoff

2.1.1 Adoption of innovations

Adoption of innovations first proceeds slowly over an introductory period after the product's commercial launch, and then later at a sharply increasing rate. (Bass 1969; Gort and Klepper 1982; Mahajan, Muller et al. 1990a; Rogers 1995) Takeoff point divides an innovator segment from early adopters and mass markets. For most innovations, takeoff point is clear because they typically penetrate the market rapidly upon reaching mass markets (Agarwal and Bayus 2002; Tellis, Stremersch et al. 2003). The point can be determined in a straightforward way from the *"hockey-stick"* or *"elbow shape"* pattern in a cumulative adoption curve. At the end of the evolution, after rapid growth in innovation adoption, the rate of adoption decreases before reaching saturation level. The adoption trend thus acquires the form of an S-curve. Figure 2.1 demonstrates these two essential turning points in the evolution of adoption:

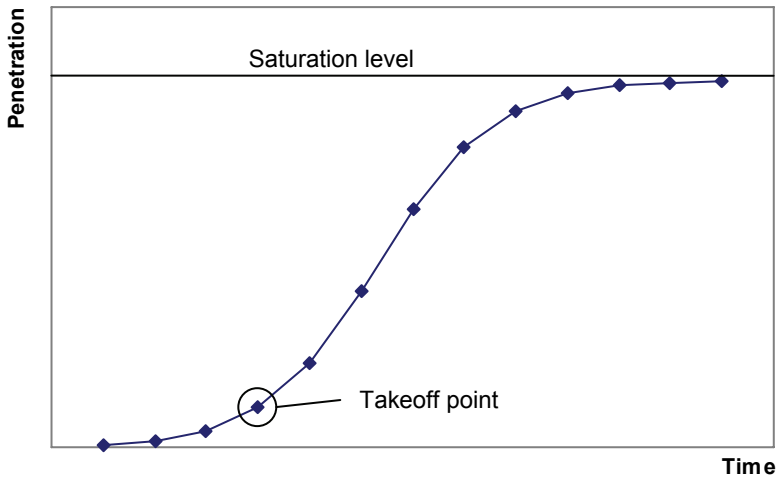

Figure 2.1. Cumulative adoption pattern with takeoff point and saturation level.

The evolution of market segments along adoption dynamics is partly explained by customers using a new innovation. The national launch of an innovation starts the adoption, where is adopted by various customer segments. Innovator segment is of special interest because it validates the functionality of a new innovation and the existence of the markets for new technological innovations (e.g. Fell, Hansen et al. 2003).

Innovators have a high level of technological sophistication and knowledge (e.g. Mahajan, Muller et al. 1990a; Rogers 1995). According to Rogers (1995), innovators' ability to understand technological foundations, toleration of unreliable products, preferring functionality over ease of use, for example, is much greater than for the later customer segments in adoption dynamics. Therefore, approaches to such issues as marketing communication, product design, and advertising message for this segment should differ from those targeted to mass markets in a later phase (e.g. Mohr 2001). Innovators also differ from the majority (i.e., the following customer segments) in terms of their price sensitivity, which is much lower (Moore 1999).

Takeoff point is critical, because the shift from pre-takeoff to post-takeoff phase in innovation adoption represents a major challenge for companies selling new products in their industry (Rogers 1995; Moore 1999). The shift from pre-takeoff to post-takeoff phase usually also represents a change in emphasis from product to process innovations (Utterback and Abernathy 1975). Customer requirements and preferences change from technical functionality to more marketing oriented attributes like usability and availability (Rogers 1995). Dramatic changes at this stage in customer needs, wants, and preferences can be quite disturbing to marketing operations because of the heterogeneity of the markets. Takeoff point is the juncture in innovation dynamics where dominant designs are adopted (Utterback 1994).

2.1.2 Researches on adoption and takeoff

Studies on takeoff has been largely ignored in marketing literature (Mahajan, Muller et al. 1990a; Kalish, Mahajan et al. 1995; Agarwal and Bayus 2002). Golder and Tellis (1997) were the first to conduct an empirical study of product takeoff. They examined totally new household consumer durables and identified a takeoff point for them. They found that price and market penetration seemed to be strongly associated with takeoff point. Agarwal and Bayus (2002) studied consumer and industrial

product innovations and explored the evolution of innovation adoption in relation to industry structure. They found that demand shifts during the early evolution of a new market due to non-price factors are the key driver of a sales takeoff. Montaguti et al. (2002) have also provided a discussion and a conceptual framework of takeoff in technology industries. However, these studies were conducted with no international or cross-national focus, and consider only a single country.

In multi-country terms, different countries launch new innovations in a sequence rather than all at the same time (e.g. Tellis, Stremersch et al. 2003). Additionally, differing customer segments are reached at different times in adoption. In the current literature, the time that has elapsed after the first global launch of a new innovation is often referred to as launch-lag and it has been showed to quicken adoption dynamics on a national level. (Takada and Jain 1991; Ganesh and Kumar 1996; Ganesh, Kumar et al. 1997; Kumar, Ganesh et al. 1998). According to these studies, the phenomenon is referred to as a *"lead-lag effect"* or *"cross-national learning effect"*, where decision-makers gather and communicate information across national borders, not solely within a national context.

Mäkinen (2002) and Tellis et al. (2003) were among the first to conduct a multi-country study in takeoff research. The authors found that a lead-lag effect exists in adoption dynamics. They also show that takeoff diminishes market uncertainty and that customer expectations regarding the innovation are less skeptical than before takeoff. Howard (1983) holds that a categorical shift takes place in consumer problem solving as well as a major modification in information requirements during an adoption life cycle. When an innovation passes takeoff in its adoption life cycle, consumer choices move from extensive to limited problem solving, which requires less information and cognitive processing. Therefore, takeoff divides managerial and competitive actions into actions implemented before and after takeoff.

Empirical evidence from previous internationally focused research shows that takeoff for new product categories may take a long time, even if marketing managers may want to accelerate it. Studies of consumer durables by Kohli et al. (1999) and Tellis (1994) found that an average takeoff time is between 10 and 12 years. However, according to Golder and Tellis (1997) and Tellis (1994), the period is becoming shorter.

Studies on the effect of national attributes to the adoption of innovations have considered mainly wealth and prosperity indicators. Tellis et al. (2003) found that industrialization affects the adoption dynamics. They provide empirical evidence for the hypothesis that innovations are adopted faster in wealthy and educated countries and in more open and internationally focused economies than in poor or less open economies. Golder and Tellis (2004), van den Bulte (2000) and Yeniyurt and Townsend (2003) found similar evidence that national economic conditions have a bearing on adoption. However, there is also contradicting evidence, which suggests that converging incomes do not automatically imply converging consumption patterns (e.g. Watson, Lysonski et al. 2002).

In addition to studies considering wealth and prosperity indicators, other indicators have also been examined. Population density has been found to affect the number of contacts between members of society (Klasen and Nestmann 2004) and information sharing (Fell, Hansen et al. 2003). Fell et al. (2003) and Frederiksen (1981) also found that population density has a positive impact on the diffusion and adoption of innovations. In addition, the traditional diffusion literature postulates that population density would increase the imitation coefficient of diffusion (Rogers 1995). This is despite the fact that the innovation coefficient negatively correlates with the imitation coefficient. However, the resulting influence is somewhat ambiguous in the way it actually affects adoption. The literacy rate, as a measure of educational systems, and its development is also a widely used measure (e.g. Glenn and Gordon 2001). Earlier studies have found that rates of illiteracy have a negative relationship with technology diffusion (Andonova 2006). Moreover, the literacy rate has also been found to moderate product adoption at the national level (Yeniyurt and Townsend 2003).

2.2 Effect of culture on adoption of innovations and takeoff

2.2.1 Hofstede's dimensions

As mentioned in Section 1.2.4, culture can be regarded as *"the collective programming of the mind which distinguishes the members of one group or category of people from another"* (Hofstede 1997). Even though markets continue to globalize and national incomes are converging, cultural value

differences can be seen to persist (de Mooij 2000; Watson, Lysonski et al. 2002). Further, cultural level values are more likely to guide and determine individual behavior and decision making within the limits of the respective culture (Kluckhohn 1951; Rokeach 1970). Therefore, each culture consists of various characteristics, such as values, attitudes, behaviors, habits, and world view. People can be classified into different cultures, even if there exists individual and sub-cultural variation inside each respective culture (Hofstede 1997).

Hofstede (1980) reduced the multidimensional cultural attributes affecting individual behavior into researchable constructs. Schwartz (1997) sees Hofstede's dimensions as a broad concept of culture comprising everyday practices, symbols, and rituals shared by the members of a society. The dimensions date back to the late 1960s and were updated in 1980. Originally, there were four cultural dimensions (power distance, individualism, masculinity, and uncertainty avoidance) representing cultural variability and different value systems in 53 cultures (Hofstede 1980). When updated, the Confucian work dynamism was added to original four; often labeled as long-term orientation (Hofstede and Bond 1988).

Power distance is *"the extent to which the less powerful members of [a culture] expect and accept that power is distributed unequally"* (Hofstede 2001). It expresses the degree to which individuals are sensitive to status differences and how much they are motivated by the need to conform with those in their status group or in status groups to which they aspire (Roth 1995). Power distance means the extent to which status differences are accepted. It affects how important it is to adopt the *"right"* innovations at the *"right"* time (Hofstede 2001).

Decision-making on whether to adopt an innovation is highly dependent on the change agents at the society level. Adopters must not adopt too early to avoid appearing presumptuous about their place in society. On the other hand, people will seek to emulate the consumption behavior of their superiors (Tarde 1903) and aspiration groups (Simmel 1971). Further, people will also quickly pick up innovations adopted by others of similar status if they fear that such adoptions might undo the present status ordering (Burt 1987). In high power distance cultures, hierarchy and its pervasiveness inhibits individual decision-making (Hofstede 1997), and there exists a general distrust of others, which further inhibits fast and decisive decision-making (Dawar, Parker et al. 1996). Doney et

al. (1998) note that high power distance cultures tend to have calculative trust formation while low power distance cultures form trust through a benevolent intentionality process.

Individualism is the opposite to of collectivism, which is the extent to which *"people from birth onwards are integrated into strong, cohesive in-groups"* (Hofstede 2001). The need to achieve and industriousness can be associated closely with individualism (Peapody 1985; Tellis, Stremersch et al. 2003). Well-being is attained by more individualistic driven motives and behaviors in high individualism cultures, whereas collectivism denotes an emphasis of group welfare. Moreover, the members of the collectivistic cultures with low individualism do not follow purely individualistic behaviors. According to Schneider and Barsoux (1997), in collective cultures, members of the society seek acceptance of the group they belong to and express the needs to maintain harmony and traditions.

In collectivist cultures people work more for the community and spend more of their time in group settings. *"We"*-identity, duty and loyalty are priorities. In such cultures people have a tendency to take care of their social networks and relationships. The need for personal reward and initiative are the preferred values in individual cultures. (Hofstede 1997; Tellis, Stremersch et al. 2003) Independent decision-making, pleasure, personal time and the need for personal reward are preferred values in cultures with high individualism (Schwartz 1992; Triandis 1995).

Masculinity is the extent to which *"social gender roles are clearly distinct: men are supposed to be assertive, tough, and focused on material success; women are supposed to be more modest, tender, and concerned with quality of life"*. Masculinity is typically associated with assertiveness; high competition; ambition; forms of materialism, like money and earnings; and ego goals, such as careers and status. (Hofstede 2001) Masculinity relates to levels of assertiveness, competition, ambition and forms of materialism like money and earnings. Masculine cultures put more emphasis on wealth, material success, and achievement (de Mooij 1998; Steenkamp, Hofstede et al. 1999). Thus, display of status in general, and display of material possessions in particular, are more prevalent in masculine than in feminine cultures. Preferences and attitudes towards various subjects are dependent on the social roles of genders. This is more marked in some societies than in others. Accordingly, femininity is attributed more to taking care of people, equality in relationships, and concern for work life and the environment.

Feminine cultures attach more importance to social goals such as relationships. (Hofstede 2001)

Generally, there is more equality between roles in feminine cultures than in masculine cultures (Hofstede 1997). Degree of masculinity is expressed, for example, in ownership of luxury articles since this reflects greater success and has more appeal to members of masculine cultures than those of feminine cultures (de Mooij and Hofstede 2002). The adoption of new products might be considered an important aspect in exhibiting wealth and success, which may be more compatible with masculine societies and influencing the takeoff time (Tellis, Stremersch et al. 2003).

Uncertainty avoidance is *"the extent to which the members of a culture feel threatened by uncertain or unknown situations"* (Hofstede 1997). High uncertainty avoidance creates group pressure and fosters avoidance of being different from the social group that individuals belong to (Dawar, Parker et al. 1996). High uncertainty avoidance is also attached to a strong identification with one's own group and its rules. Uncertainty creates anxiety in individuals and this anxiety is typically managed through adoption of technology (artifacts), laws (rules), and religion (knowledge of unknown) at society level, as well as at the individual level (Hofstede 2001). In this dimension a lower intrinsic tendency to adopt innovations could be expected, since consumers in such countries are more averse to what is different and new.

In creating rules for themselves, individuals are made to feel that threats to existing structures can to be avoided. (Vitell, Nwachukwu et al. 1993). In high uncertainty avoidance cultures, an individual's behavior must be perceived as positive, desirable, and loyal in order to maintain group membership. Rallapalli et al. (1994) observe that a propensity for taking risks is highly correlated with unethical actions in a consumer setting. Moreover, it has been established that cultures with high uncertainty avoidance are intolerant of ambiguity and distrustful of new ideas or behaviors (Dawar, Parker et al. 1996). Steenkamp et al. (1999) support this view, finding a negative association between a country's uncertainty avoidance and the levels of innovativeness of its citizens.

Long-term orientation is related to the extent to which a culture is orientated toward the future. The dimension involves the temporal emphasis of a society; whether goal-seeking behavior is directed to the

future or whether short-term results are sought. (Hofstede 2001) A high long-term orientation value indicates the importance attached to building relationships, perseverance in achieving slow results and concentration on future prosperity, rather than short-term fulfillment. Short-term values are oriented toward the past and the present. Value is placed on respect for tradition, personal steadiness and stability, fulfilling social obligations and a reciprocation of favors and gifts (Bond, Akhtar et al. 1987; Hofstede and Bond 1988; Hofstede 2001; Kirkman, Lowe et al. 2006).

2.2.2 Researches on adoption and culture

These dimensions have been used in earlier research seeking explanatory factors for national level behaviors and cross-cultural variations (e.g. Dawar, Parker et al. 1996). Although Hofstede's dimensions are not without their critics, they can, nevertheless, be considered as a coherent theory to explain variation between national cultures (Søndergaard 1994; Sivakumar and Nakata 2001; Hofstede, Wedel et al. 2002; McSweeney 2002b; McSweeney 2002a; Yeniyurt and Townsend 2003; Hofstede and Hofstede 2005; Earley 2006; Hofstede 2006; Javidan, House et al. 2006; Smith 2006). For example, Watson et al. (2002) provide support for the existence of dimensions and their power in classifying national cultures. In addition, Kirkman et al. (2006) note that despite such criticism, researchers have favored this framework because of its clarity, parsimony and resonance with managers. Therefore, the validity and reliability of the dimensions is considered to be established in the current literature

Hofstede's dimensions have been widely used in the literature studying adoption. In addition to lead-lag effect, national level cultural attributes have also been found to influence technology and innovation adoption in a cross-national setting (e.g. de Mooij 2000). Dwyer et al. (2005) provide evidence linking Hofstede's cultural dimensions to cross-national product diffusion. They found that power distance affects adoption dynamics: high power distance, for example, is shown to positively affect adoption of new products. On the other hand, some researchers claim that power distance does not affect consumer behavior and adoption (e.g. Steenkamp, Hofstede et al. 1999; Tellis, Stremersch et al. 2003). They also argue that there is neither theoretical nor empirical support for linking power distance to the takeoff time of new products. However, there is also contradicting evidence that high power distance does indeed hinder the adoption of new products (Sivakumar and Nakata 2001). These

conflicting views reflect the lack of consensus within the field as to the actual relations between power distance and adoption.

Previous studies indicate that high individualism results in faster adoption of new products (Sivakumar and Nakata 2001). Tellis et al. (2003) found that a strong need for achievement and industriousness are factors that affect the adoption dynamics. Furthermore, Steenkamp et al. (1999) reported a positive association between a country's individualism and its citizens' consumer innovativeness. Therefore, the findings on individualism are consistent.

With regard to masculinity, Steenkamp et al. (1999) demonstrated a positive association between this dimension and consumer innovativeness. Tellis et al. (2003) hypothesized that the adoption of new products might be an important aspect in exhibiting wealth and success and thus influencing the takeoff time. However, they do not claim to find empirical evidence to support this view. For their part, Yeniyurt & Townsend (Yeniyurt and Townsend 2003) have reported that masculinity has no significant effect on product acceptance or innovation adoption. Thus, there is a clear lack of consensus in the current literature relating to this dimension.

Sivakumar and Nakata (2001) have found uncertainty avoidance to be a hindrance to the adoption of new products. Similarly, Tellis et al. (2003) have reported that low uncertainty avoidance results in faster overall adoption. Therefore, here, the findings in the existing literature are in agreement.

Studies of long-term orientation and the behavior at the organizational or group level have produced contradictory results (e.g. Peterson, Debrell et al. 2002). Research into product adoption dynamics has shown that high long-term orientation value has a positive influence on adoption of information systems at company level (Waarts and van Everdingen 2005). Conversely, Hofstede and Hofstede (2005) have demonstrated at the societal level, that in countries with low long-term orientation, individual behavior is directed to quick results. They add that in countries with short-term orientation, there exist social pressure toward spending and concern with social and status obligations.

2.3 Determination of takeoff point

2.3.1 Determination methods

In recent decades, a few procedures have been developed to determine innovation adoption takeoff point (e.g. Gatignon and Robertson 1985; Gatignon, Eliashberg et al. 1989; Mahajan, Muller et al. 1990a; Dekimpe, Sarvary et al. 2000; Agarwal and Bayus 2002). These studies have employed procedures based on content analysis, discrimination analysis or diffusion analysis.

Content analysis is a visual inspection type of qualitative evaluation, which, in general, involves a few (usually two or more) researchers making subjective classifications of research objects. The classifications are based on a handbook that provides guidelines to enable an analyst to identify, extract, and classify research objects accordingly. The research objects can be, for example, audio-visual objects like video clips, textual objects like news headlines, or graphics like advertisements. Content analysis is explicit in its classification procedures. The independence and reproducibility of its analysis results are transparent and a reliability assessment can also be conducted (Krippendorff 1980).

Discrimination analysis is based on both visual inspection and mathematical methods. The analysis begins with a content analysis type of classification of data points. It then compares averages of before and after a hypothetical takeoff point, following Agarwal and Bayus (2002). To determine the takeoff time by means of a generalized version of discrimination analysis similar to Mäkinen (2002), the current study follows the statistical procedure of Gort and Klepper (1982) and Agarwal and Gort (1996). The procedure is based on means analysis, which makes it possible to distinguish between any two consecutive intervals by examining data on the annual percentage changes in sales (for each product).

The diffusion analysis method is based on the pure mathematics of the Bass (1969) diffusion model. Differentiation of the S-shaped cumulative adopter distribution $F(t)$ gives the non-cumulative adopter distribution $f(t)$ representing the specified diffusion process. The non-cumulative adopter distribution is symmetric with respect to the period around the peak sales time T^* from 0 to $2T^*$.

However, the above would have required estimation of the coefficient of innovation (p) and the coefficient of imitation (q), and continuous time series. Therefore, this study follows Mahajan et al. (1990b) and Ziemer (1985) when developing the following procedure to define takeoff point in discrete time series. An essential feature of the method is that it cannot be used for determining takeoff point if takeoff has taken place during the first four years following commercial launch. This means that the method is based on calculations that require data from the current and the three previous years.

2.3.2 Prior research on determination of takeoff point

The determination of takeoff point in previous international studies has been based largely on diffusion models (e.g. Gort and Klepper 1982; Mahajan, Muller et al. 1990b; Kalish, Mahajan et al. 1995; Mahajan, Muller et al. 1995; Golder and Tellis 1997; Agarwal and Bayus 2002; Tellis, Stremersch et al. 2003). These authors evaluated the takeoff year either by using a combination of visual inspection and mathematical methods or by fitting diffusion models to the data. Such methods did not allow determination of the takeoff year to be made unambiguously, and further research was called for. Agarwal and Bayus (2002) and Gort and Klepper (1982) determined takeoff point using discrimination analysis. They also recommended further research into the evolution of the diffusion process, especially modeling of the takeoff phenomenon.

According to previous studies (e.g. Gatignon and Robertson 1985; Gatignon, Eliashberg et al. 1989; Mahajan, Muller et al. 1990a; Dekimpe, Sarvary et al. 2000; Agarwal and Bayus 2002), takeoff point is clearly identifiable in about half of the adoption time series. In the other half of the time series, takeoff point is less easily identifiable because of the different adoption dynamics, such as smooth exponential curves. In these time series, determination of takeoff point must be performed in a uniform manner. There are, however, no studies comparing or evaluating determination methods.

In summary, earlier studies have utilized some of the three determination methods as adjuncts to the primary study, but they have neither evaluated the methods nor provided guidelines for the reliable and coherent determination of takeoff point. Therefore, a research gap exists in the field for a comparative evaluation of determination methods.

3 FINDINGS AND CONTRIBUTIONS OF THE ARTICLES

3.1 Key findings of the articles

3.1.1 An empirical study of the determination of innovation adoption takeoff point by using content analysis

Earlier studies of takeoff point have employed some of the existing determination methods as adjuncts to the primary study. The underlying assumption in such studies has been that determination is not dependent on the method. As a result, they provide no detailed evaluation of content analysis as to the precision of the determination method.

Therefore, the objective in the first paper was to study and analyze the content analysis of adoption time series. The paper reported results on how well the experts and non-experts are able to identify takeoff point in *ex post* consideration and how the differences between determination results can be explained.

The key contributions of this paper concern the challenges of determination and the reliability of content analysis. The results of the study showed that determination of takeoff point is very challenging, even in *ex post* considerations. It is all the more challenging in cases where there is a smooth adoption diagram since there is no clear point where takeoff occurs, if indeed, it even can be determined. However, for a company launching an innovation, the challenges are totally different when the estimation has to be made either in advance, or at least, in the early stages of adoption.

The study shows that content analysis is a reliable method for identifying takeoff point in self-evident cases. However, when takeoff is not self-evident (i.e. there is no clear *"elbow shape"* pattern), the method requires more expertise to achieve reliable results. Moreover, the study demonstrates that overall results differ significantly between expert and

non-expert groups. This may be because the experts understand the concept and the underlying aspects differently to the non-experts. The results also suggest that experts achieve more reliable results than non-experts. Thus, in determining takeoff point, the study recommends that companies select knowledgeable, skilled personnel who understand adoption dynamics and its underlying factors.

In addition to this, the study demonstrates that the method is very quick and easy to use. This means that the method is useful in typical situations when the pace of change is fast. The study further reports that content analysis can be used before the saturation level. Managers do not, therefore, need to know the total penetration or to have long time series to be able to estimate takeoff point.

3.1.2 Determining the takeoff point in adoption of innovations: a comparison of content and discrimination analysis

Current studies on takeoff have employed some of the existing determination methods along with the primary study with the assumption that determination is not dependent on the method. However, the studies neither compare nor evaluate in any detail the precision of their identification methods in comparison to other alternatives.

Therefore, the objective of the second paper was to analyze two different ways to determine takeoff point in an adoption time series. The methods considered were content analysis and discrimination analysis. The study examined whether it is possible to identify takeoff point from the adoption data alone, without additional explanatory variables. The study also evaluated how accurately takeoff point can be identified and which of the methods used in the study was best in terms of reliability assessment. The paper compared how well experts and non-experts identified takeoff point *ex post* by content analysis, and how these results differ from those gained by discrimination analysis. The paper also discussed the usability of the methods both in practice and in a research setting.

The key contributions of this paper concern the challenges of the determination and the comparison of content and discrimination analyses. The study showed that determining a takeoff point from adoption data alone is by no means straightforward. Certain cases called for careful evaluation and expertise to identify takeoff point unambiguously. Such cases are common in international adoption data.

This was confirmed by the disparity in the degrees of accuracy between the expert and non-expert evaluations in determining takeoff point. The study also showed that in the cases where there was no clear takeoff point, the result differed according to the evaluation method adopted. Determination should, therefore, be made by using only a single method irrespective of the one selected.

In content analysis, the experts produced the most reliable results when identifying takeoff point. Reliability was found to decrease with non-experts, and discrimination analysis also produced weaker results. Discrimination analysis alone produced consistent results, provided the data points were classifiable as pre-, in-between-, and post-takeoff points. However, the reliability of discrimination analysis depends on the correct classification of data points, which is an inherently subjective procedure requiring expertise. Therefore in this paper, the experts' determination of takeoff point was preferred to that of the non-experts and also to use of discrimination analysis.

3.1.3 Determining Takeoff Point of Innovation Adoption in International Setting: An Analysis of Three Methods

Previous studies on takeoff have assumed that determination of takeoff point does not depend on the method used. However, such studies make no broad comparison between the various identification methods. Further, they fail to provide any detailed evaluation as to the precision of their identification methods compared to alternative methods.

Therefore, the third paper evaluated three different ways to determine takeoff point in an adoption time series. The methods under consideration were content analysis, discrimination analysis, and diffusion analysis. The paper reported on the relative success of experts and non-experts in identifying takeoff point *ex post* by content analysis, and how these results differ from those gained by discrimination and diffusion analyses. The paper also examined the differences between the methods and compared their reliability.

As in the second article, the key contributions of the third paper concern the challenges of determination and comparison of determination methods. Here, comparison of the methods focuses on content, discrimination, and diffusion analyses. The study showed that it is difficult to determine takeoff point in *ex post* considerations. Adoption

does not always follow a traditional adoption pattern, so that in such cases determination requires careful evaluation.

The results demonstrated that content analysis by expert evaluators can produce more coherent and reliable results than either discrimination analysis or diffusion analysis. Content analysis was also found to be quicker than discrimination analysis or diffusion analysis because it requires no formal calculations. In particular, the results suggest that experts understand the concept and the underlying aspects differently to non-experts. In addition, the results indicate that understanding underlying aspects is important in achieving reliable results. This means that mathematical methods alone do not produce good results.

The study also demonstrated that all of the methods investigated here can be used before the saturation level is reached. This means that managers do not need to know the total penetration to be able to estimate takeoff point. On the other hand, however, none of these methods can be used for forecasting so that they can be used only after takeoff is assumed to have taken place.

3.1.4 An International Study of the Adoption of Innovations: The Effects of National Attributes on Takeoff Timing

Previous studies on the dynamics of innovation adoption have confined themselves to a limited geographical area or to the national level only. The studies report that the adoption process is both product and country specific and also that cross-national influences affect adoption. However, the current literature makes no mention of the global cross-national patterns of national innovation adoption dynamics with regard to the various customer segments adopting innovation. There is a lack of any research into the effects of cultural and national attributes on innovation adoption timing at the global level.

Therefore, the fourth paper investigated the effect of cultural and national attributes and launch timing on innovation adoption and takeoff. The paper reports how cultural and national level attributes and launch timing affect the time it takes on an innovation adoption to take off in a cross-national setting. The innovations studied in this research were CD, personal computer, and video camera.

The key contribution of this study is the findings on the global cross-national influence of cultural values on innovation adoption at a national level. The results of the study confirmed the earlier empirical findings that cultural values do influence the dynamics of innovation adoption at a national level. Furthermore, the study demonstrated that, in the CD category, the more powerful and wealthy a nation is, the earlier takeoff point occurs. The empirical results also indicated that a high uncertainty avoidance index, high launch-lag, and low export per import ratio all result in faster takeoff point occurrence in the PC category. The results in the video camera category showed that a high uncertainty avoidance index and long-term orientation brings about faster innovation adoption among innovators.

The results relating to the power distance and uncertainty avoidance indices and to long-term orientation run counter to the findings of the earlier literature. However, the results on wealth and launch-lag concur with those in the current literature.

3.1.5 Cross-national adoption of innovations: the effects of cultural dimensions on the number of adopters at takeoff

The existing literature on international innovation adoption has reported that the adoption process is both product- and country-specific and that cross-national influences may also affect the adoption of innovation. However, little of this research has attempted to identify the cross-national patterns describing national innovation adoption dynamics in terms of the differing customer segments adopting the innovation. There are no studies dealing with the effect of cultural and national attributes on the number of innovation adopters.

Therefore, the fifth paper developed the topic of the fourth paper by examining it from a different point of view. The paper reported how cultural and national level attributes affect the number of innovation adopters at takeoff point in a cross-national setting. The empirical research involved the following innovations: mobile telephone, personal computer and internet hosts.

The key contribution of this article is the findings on the cross-national influence of cultural values on innovation adoption in terms of number of adopters at a national level. The paper confirmed that cultural values do influence the adoption dynamics of national-level innovation. This

supported the thesis that cultural and national differences persist, despite the globalization markets.

Empirical results relating to the mobile telephone suggested that takeoff will occur earlier in countries which have high indices of masculinity, uncertainty avoidance, future orientation, and education and also where the GDP per capita is low. Empirical results for PC showed that in collective, masculine, educated, and low income countries, adoption of innovations takes off with a smaller number of adopters. The, empirical study with internet hosts showed that high masculinity results in earlier innovation adoption takeoff, whereas higher education leads to later innovation adoption takeoff.

The results indicated that companies launching radical innovations can expect earlier occurrence of takeoff in more masculine and indigent countries. It also appears that levels of education are linked to the number of adopters at takeoff. The power distance dimension, however, appeared to have no such impact on innovation adoption.

3.2 Synthesis of the findings

3.2.1 Theoretical contributions

Previous studies on takeoff have employed some of the existing determination methods along with the primary study. However, they have neither compared their identification methods to other alternatives nor evaluated in any detail the precision of their identification methods in comparison to alternative methods. Thus, the first three articles of this dissertation fill this research gap by evaluating and comparing various kinds of determination methods and providing guidelines for reliable and coherent determination.

The determination studies showed that, overall, determination of takeoff point is by no means straightforward. There are numerous ways to determine the point, and different methods produce slightly different results. The studies demonstrate that actual trends often run counter to expected patterns and, even in *ex post* considerations, determination is far from simple.

The first three papers of this dissertation also showed that content analysis is most reliable and coherent when carried out by expert evaluators. Expertise is needed because the method requires understanding of the takeoff phenomenon and its underlying factors. The results also established that content analysis is appropriate and produces reliable results when adoption proceeds according to an identifiable pattern and when takeoff point is self-evident. In addition, the papers reported content analysis to be the fastest determination method of the three methods analyzed. The second and third papers also considered the other two analyzed methods, but these were found to be less reliable and less appropriate than content analysis. The three studies also showed that the methods cannot be used for forecasting.

The current literature on the dynamics of international innovation adoption is either confined to a limited geographical area or considers only the national level. Such studies report that the adoption process is both product- and country-specific and that cross-national influences affect adoption as well. However, the global perspective remains unexplored, and no study has considered the effect of cultural and national attributes on the number of innovation adopters. The last two articles of this dissertation fill this gap. Taking a global perspective, they investigate the influence of cultural and national attributes on innovation adoption and takeoff, as well as the number of innovation adopters at takeoff.

These papers both confirmed the influence of cultural dimensions on the adoption dynamics of innovation at a national-level, especially on takeoff. The studies showed that the dimensions of collectivism, masculinity, uncertainty avoidance, and the long-term orientation of a culture accelerate the adoption. In particular, the studies underlined the effect of masculinity, uncertainty avoidance and long term orientation on innovation adoption and takeoff. To a lesser extent the studies also observed the influence of individualism, but found contradictory evidence for the influence of the power distance dimension.

As national attributes, GDP per capita, education, export per import ratio, and launch-lag were all found to affect the occurrence of takeoff. Lower levels of international trade and a later launch were also found to impact positively on the occurrence of takeoff. The results concerning GDP per capita and education were inconclusive.

The results relating to the cultural dimensions in the last two papers are somewhat similar to those found in the current literature. The results do not accord with sources in terms of the direction of the effects of certain cultural dimensions. Nonetheless, the results do agree with existing research in that cultural dimensions do have an influence on the adoption of innovation and the occurrence of takeoff. The results concerning national attributes also concur with earlier research on their influence on takeoff.

The contradictory result in terms of the direction of the effects of cultural dimensions and national attributes may be explained partially by the innovations in question. Since the installed base is sufficient, frequent communication between users might change the innovation adoption process. Widespread publicity and popularization through the media of the innovations might also partially explain these results.

3.2.2 Implications for practice

All five papers contain a number of practical implications. The first three papers demonstrate that content analysis is a faster, more coherent, and more reliable method than either discrimination analysis or diffusion analysis. In practical terms, speed is important for companies. In business the pace of change is typically fast and strategies must be implemented without delay in order to achieve and maintain competitive advantage.

Analysts conducting a content analysis type of *ex post* determination should be knowledgeable and thoroughly versed in the evolutionary dynamics of adoption processes. To determine takeoff point, therefore, it is vital for an organization to select knowledgeable, informed individuals who understand adoption dynamics and the underlying factors. In an industrial setting it is possible to determine takeoff point using experts' evaluations without the need for sophisticated mathematical procedures. In practice, content analysis conducted by more than one analyst is a reliable and effective method for takeoff point identification.

All three methods can be employed before saturation level is reached. Managers do not, therefore, need to know full adoption penetration or long time series in order to estimate takeoff point. Moreover, in industrial usage, content analysis method can be easily applied. The analysts' handbook should outline all possible forms of takeoff point (self-evident,

smooth identifiable, and distorted non-identifiable) as well as the instructions on how to determine takeoff point. Underlying assumptions, such as technology specific attributes involving network externalities, specificity of investments in infrastructures, installed base, pricing evolution, for example, should also be outlined. The results of the first three papers demonstrate that, equipped with a comprehensive handbook, the expert analysts' identification is both accurate and reliable.

The practical implications of the fourth and fifth papers suggest that, overall, cultural dimensions must be considered when planning cross-national commercialization of innovation. According to the results, gender roles, intolerance of ambiguity and the future orientation of culture all have a marked influence on the adoption and occurrence of takeoff. However, individualism and inequality of culture should also be taken into consideration.

Another practical implication of these studies is that companies launching radical innovations cross-nationally should also consider national attributes when selecting launch order. National wealth, education, international trade, and launch lag were shown to influence innovation adoption and the occurrence of takeoff.

Companies can benefit from these results by taking them into account when planning operations such as production capacity and logistics. However, there are also many other variables that need to be considered when anticipating the adoption dynamics to reach majority. Factors such as competition, institutional environment, infrastructure, inter-company co-operation might also have a bearing on the adoption and occurrence of takeoff. Industry and product type are also additional elements to be considered because this thesis focused on product category level, and because industry and product type can be expected to influence the behavior of the adopters.

The results are of particular interest in the planning of marketing communications, product development, and market entry determination. According to the results, companies considering entering markets in a cross-national setting can plan appropriate entry strategy and sequence. Companies can also benefit from the results of the study when directing their marketing efforts. The results can also help in modifying the marketing mix during the transition when national markets shift from

introduction phase to growth phase of innovation adoption, since the adoption dynamics changes after takeoff. The results are also useful for anticipating similar changes in national level markets and integrating them into international or global marketing management and planning.

4 CONCLUDING REMARKS

4.1 Validity and reliability of the study

In order to contribute to the theoretical discussion of current literature, research must demonstrate sufficient validity, reliability and generalizability (Uusitalo 1991). It is also necessary to evaluate validity and reliability from different stances.

Validity is the extent to which an indicator of some abstract concept measures what it purports to measure. It is the extent to which the measures and methods describe the phenomenon under consideration rather than reflecting some other phenomenon. (Hardy and Bryman 2004; Carmines and Woods 2005b) Several types of validity are appropriate in the positivist paradigm research. Each has a slightly different approach in assessing the degree to which a measure is valid. The criteria of validity commonly used in the positivist paradigm are face validity, internal validity, external validity, and construct validity. (e.g. Eisenhardt 1989; Hirsijärvi, Remes et al. 1997; Austin, Boyle et al. 1998; Yin 2003)

In face validity evaluation, the research is considered as a whole. It deals with the attainment of the results, i.e., are the results based on correct and credible evidence and do the results seem to be correct as a whole. (Carmines and Woods 2005b) In the present study, most of the results were based on mathematical evidence. Further, the results gained without mathematical evidence were gained by means of extensive evaluation from different stances. Therefore, it can be argued that the study has high face validity.

Internal validity refers to the establishment of a causal relationship where certain conditions are shown to lead to others. (Emory 1985; Mitchell 1985; Eisenhardt 1989) That is, internal validity focuses on the robustness of the relationship of a concept to another internal to the research question under study (McDonald 2005). Attempts to improve

internal validity were made by using long time series, which extensively covered the point of interest. Widely accepted models and variables were used for describing cultural dimensions and national attributes. Accordingly, it can be claimed that causal relations are highly credible and that the study has high internal validity.

External validity relates to the domain into which the results can be generalized. (Emory 1985; Mitchell 1985; Lukka and Kasanen 1993) Replication (Eisenhardt 1989; Yin 1994) is a fundamental requirement for the existence of external validity. Long time series from the numerous countries studied in this research are essential for ensuring generalizability within the limits of limitations. Moreover, in-depth analysis of certain types of innovation strengthens the generalizability of the results among similar types of innovation. The replicability of the research is ensured by detailed documentation of the research procedure. Along with other issues regarding research quality, generalizability is discussed extensively in the articles. The results can, in consequence, be considered to have high external validity.

Construct validity concerns the establishment of appropriate operational measures for the concepts studied. It involves the theoretical expectations related to a particular empirical indicator. The fundamental feature of construct validation is theory. (Carmines and Woods 2005b) Construct validity is thus concerned with the validity of the theoretical frameworks and the concepts used in the study. (Scandura and Williams 2000) The theoretical frameworks and the concepts employed are based on the existing literature. The operationalizations of the concepts were also derived from the literature, with the exception of the operationalization of the number of adopters in the fifth article. However, multiple sources of evidence and comments from numerous researchers were used in the operationalization of the number of adopters. Hence, it can be argued that the construct validity of the study is high.

Reliability relates to the assessment of random error and estimating its consequences. In reliability assessment, the criteria of objectivity should also be evaluated. Reliability is the extent to which an experiment, test, or any measuring procedure yields the same results on repeated trials. (Alwin 2005; Carmines and Woods 2005a) The empirical data in the present research – except for takeoff points in content analysis and discrimination analysis – were gathered or mathematically derived from databases and the data were processed using mathematical methods. In

addition, the first three articles considered the reliability of the determinations. Therefore, it can be argued that the same non-random results could be gained on repeated trials. Moreover, since the results are based on mathematical methods, the study can be deemed objective.

In sum, the foregoing discussion provides the necessary confirmation of the overall validity and reliability of the results and interpretations. On the basis of above analyses it can be asserted that the present research fulfils the criteria claimed for the validity and reliability of doctoral level scientific research.

4.2 Limitations of the study and avenues for further research

Irrespective of the holistic approach to the topic, there is a need to address certain limitations of the study. First, the method selected as being the most coherent and reliable for determining takeoff points according to the articles I-III, and which was also used in determination of takeoff points in articles IV-V is, by its nature, subjective. Content analysis is a method based on the subjective assessment of adoption patterns. However, when documented and correctly applied, the method is shown to be replicable and to produce consistent results that can be subjected to rigorous reliability assessment. Thus, one option for further research could be an assessment of how increasing the number of expert analysts might reduce discrepancies in their determinations.

A second limitation concerns the data used in the study. There were a limited set of innovations and, similarly, a limited number of countries under investigation. An obvious avenue for future research is to increase the number of innovations and countries under investigation. To corroborate and generalize the findings of the current study, there is need of further research employing other innovations in more countries. On the other hand, as innovation in this study was defined in terms of category level innovations, the results here are not directly applicable to any single product level innovation. Indeed, some of the data sets in this study consider yearly possession per household, rather than sales or penetration data. This is also discussed in the original publications, but it does pose challenges for the accuracy of the dynamics, for example, in cases of multiple or replacement purchases. Future research could help to resolve these issues.

Thirdly, the studies were conducted as *ex post* considerations. As a result most of the evolutionary dynamics of adoption was available to the analysts. In authentic situations, the challenges are very different when the estimation should be made in advance, or at least, in the early stages of adoption. However, none of the methods can be used for forecasting. Further studies could, therefore, usefully concentrate on developing models for estimating takeoff in advance.

The fourth limitation concerns the modeling of adoption. The last two articles considered only a small fraction of possible variables. However, if the effects of cultural attributes are to be studied as a holistic market environmental factor, more variables are needed. The contradicting results, especially those concerning power distance and uncertainty avoidance, provide fruitful areas for further research. Future studies could examine the mechanisms and processes involved in adoption in a cross-national setting. Productive fields for future research are how and why different attributes affect innovation adoption and whether this might be related to personal traits or other psychological attributes.

Fifthly, the fourth and fifth articles utilize regression analysis in modeling the occurrence of takeoff. The articles provide information about statistically significant variables in the cross-national adoption of innovations, and how well the model of the variables explains the variation of adoption in a best case. Another way of examining this would have been to utilize proportional hazard models, which analyze the time between events. Future studies could, therefore, usefully approach the issue employing such hazard models.

Finally, one other avenue for further research would be an investigation of the relationship between takeoff time and the number of adopters at takeoff. That is, if takeoff occurs earlier in chronological terms does it also, therefore, occur earlier in quantitative terms? This would provide insight into such issues as the behavior of adopters and the requirements to reach mass markets in cases when takeoff is timely delayed.

4.3 In conclusion

To summarize the foregoing discussion and the key findings of the dissertation, Figure 4.1 presents the original research questions contained in Section 1.3:

1. Can the takeoff point in the adoption of innovations be determined?

2. If so, how can it be determined reliably?

3. Do cultural dimensions influence the occurrence of takeoff of adoption in cross-national settings?

Figure 4.1. Primary research questions of the study.

Research questions one and two shown in the Figure 4.1 were explored in the articles I–III. The results contained in the articles show that there are numerous ways to determine takeoff point. However, the results also show that different methods produce different determination results. Therefore, the study answered the first question by demonstrating that the takeoff point can be determined, if it is done carefully and carried out in a certain way.

The study also proposes that content analysis is the method best-suited for determining takeoff point reliably and coherently. The method can be employed for all kinds of innovation and innovation adoption patterns, except for patterns where the adoption dynamics is distorted. The method requires the involvement of at least two expert analysts, careful preparation and procedure follow-up. The determination results produced by content analysis are statistically reliable and coherent. This responded to the second research question.

The subject of the third research question was investigated in articles IV and V. The findings of the studies confirmed that various cultural dimensions and certain national attributes influence the occurrence of takeoff. The results show that the occurrence of takeoff varies radically between countries and that culture plays a key role in this. The research demonstrated clear evidence of the cross-national influence of specific

cultural dimensions on the occurrence of takeoff, thereby providing the answer to the third research question.

The key contributions and implications of this dissertation are two-fold. First this study provides a detailed evaluation and comparison of takeoff determination methods. The key implications for the practicing community are the guidelines for determining takeoff point reliably and coherently. The results highlight the challenges involved in the commercialization of innovation and in the early phase of innovation adoption. The results demonstrate how the challenges relating to the determination of takeoff point can be managed and how the determination should be made. In companies, early and reliable determination requires certain resource allocations but this is offset by the prospect of gaining a competitive edge over competitors.

The second key contribution of this study is the global perspective it brings to the influence of cultural and national attributes on takeoff timing and volume. Key implications for the practicing community are the guidelines for benefiting from these findings. The results provide evidence for the influence of cultural dimensions on the early phase of innovation adoption. This information is particularly helpful to a company that has to meet the challenges associated with international scope of operations. The results can be generalized for similar types of innovation. Further, the outcomes of this research can be utilized not only in selection of the sequence of national market launches, but – more extensively – also in planning strategies and tactics for competition.

REFERENCES

Agarwal, R. and Bayus, B. L. (2002). "The market evolution and sales takeoff of product innovations." Management Science **48**(8): 1024-1041.

Agarwal, R. and Gort, M. (1996). "The Evolution of Markets and Entry, Exit and the Survival of Firms." The Review of Economics and Statistics **78**(3): 489-498.

Alwin, D. F. (2005). Reliability. Encyclopedia of Social Measurement. K. Kempf-Leonard. Oxford, Elsevier Ltd. **3:** 1100.

Andonova, V. (2006). "Mobile phones, the Internet and the institutional environment." Telecommunications Policy **30**(1): 29-45.

Ansoff, I. H. (1975). "Managing Strategic Surprise by Response to Weak Signals." California Management Review **18**(1): 12.

Austin, J. T., Boyle, K. A. and Lualhati, J. C. (1998). "Statistical conclusion validity for organizational science researchers: A review." Organizational Research Methods **1**(2): 164–208.

Barnett, H. (1953). Innovation New York, McGraw-Hill.

Bass, F. M. (1969). "A New-Product Growth Model for Consumer Durables." Management Science **15**: 215-227.

Becker, S. W. and Whisler, T. L. (1967). "The Innovative Organization: A Selective View of Current Theory and Research." The Journal of Business **40**: 462-469.

Bond, M. H., Akhtar, H., Ball, P., Bhanthumnavin, D., Boski, P., Carment, W., Cha, J. H., Dutton, D., Forgas, J., Forss, K., Giles, H., Iwawaki, S., Kisiel, A., Latane, B., Leung, K., Moghni, S., Munro, D., Nauta, R., Ng, S. H., Protacio-Marcelino, E., Rodrigues, A., Sinha, J. B. P., Ward, C. and Yang, K. S. (1987). "Chinese Values and the Search for Culture-Free Dimensions of Culture." Journal of Cross-Cultural Psychology **18**(2): 143–164.

Burrell, G. and Morgan, G. (1979). Social paradigms and organisational analysis: elements of the sociology of corporate life Aldershot, Ashgate Publishing Limited.

Burt, R. S. (1987). "Social Contagion and Innovation: Cohesion Versus Structural Equivalence." American Journal of Sociology **92**: 1287-1335.

Carmines, E. G. and Woods, J. A. (2005a). Reliability Assessment. Encyclopedia of Social Measurement. K. Kempf-Leonard. Oxford, Elsevier Ltd. **3:** 1100.

Carmines, E. G. and Woods, J. A. (2005b). Validity Assessment. Encyclopedia of Social Measurement. K. Kempf-Leonard. Oxford, Elsevier Ltd. **3:** 1100.

Carroll, J. (1967). "A Note on Departmental Autonomy and Innovation in Medical Schools." The Journal of Business **40**: 531-534.

Damanpour, F. (1996). "Organizational Complexity and Innovation - Developing and Testing Multiple Contingency Models." Management Science **42**(5): 693-716.

Dawar, N., Parker, P. M. and Price, L. J. (1996). "A Cross-cultural study of Interpersonal Information Exchange." Journal of International Business Studies **27**(3): 497-516.

de Mooij, M. (1998). Global Marketing and Advertising: Understanding Cultural Paradoxes Thousand Oaks, CA, Sage.

de Mooij, M. (2000). "The future is predictable for international marketers: Converging incomes lead to diverging consumer behavior." International Marketing Review **17**(2): 103-113.

de Mooij, M. (2004). Consumer Behavior and Culture. Consequences for Global Marketing and Advertising Thousand Oaks, CA, Sage Publications.

de Mooij, M. and Hofstede, G. (2002). "Convergence and divergence in consumer behavior: implications for international retailing." Journal of Retailing **78**(1): 61-99.

Dekimpe, M. G., Parker, P. M. and Sarvary, M. (1998). "Staged estimation of international diffusion models: An application to global cellular telephone adoption." Technological Forecasting and Social Change **57**: 105-132.

Dekimpe, M. G., Sarvary, M. and Parker, P. M. (2000). "Global diffusion of technological innovations: A coupled-hazard approach." Journal of Marketing Research **37**(Feb): 47 - 59.

Doney, P. M., Cannon, J. P. and Mullen, M. R. (1998). "Understanding the influence of national culture on the development of trust." Academy of Management Review **23**(3): 601-620.

Douglas, S. and Craig, S. C. (1995). Global marketing strategy New York, USA, McGraw-Hill.

Dwyer, S., Mesak, H. and Hsu, M. (2005). "An exploratory examination of the influence of national culture on cross-national product diffusion." Journal of International Marketing **13**(2): 1-27.

Earley, C. P. (2006). "Leading cultural research in the future: a matter of paradigms and taste." Journal of International Business Studies **37**(6): 922-931.

Easterby-Smith, M., Thorpe, R. and Lowe, A. (1991). Management Research. An Introduction London, Sage Publications.

Eisenhardt, K. M. (1989). "Building Theories from Case-Study Research." Academy of Management Review **14**(4): 532-550.

Emory, W. C. (1985). Business Research Methods, 3 ed. Homewood, IL, Irwin.

Evan, W. A. and Black, G. (1967). "Innovation in Business Organizations: Some Factors Associated with Success or Failure of Staff Proposals." The Journal of Business **40**: 519-530.

Fell, D. R., Hansen, E. N. and Becker, B. W. (2003). "Measuring innovativeness for the adoption of industrial products." Industrial Marketing Management **32**(4): 347-353.

Frederiksen, P. (1981). "Further evidence on the relationship between population density and infrastructure: the Philippines and electrification." Economic Development and Cultural Change: 749-758.

Ganesh, J. and Kumar, V. (1996). "Capturing the cross-national learning effect: An analysis of an industrial technology diffusion." Journal of the Academy of Marketing Science **24**(1): 328-337.

Ganesh, J., Kumar, V. and Subramaniam, V. (1997). "Learning effect in multinational diffusion of consumer durables: An exploratory investigation." Journal of the Academy of Marketing Science **25**(3): 214-228.

Gatignon, H., Eliashberg, J. and Robertson, T. S. (1989). "Modeling multinational diffusion patterns: An efficient methodology." Marketing Science **8**(3): 231-247.

Gatignon, H. and Robertson, T. S. (1985). "A propositional inventory for new diffusion research." Journal of Consumer Research **11**: 849-867.

Geertz, C. (1974). The Interpretation of Cultures: Selected Essays New York, Basic Books.

Glenn, J. C. and Gordon, T. J. (2001). "The Millennium Project: Challenges We Face at the Millennium." Technological Forecasting and Social Change **66**(2-3): 129-312.

Golder, P. N. and Tellis, G. J. (1997). "Will It Ever Fly? Modeling the Takeoff of Really New Consumer Durables." Marketing Science **16**(3): 256-270.

Golder, P. N. and Tellis, G. J. (2004). "Growing, growing, gone: Cascades, diffusion, and turning points in the product life cycle." Marketing Science **23**(2): 207-218.

Gort, M. and Klepper, S. (1982). "Time paths in the diffusion of product innovations." The Economic Journal **92**(367): 630-653.

Guba, E. G. and Lincoln, Y. S. (1994). Competing Paradigms in Qualitative Research. Handbook of Qualitative Research. N. K. Denzin and Y. S. Lincoln. Thousand Oaks (CA), Sage Publishers**:** 105-117.

Gudykunst, W. B. and Kim, Y. Y. (1984). Communicating with Strangers: An Approach to Intercultural Communication Reading, MA, Addison-Wesley Publishing Co.

Gummesson, E. (2000). Qualitative methods in management research, 2 ed. Thousand Oaks (CA), Sage.

Gummesson, E. (2003). "All research is interpretive!" Journal of Business & Industrial Marketing **18**(6/7): 482-292.

Hall, E. T. (1976). Beyond Culture New York, Anchor Books/Doubleday.

Hammel, E. A. (1990). "A Theory of Culture for Demography." Population and Development Review **16**(3): 455-485.

Hardy, M. and Bryman, A. (2004). Handbook of Data Analysis London, UK, Sage Publishing.

Heeler, R. M. and Hustad, T. P. (1980). "Problems in predicting new product growth for consumer durables." Management Science **26**: 1007-1020.

Helsen, K., Jedidi, K. and DeSarbo, W. S. (1993). "A new approach to country segmentation utilizing multinational diffusion patterns." Journal of Marketing **57**: 60-71.

Hirsijärvi, S., Remes, P. and Sajavaara, P. (1997). Tutki ja kirjoita Helsinki, Kirjayhtymä.

Hofstede, F. T., Wedel, M. and Steenkamp, J. E. M. (2002). "Identifying Spatial Segments in International Markets." Marketing Science **21**(2): pp. 160-177.

Hofstede, G. (1980). Culture's Consequences: International Differences in Work-related Values Beverly Hills, CA, Sage Publications.

Hofstede, G. (1997). Cultures and Organizations. Software of the Mind New York, USA, McGraw-Hill.

Hofstede, G. (2001). Culture's consequences: Comparing values, behaviors, institutions, and organizations across nations, 2nd ed. Thousand Oaks, California, Sage Publications.

Hofstede, G. (2006). "What did GLOBE really measure? Researchers' minds versus respondents' minds." Journal of International Business Studies **37**(6): 882-896.

Hofstede, G. and Bond, M. H. (1988). "The Confucius Connection - from Cultural Roots to Economic-Growth." Organizational Dynamics **16**(4): 5-21.

Hofstede, G. and Hofstede, G. J. (2005). Cultures and Organizations: Software of the mind New York, USA, McGraw-Hill.

Horowitz, A. W. and Lai, E. L.-C. (1996). "Patent Length and the Rate of Innovation." International Economic Review **37**(4): 785-801.

House, R. J., Hanges, P. J., Javidan, M., Dorfman, P. W. and Gupta, V. (2004). Culture, leadership, and organizations: the GLOBE study of 62 societies Thousand Oaks (CA), Sage Publications.

Howard, J. A. (1983). "Marketing theory of the firm." Journal of Marketing **47**(4): 90-100.

Inglehart, R., Basanez, M. and Moreno, A. (1998). Human Values and Beliefs: A Cross-Cultural Sourcebook Ann Arbor, Michigan, University of Michigan Press.

Javidan, M., House, R. J., Dorfman, P. W., Hanges, P. J. and Sully de Luque, M. (2006). "Conceptualizing and measuring cultures and their consequences: a comparative review of GLOBE's and Hofstede's approaches." Journal of International Business Studies **37**(6): 897-914.

Kakkuri-Knuuttila, M.-L. (1998). Argumentti ja kritiikki. Lukemisen, keskustelun ja vakuuttamisen taidot Helsinki, Gaudeamus.

Kalish, S., Mahajan, V. and Muller, E. (1995). "Waterfall and Sprinkler New-Product Strategies in Competitive Global Markets." International Journal of Research in Marketing **12**: 105-119.

Kessler, E. H. (2004). "Organizational Innovation a Multi-Level Decision-Theoretic Perspective." International Journal of Innovation Management(3): 275-295.

Kirkman, B. L., Lowe, K. B. and Gibson, C. B. (2006). "A quarter century of Culture's Consequences: a review of empirical research incorporating Hofstede's cultural values framework." Journal of International Business Studies **37**(3): 285-320.

Klasen, S. and Nestmann, T. (2004). "Population, population density and technological change." CESifo Working Paper Series(No. 1209).

Klepper, S. (1997). "Industry life cycles." Industrial and Corporate Change **6**(1): 145-181.

Kluckhohn, C. (1951). Values and Value-Orientations in the Theory of Action: An Exploration in Definition and Classification. Toward a General Theory of Action. T. Parsons and E. A. Shils. Cambridge Massachusetts, Harvard University Press**:** 388-433.

Knight, K. E. (1967). "A Descriptive Model of the Intra-Firm Innovation Process." The Journal of Business **40**: 478-469.

Kohli, R., Lehmann, D. R. and Pae, J. (1999). "Extent and impact of incubation time in new product diffusion." Journal of Product Innovation Management **16**(March): 134-144.

Krippendorff, K. (1980). Content Analysis: An Introduction to its Methodology, 2nd ed. Beverly Hills, Sage.

Kroeber, A. L. and Parsons, T. (1958). "The Concepts of Culture and of Social System." American Sociological Review **23**: 582-583.

Kumar, V., Ganesh, J. and Echambadi, R. (1998). "Cross-national diffusion research: What do we know and how certain are we?" Journal of Product Innovation Management **15**: 255-268.

Kustin, R. A. (1994). "Marketing Globalization: A Didactic Examination for Corporate Strategy." International Executive **36**(1): 79-93.

Levitt, T. (1983). "The globalization of markets." Harvard Business Review **May-June**: 2-11.

Lukka, K. and Kasanen, E. (1993). "Yleistettävyyden ongelma liiketaloustieteessä." Liiketaloudellinen aikakauskirja **41**(4): 33.

Mahajan, V. and Muller, E. (1994). "Innovation diffusion in a borderless global market: Will the 1992 unification of the European Community accelerate diffusion of new ideas, products, and technologies?" Technological Forecasting and Social Change **45**: 221-235.

Mahajan, V., Muller, E. and Bass, F. (1995). "Diffusion of New Products: Empirical Generalizations and Managerial Uses." Marketing Science **14**(3, Part 2): 79-88.

Mahajan, V., Muller, E. and Bass, F. M. (1990a). "New Product Diffusion Models in Marketing: A Review and Directions for Research." Journal of Marketing **54**(1): 1-21.

Mahajan, V., Muller, E. and Srivastava, R. K. (1990b). "Determination of Adopter Categories by Using Innovation Diffusion Models." Journal of Marketing Research **27**(1): 37-50.

Mansfield (1963). "Size of Firm, Market Structure, and Innovation." Journal of Political Economy **71**: 556-576.

March, J. G. and Simon, H. A. (1958). Organizations New York, Wiley.

McDonald, M. P. (2005). Validity, Data Sources. Encyclopedia of Social Measurement. K. Kempf-Leonard. Oxford, Elsevier Ltd. **3:** 1100.

McSweeney, B. (2002a). "The essentials of scholarship: A reply to Geert Hofstede." Human Relations **55**(11): 1363-1372.

McSweeney, B. (2002b). "Hofstede's model of national cultural differences and their consequences: A triumph of faith – a failure of analysis." Human Relations **55**(1): 89-118.

Mitchell, T. (1985). "An evaluation of the validity of correlational research conducted in organizations." Academy of Management Review **10**: 192-205.

Mohr, J. (2001). Marketing of high-technology products and innovations Upper Saddle River, New Jersey, Prentice-Hall.

Mohr, L. B. (1969). "Determinants of Innovation in Organizations." The American Political Science Review: 111-126.

Montaguti, E., Kuester, S. and Robertson, T. S. (2002). "Entry strategy for radical product innovations: A conceptual model and propositional inventory." International Journal of Research in Marketing **19**: 21-42.

Moore, G. A. (1999). Crossing the chasm, Revised Edition New York, USA, HarperCollins Publishers.

Moore, G. A. (2006). Dealing with Darwin: How great companies innovate at every phase of their evolution Chichester Capstone.

MOT. (2005). "MOT Collins English Dictionary 1.0a Online." 2006.

Mäkinen, S. (2002). Cross-National Technology Adoption, Take-off Phenomenon and Lead-lag Effect: Analog Cellular Technology in APAC Region. NUS School of Business Research Papers**:** 18.

Olkkonen, T. (1994). Johdatus teollisuustalouden tutkimustyöhön Espoo, Helsinki University of Technology.

Peapody, D. (1985). National Characteristics Cambridge, UK, Cambridge University Press.

Peterson, R. M., Debrell, C. C. and Pett, T. L. (2002). "Long- vs. short-term performance perspectives of Western European, Japanese, and U.S. countries: where do they lie?" Journal of World Business **37**: 245-255.

Pierce, J. L. and Delbecq, A. L. (1977). "Organization Structure, Individual Attitudes and Innovation." Academy of Management Review **2**(1): 27-37.

Raatikainen, P. (2004). Ihmistieteet ja filosofia Helsinki, Gaudeamus.

Rallapalli, K. C., Vitell, S. J., Wiebe, F. A. and Barnes, J. H. (1994). "Consumer Ethical Beliefs and Personality Traits: An Exploratory Analysis." Journal of Business Ethics **13**: 487-495.

Rogers, E. M. (1995). Diffusion of innovations, 4th ed. New York, USA, The Free Press.

Rokeach, M. (1970). Beliefs, Attitudes, and Values: A Theory of Organization and Change San Francisco, Cal., Jossey-Bass Inc.

Roth, M. S. (1995). "The effects of culture and socioeconomics on the performance of global brand image strategies." Journal of Marketing Research **32**: 163-175.

Sanz, I. and Velázquez, F. J. (2006). "Has European Economic Integration Affected the Functional Composition of Government Expenditures?" Contemporary Economic Policy **24**(2): 300-315.

Scandura, T. A. and Williams, E. A. (2000). "Research Methodology in Management: Current Practices, Trends, and Implications for Future Research." Academy of Management Journal **43**(6): 1248-1264.

Schmittlein, D. C. and Mahajan, V. (1982). "Maximum likelihood estimation for an innovation diffusion model of new product acceptance." Marketing Science **1**: 57-78.

Schneider, S. C. and Barsoux, J.-L. (1997). Managing across Cultures, 2nd ed. London, UK, FT Prentice Hall.

Schwartz, S. H. (1992). Universals in the Content and Structure of Values: Theoretical Advances and Empirical Tests in 20 Countries Orlando, FL, Academic Press.

Schwartz, S. H. (1994). Beyond individualism/collectivism: New cultural dimensions of values. Individualism and collectivism: Theory, methods, and applications. U. Kim, H. C. Triandis, C. Kagitcibasi, S. C. Choi and G. Yoon. Thousand Oaks, Sage Publications**:** 85-119.

Schwartz, S. H. (1997). Values and Culture. Motivation and Culture. D. Munro, S. C. Carr and J. F. Schumaker. New York, USA, Routledge**:** 69-84.

Simmel, G., Ed. (1971). Georg Simmel on Individuality and Social Forms. The Heritage of Sociology. Chicago, IL, University of Chicago Press.

Sivakumar, K. and Nakata, C. (2001). "The Stampede Toward Hofstede's Framework: Avoiding the Sample Pit in Cross-Cultural Research." Journal of International Business Studies **32**(3): 555-574.

Smith, P. B. (2006). "When elephants fight, the grass gets trampled: the GLOBE and Hofstede projects." Journal of International Business Studies **37**(6): 915-921.

Sommers, M. and Kernan, J. (1967). "Why Products Flourish Here, Fizzle There." Columbia Journal of World Business **11**(2): 89-97.

Steenkamp, J.-B. E. M., Hofstede, F. and Wedel, M. (1999). "A Cross-National Investigation into the Individual and National Cultural Antecedents of Consumer Innovativeness." Journal of Marketing **63**(2): 55-69.

Stremersch, S. and Tellis, G. J. (2004). "Understanding and managing international growth of new products." International Journal of Research in Marketing **21**(4): 421-438.

Søndergaard, M. (1994). "Hofstede's Consequences: A Study of Reviews, Citations and Replications." Organization Studies **15**(3): 447-456.

Takada, H. and Jain, D. (1991). "Cross-national analysis of diffusion of consumer durables in Pacific Rim countries." Journal of Marketing **55**(Apr): 48-54.

Talukdar, D., Sudhir, K. and Ainslie, A. (2002). "Investigating new product diffusion across products and countries." Marketing Science **21**(1): 97-114.

Tarde, G. (1903). The Laws of Imitation New York, Henry Holt and Company.

Tellefsen, T. and Takada, H. (1999). "The relationship between mass media availability and the multicountry diffusion of consumer products." Journal of International Marketing **7**(1): 77-96.

Tellis, G. J. (1994). Forecasting Market Opportunities: Predicting the Takeoff of New Durables. And Now for Something Completely Different. "Really" New Products, Marketing Science Institute Report, Conference Summary. M. Adams and J. La Cugna.

Tellis, G. J., Stremersch, S. and Yin, E. (2003). "The International Takeoff of New Products: The Role of Economics, Culture and Country Innovativeness." Marketing Science **22**(2): 188-208.

Triandis, H. C. (1995). Individualism and Collectivism Boulder, CO, Westview.

Tushman, M. L. and Anderson, P., Eds. (1997). Managing Strategic Innovation and Change. Oxford, Oxford University Press.

Utterback, J. M. (1994). Mastering the dynamics on innovation Boston, Harvard Business School Press.

Utterback, J. M. and Abernathy, W. J. (1975). "A dynamic model of process and product innovation." Omega **33**: 639-656.

Uusitalo, H. (1991). Tiede, tutkimus ja tutkielma: johdatus tutkielman maailmaan Helsinki, WSOY.

Waarts, E. and van Everdingen, Y. (2005). "The influence of national culture on the adoption status of innovations: An empirical study of firms across Europe." European Management Journal **23**(6): 601-610.

van den Bulte, C. (2000). "New product diffusion acceleration: Measurement and analysis." Marketing Science **19**(4): 366-380.

Watson, J., Lysonski, S., Gillan, T. and Raymore, L. (2002). "Cultural values and important possessions: a cross-cultural analysis." Journal of Business Research **55**(11): 923-931.

Wilson, J. Q., Ed. (1966). Innovation in Organization: Notes Toward a Theory. Approaches to Organization Design. Pittsburgh, University of Pittsburgh Press.

Vitell, S. J., Nwachukwu, L. and Barnes, J. H. (1993). "The Effects of Culture on Ethical Decision-Making: An Application of Hofstede's Typology." Journal of Business Ethics **12**: 753-760.

von Wright, G. H. (1970). Tieteen filosofian kaksi perinnettä Helsinki, Helsingin yliopiston julkaisuja.

Yeniyurt, S. and Townsend, J. D. (2003). "Does culture explain acceptance of new products in a country? An empirical investigation." International Marketing Review **20**(4): 377-396.

Yin, R. K. (1994). "Discovering the Future of the Case-Study Method in Evaluation Research." Evaluation Practice **15**(3): 283-290.

Yin, R. K. (2003). Case study research: design and methods Thousand Oaks (CA), Sage Publications.

Ziemer, D. R. (1985). Growth and Saturation Scenarios: A Practical Application of Diffusion Theory. ORAS/TIMS Conference, Atlanta.

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