Department of Management and International Business

Characteristics of innovative, high growth and highly successful SMEs

Tomi Heimonen

Aalto University

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Abstract

This dissertation is based on a series of studies that examine characteristics of innovative, high growth and highly successful small and medium sized enterprises (SMEs). Previous analyses emphasise that innovation and growth are the very essence of successful entrepreneurship. However, despite major investments in attempts to foster innovation, and intensive investigation of relevant factors, the proportions of SMEs that are innovative, rapidly growing and highly successful are marginal. Many entrepreneurs fail, and an examination of relationships between variables, e.g. growth and success, should consider how they are related across their ranges rather than merely at one end of the ranges of the variables. Moreover, very few studies have examined simultaneously the influential factors and relationships among innovation, growth and success.

The dissertation consists of anoverview and four appendedarticles that address two key questions. Firstly, what are the relationships (if any) between innovation, growth and the success of firms? Secondly, how could high, innovation-driven growth been supported? These questions were addressed by applying mixed methods, including regression, discriminant analyses, logistic regression and case studies. The data were collected using a purposeful sampling strategy and came from the following sources: 1) the Voitto+ CD-ROM database, from which 567 growing businesses in Finland were identified – 466 in urban and 101 in rural areas; 2) a refined sample from these sets of 348 SMEs, 262 located in urban and 86 in rural areas; 3) a survey of 213 small knowledge-intensive business service firms, 4) detailed examination of five selected HGS SMEs and 5) interviews with key informants of 12 small technology-based knowledge intensive business service firms.

The results confirm that there is a positive relationship between innovation and growth, but negative relationships were found between financial success and both growth and innovation. Thus, the concepts of growth and success do not appearto be surrogates.The results also show that successful ventures have no discernible typical characteristics, and HGS firms follow diverse development paths. However, focused strategies and critical events that trigger strategic changes generally precede HGS periods of SMEs. Furthermore, the type of ownership may affect the relative attention paid to maximizing growth and increasing profitability or other parameters of financial success. The results also indicate that current innovation support services are insufficiently flexible to provide the support firms need to meet the challenges that growing innovative firms may face during commercialisation of their technologies and inventions. The investigations also identified several methodological problems that arise when analysing characteristics of HGS SMEs, and possible ways to address them.

Keywords Innovation, high growth, high success, SMEs, Finland

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Tekijä
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Väitöskirjan nimi
Innovatiiviset, korkean kasvun ja korkean menestyksen pk-yritykset

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Tutkimusala Yrittäjyys

Tiivistelmä

Väitöskirja perustuu useisiin tutkimuksiin, joissa tarkastellaan innovatiivisten, korkeasti kasvaneiden ja korkeasti menestyneiden pk-yritysten ominaispiirteitä. Aihealueen aikaisemmat tutkimukset korostavat innovatiivisuuden ja kasvun merkitystä menestyvässä yrittäjyydessä. Toisaalta innovatiivisten korkean kasvun ja korkean menestyksen omaavien pk-yritysten määrä on marginaalinen suhteessa yleiseen innovaatio- ja kasvupanostukseen. Yrittäjyydessä liiketoiminnan menestystä ei tulisi tarkastella yksiulotteisesti pelkästään kasvun tai menestyksen näkökulmista vaan kummatkin edellä mainitut näkökulmat huomioiden simultaanisesti. Tutkimuksen tarvetta korostaa vähäinen empiirinen yrittäjyysteorian kehittely erilaisten vaikutustekijöiden osalta, jotka erityisesti simultaanisesti saattavat vaikuttaa pk-yritysten innovatiivisuuteen, kasvuun ja menestykseen.

Väitöskirja sisältää yhteenvedon ja neljä artikkelia, joiden tarkoituksena on vastata kahteen pääkysymykseen: 1) Minkälainen vaikutussuhde on innovaatioilla, kasvulla ja menestyksellä? 2) Miten innovatiivista korkeaa kasvua voidaan tukea? Tutkimuskysymyksiin vastaamisessa on hyödynnetty mixed method -metodologista lähestymistapaa erityisesti regressio-, diskriminantti-, logistista regressiomallinnusta ja tapaustutkimusta. Aineisto on kerätty tarkoituksenmukaista otantaa hyödyntäen. Aineistona on käytetty seuraavia lähteitä: 1) Voitto+ CD-Rom yritystietokanta, josta valikoitui 567 kasvuyritystä Suomesta – 466 kaupunkimaiselta alueelta ja 101 maaseudulta; 2) edelleen saatu aineisto (1) jalostettiin 348 pk-kasvuyrityksen aineistoksi, jossa yrityksistä 262 kaupunkimaiselta alueelta ja 86 maaseudulta; 3) Kyselyaineisto itäsuomalaisista 213 tietointensiivisestä palveluyrityksestä; 4) viiden korkeasti kasvaneen ja korkeasti menestyneen pk-yrityksen tapausaineisto ja 5) 12 itäsuomalaisen teknologia-tietointensiivisen palveluyrityksen haastatteluaineisto.

Tulokset vahvistavat innovaatioiden ja kasvun välillä vallitsevan positiivisen suhteen. Negatiivinen suhde havaittiin yrityksen menestyksen ja innovatiivisen kasvun välillä. Tutkimuksen perusteella yrityksen kasvu ja menestys ovat eri tekijöitä, joita ei pidä sekoittaa toisiinsa. Tulokset osoittavat, että menestyneillä yrityksillä ei ole tyypillisesti havaittavaa yhtenäistä kehityspolkua. Toisaalta korkean kasvun ja korkean menestyksen aikajänteitä edelsivät strateginen fokusoituminen ja kriittiset tapahtumat, jotka käynnistivät strategisen muutosprosessin yrityksissä. Omistajuudella näyttäisi olevan vaikutusta siihen, miten yrityksissä suhtaudutaan kasvun maksimoimiseen, kannattavuuden lisäämiseen ja muihin taloudellisen menestyksen mittareihin. Lisäksi tulokset osoittavat, että olemassa olevat innovaatiotukipalvelut eivät kykene riittävän joustavasti tukemaan ja vastaamaan innovatiivisten kasvuyritysten teknologian kehittämisen ja kaupallistamisen haasteisiin. Tulosten perusteella esille nousi korkean kasvun ja korkean menestyksen pk-yritysten ominaispiirteiden tutkimuksen menetelmälliset ongelmat ja mahdolliset ratkaisut esille nousseisiin ongelmiin.

Avainsanat Innovaatio, korkea kasvu, korkea menestys, pk-yritykset, Suomi

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Mikkeli, January 2013

Tomi Heimonen

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List of Articles

This thesis is based on the following articles, which are referred to by the corresponding Roman numerals in the text.

I. Heimonen, T. (2012). What are the factors that affect innovation in growing SMEs? *European Journal of Innovation Management*, Vol. 15, Issue 1, p. 122-144.

II. Heimonen, T. and Virtanen, M. (2012). Characteristics of successful gazelles – problems in approaches and methods of analysing the data. *International Journal of Business and Globalisation*, Vol. 9, No. 1, p. 12-41.

III. Virtanen, M. and Heimonen, T. (2011). The development of high growth and highly successful SMEs: cases from Eastern Finland. *International Journal of Technology Transfer and Commercialisation,* Vol. 10, Nos. 3/4, p. 411-432.

IV. Siikonen, J., Heimonen, T. and Pellikka, J. (2011). Developing innovation support services for small high-growth technology firms in Eastern Finland. *International Journal of Entrepreneurial Venturing,* Vol. 3, No. 4, p. 392-419.

PART 1: OVERVIEW OF THE DISSERTATION

1 Introduction

1.1 Relevance of the studies

Innovation is regarded as one of the most important drivers of growth and profits (Bhide, 2000; Schumpeter, 1934). Therefore, innovation and growth policies in Europe have been strongly targeted to enhance the creation and exploitation of innovation, particularly in small and medium sized firms (SMEs). However, despite intense apparent investment of effort and resources in fostering innovation the proportion of innovative, highly growing and successful (IHGS) SMEs is marginal. One of the reasons for the small proportion of IHGS firms may be the so-called 'profiting from innovation paradox', i.e. the frequent failure of firms to obtain significant profits from innovation, since they lack the ability to develop, commercialise and sell inventions successfully, especially in global markets (Autio, 2009; Teece, 1986, 2006). In order to discover possible solutions to this problem there is a need to examine more deeply the relationships between innovation and both the growth and success of firms.

Recent empirical surveys have firmly established that only small proportions of entrepreneurial firms in advanced economies such as the US and Europe achieve and maintain high-growth (Acs et al., 2008; Autio and Hölzl, 2008). However, this small minority has a disproportionally strong economic impact. Autio (2009) found that between 3 and 10 per cent of any new cohort of firms will deliver 50 to 80 per cent of the aggregate economic impact of the cohort over its lifetime. Thus, the growth of entrepreneurial firms is clearly an important phenomenon to examine for researchers (and policymakers) interested in entrepreneurial activities, economic growth and associated factors.

Some scholars claim that innovation and growth are the very essence of successful entrepreneurship (Cole, 1968; Drucker, 1985 Penrose, 1959; Sexton, 1997; Schumpeter, 1934). In practice, entrepreneurship and venture researchers have been interested in identifying characteristics of firms that are associated with innovativeness, and have analysed symptoms of growth and success from various perspectives (Almus, 2002; Gibb and Davies 1990; Lumpkin and Dess, 1996; Storey, 1994; Zhao and Aram, 1995). From the perspective of new value creation, principal business goals of an entrepreneurial firm could be to increase profitable sales through the creation of new economic activities, such as new organizations and/or innovation (Bhide, 2000; Davidsson et al., 2005; Low and MacMillan, 1988; Shane and Venkataram, 2000; Stevenson and Jarillo, 1990). IHGS SMEs and their entrepreneurs may be linked to characteristics of successful entrepreneurs and entrepreneurial activities, as defined by Penrose (1995, p.31): *"Successful entrepreneurs are those entrepreneurs who conduct entrepreneurial activities such as seeking to realize a productive opportunity which comprises all of the productive possibilities that its entrepreneurs see and can take advantage of it".* Thus, according to Penrose, continuation of the successful growth of a firm rests on the entrepreneur's identification and exploitation of new opportunities.

Elucidating the characteristics of IHGS ventures and their entrepreneurs will increase holistic understanding of the characteristics of entire small business populations. Moreover, from the policy development perspective the ability to differentiate IHGS firms from others would be highly valuable, because they will probably be the most important creators of new jobs and prosperity. Several previous studies (Acs et al., 2008; Smallbone et al., 1995) have also shown that firms with strong growth and innovation records are more likely to survive and succeed than non-innovative and -growing firms.

High expectations are loaded onto entrepreneurs and their businesses, especially when markets and societies change. However, these expectations, and the following allocation of resources for business development, may be exaggerated because of the wide diversity of entrepreneurs and firms (including those that fail or stagnate, as well as those that rapidly grow and succeed). Thus, identification of dynamic actors in society, such as IHGS businesses and their entrepreneurs, could decrease the gap between expectations and actual outcomes. According to Global Entrepreneurship Monitor studies (Autio, 2009), most innovative firms and their owners have a desire to grow. However, only very small proportions of firms and their entrepreneurs manage to create and foster dynamic changes in markets and societies, by for instance making major contributions to new opportunities

for jobs, technological progress and wealth creation (Acs et al., 2008; Birch, 1979; Moskowitz and Vissing-Jørgensen, 2002).

Currently, no set of measures for assessing firms' performance and identifying highly successful firms is universally accepted by entrepreneurship and small business researchers (Murphy et al., 1996; Parker et al., 2010), despite efforts by the Eurostat and OECD (2007) to formulate common definitions of some aspects of high organizational performance (e.g. high growth). Furthermore, very few empirical studies have focused on factors affecting performance in a small firm context holistically, and there has been little relevant conceptual and methodological development, although numerous theoretical and empirical studies have examined the innovation, growth and success of firms separately. These studies continue to face many challenges, associated with (*inter alia*): operationalization of the concepts; identification and selection of key variables; and measurement of innovation, growth, success and other important characteristics of entrepreneurial firms (Birley et al., 1995; Markman and Gartner, 2002, OECD Oslo Manual, 2005). As Shepherd and Wiklund (2009) stated, major causes of the limited theoretical development in contemporary performance (growth) studies are likely to be methodological issues, including:

- A lack of theory-driven models (Davidsson and Wiklund, 2000)
- Narrow theoretical focus of most studies (Wiklund et al., 2009)
- Multiple definitions of high performance (Parker et al., 2010)
- Problems of comparing diverse studies (Delmar, 1997)
- Problems in acquiring relevant data (Birley et al., 1995)
- Problems in selection of variables (Janssen, 2009)
- Problems in transformation of variables (Delmar, 1997)
- Problems in selection of appropriate timespans (Davidsson and Wiklund, 2000)

Studies focusing on growth and success in the small business context often conceptualize organizational performance multidimensionally (Baum et al., 2001). Furthermore, Wiklund et al. (2009) pointed out that literature in the field of entrepreneurship growth is highly fragmented, and that several theoretical perspectives have been independently developed. In addition, there have been few attempts to connect or combine these diverse theoretical frameworks and concepts. A further problem in previous growth research studies, highlighted by Davidsson et al. (2009), is the lack of consideration of financial success when analysing the growth of firms.

In addition, the duration of IHGS periods is far from certain, and indeed may vary substantially among firms, thus future research should focus on longer-term perspectives of business change and take into account the uncertainties and probable discontinuity of variables. Previous high performance studies have mostly used time-spans of one to five years (Parker et al., 2010; Steffens et al., 2009), but these arbitrary periods may fail to capture important longer or shorter term trends or events. Further, there is a need for statistical methods that are more appropriate for handling the data, especially methods that are consistent with rigorously tested assumptions about the nature of entrepreneurial markets and high performance businesses. A robust basis for high performance entrepreneurship and entrepreneurial firm research requires more longitudinal field research, including both quantitative and in-depth longitudinal case studies and use of mixed approaches, incorporating analyses of both behavioural and management issues (Birch, 1987; Bygrave, 2006; Richard et al., 2009).

More detailed understanding of empirically confirmed characteristics of high performance entrepreneurial firms and their entrepreneurs is also required to understand and support the creation of innovation, growth and success, locally and globally. As Rae and Frith (2007) pointed out, future venture development programmes designed to assist firms to achieve high performance should reflect the particular composition of businesses within the specific context. Fisher and Reuber (2003) recommended that such programmes, offered by local government policy officers and external resource providers, for example, should be designed and organised by utilizing network-based approaches to support the rapid growth and success of firms.

Most previous entrepreneurship studies have analysed innovation, growth and success separately. Moreover, numerous studies have analysed overall growth, without combining different growth and success perspectives, or attempting to identify factors that may be linked particularly strongly to both high growth and high success. Therefore, the objective of the investigations underlying this dissertation (described in Articles I-IV) was to fill some gaps in prior understanding of the links (if any) between innovation, high growth and high success of SMEs. For this reason, innovation, growth, success and the factors influencing these performance indicators have been analysed simultaneously.

Linear regression approaches have been applied in most attempts to model the examined phenomena, without critically considering their possible (or probable) shortcomings for addressing the interactive effects of innovation, growth and success, or the uncertainties and discontinuities

usually present in growth and success data. Thus, in order to understand the in-depth discontinuities and uncertainties characterising the development of innovative, high growth and highly successful ventures both more appropriate, non-linear quantitative evaluations and qualitative assessments should be included in the analyses. Further, to address the innovation paradox and assist firms to profit from innovations more robustly there is a need to develop further ideas and concepts to improve support for innovation-driven high growth. In the studies this thesis is based upon attempts have been made to meet these objectives by examining the suitability of various statistical techniques, and assessing the possible needs and requirements of growing innovative ventures and their prior experiences of using innovation-supporting services.

1.2 Research aims, objectives and questions

The aims of the studies this thesis is based upon were to examine: characteristics of innovative, high growth and highly successful SMEs; requirements to support innovation-driven, rapidly growing SMEs; and relationships between innovation, growth and the success of SMEs. The main research questions addressed are:

What are the relationships between innovation, growth and success of firms?
How could high innovation-driven growth be supported?

More specific questions are:
How do age, location, size, success and public R&D funding affect the innovativeness of growing ventures?
What are the characteristics of high growth and highly successful (HGS) firms and what factors are linked to both growth and success?
Are high growth and high success surrogate concepts?
What methodological challenges may arise when studying HGS SMEs?
What kinds of factors may influence the development of HGS SMEs?
How could regional innovation support services be enhanced to foster growth of innovative ventures?

To achieve the defined research objectives and address the research questions, relationships between innovation, growth and the success of firms in Finland, and the role of services intended to support innovation-driven high growth, have been analysed. The framework of the studies is presented in Figure 1.

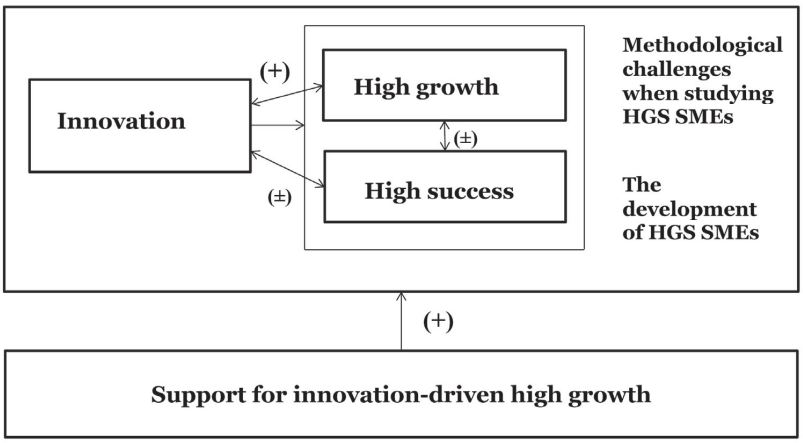

Figure 1: Framework of the studies

Note: The signs of interrelationship are presuppositions based on previous research. (+) positive correlation between variables, (±) positive-, negative- or no statistical correlation between variables

Overall, the studies contribute to contemporary discussion of high growth performance entrepreneurship and venture research by analysing factors that affect growing, innovative SMEs. Since there are no-all embracing or clear-cut theoretical foundations for such analyses, a new conceptual framework has been constructed, based (*inter alia*) on resource-munificence, regional competitiveness and life-cycle theories (Gibb and Davies, 1990; Storey, 1994) and results of previous empirical studies on innovation, growth and the success of SMEs. The studies contribute to both innovation and entrepreneurship theory by presenting a theoretical model that was developed and tested on a longitudinal sample (1988-2005) of growing SMEs (n=348). The relationships between innovation, growth and success were examined by analysing the correlations between them both separately and in combination.

The studies investigate characteristics of successful, high growth SMEs and methodological problems that may arise when analysing firms' growth and success quantitatively and simultaneously. The novel empirical perspective is the focus on the factors, including innovation, that promote high growth and high success both singly and simultaneously. The methodological focus is on challenges associated with use of regression modelling when analysing high-performance SMEs.

There is a need for more longitudinal field research, including explorative and pragmatic in-depth case studies to increase fine-grained understanding of entrepreneurship (Abetti, 2001; Achtenhagen et al., 2010; Birch, 1987; Birley et al., 1995; Bygrave, 2006; Wiklund and Davidsson, 2000; Parker et

al., 2010). Therefore, longitudinal development processes and paths before, during and after firms' high growth and high success (HGS) periods have been analysed, based on the firms' entrepreneurs' and managers' perceptions.

The studies also include analyses of the performance of ventures and their entrepreneurs, based on prior theory and empirical performance case studies. The items addressed in these analyses include: the role of the entrepreneur; experience and motives at start-up and during growth; product and production policy; management and ownership; finance; markets and customers; firms' strategic choices and social capital; and future challenges. The relationships between innovativeness, high growth and high success in this phase of the investigation were considered from the perspective of subjective meanings that entrepreneurs themselves give to these characteristics.

There has been little research on the kind of support entrepreneurs and their businesses need to foster both innovation and high growth (Blakely, 1994; Fischer et al., 2003; Klofsten and Jones-Evans, 1996; Rae et al., 2007). Therefore, one appended article examines, in detail, the business requirements of small, innovative high growth knowledge-intensive technology firms (T-KIBS) that are not fully met by regional innovation support services (Kaufman and Tödtling, 2002; Pellikka and Virtanen, 2009), to ascertain ways in which the services could be adjusted to enhance the overall innovativeness, growth and success of small firms.

1.3 Outline of the studies

This dissertation consists of two parts. Part 1 is an overview of the subject matter, divided into four chapters. The introductory chapter covers the relevance of the studies, research aims, objectives and questions addressed, then presents an outline of the studies and key concepts used (Figure 2). Chapter two presents a literature review and the conceptual framework of the studies. Chapter three outlines the methodological basis of the studies, focusing on the key methodological choices made, and describing the research strategy and design, data collection, data analysis and questions related to the validity and reliability of the results. Finally, chapter four reviews and summarises the results and theoretical contributions of the research, then considers its limitations and possible avenues for further research.

Part 2 consists of four articles (I, II, III and IV) describing research efforts to address, empirically, the objectives, main research questions and more specific issues considered in this dissertation. Article I, *What are the*

factors that affect innovation in growing SMEs? (Heimonen 2012) reports a study aimed at identifying factors that affect the innovativeness of growing SMEs. This study contributes to discussion in this area by examining the following questions. Firstly, how does location affect innovativeness? Secondly, how is a firm's innovativeness affected by its age and size? Thirdly, how does success affect innovativeness? Fourthly, what is the impact of public R&D funding on innovativeness?

Article II, *Characteristics of successful gazelles – problems in approaches and methods of analysing the data* (Heimonen and Virtanen, 2012) focuses on the characteristics of HGS firms and methodological problems in analysing the growth and success of firms, quantitatively and simultaneously. The paper addresses the following specific questions. What factors explain the simultaneous growth and success of firms according to different statistical models? What problems are connected with different methods for analysing high growth and highly successful SMEs? How does the selection of different analytical techniques affect the results? How could we improve the robustness of the data and methods used in the analysis? What impact does the ignorance of *a priori* probabilities of firms growing rapidly and being highly successful have on the results of the analysis?

Article III, *The development of high growth and highly successful SMEs: cases from Eastern Finland* (Virtanen and Heimonen, 2011), analyses the development of high growth and highly successful (HGS) firms before and after their HGS period in Eastern Finland. It focuses on the following defined research questions. What factors affect growth and success of the firms? How do the entrepreneurs evaluate their growth and success? How do these firms contribute to job creation and employment growth?

Article IV, *Developing innovation support services for small high-growth technology firms in Eastern Finland* (Siikonen, Heimonen and Pellikka, 2011), examines innovation support service requirements of small, high-growth knowledge intensive technology (T-KIBS) firms in Eastern Finland. The key question addressed is: What enhancements to regional innovation support services can regional policymakers and economic developers make to foster the overall growth of small firms? To answer this question, the following more specific questions are addressed. What are the rapidly growing industrial branches in Eastern Finland? What characteristics distinguish firms in fast-growing industrial branches from those in other branches? What do these small firms require from regional innovation support services?

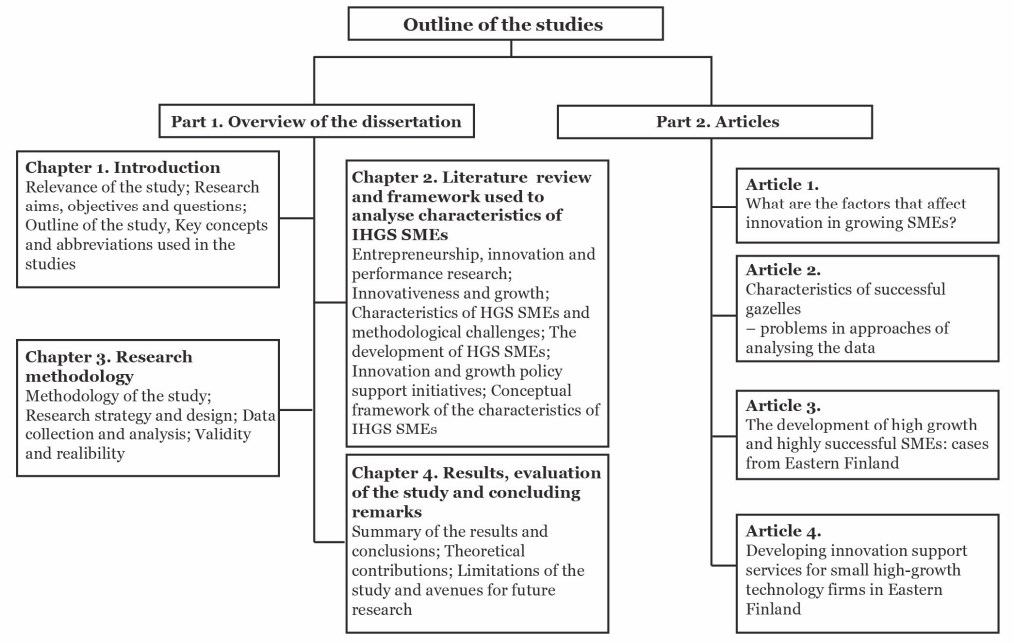

Figure 2: Outline of the studies

1.4 Key concepts and abbreviations used in the studies

Key concepts and abbreviations used in the studies are shown in Table 1. More detailed definitions of innovation, high growth, high success, small and medium sized enterprise (SME) and urban and rural areas are given in Appendix 1. The content and construction of success is explained in Appendix 2, and a more detailed view of the context of the studies is presented in Appendix 3.

Table 1: Key concepts and abbreviations used in the studies

Concepts	**Definitions**
Innovation	In some analyses intellectual property rights such as patents, utility models, registered designs and trademarks are used as proxies for innovation. In others, innovation is understood as the intentional introduction and application within a role, group or organisation of ideas, processes, products or procedures, new to the relevant unit of adaption, designed to benefit the individual, group, organisation or wider society.
Growth / High growth	Sales turnover growth is used as the indicator of firm-level growth. A firm is defined as showing high growth if its turnover grows by at least 20% annually for at least three years.
Success / High Success	A financial success index (SI), ranging from 0-100 points, is used as a proxy for success of a firm. A firm is classified as highly successful if it scores at least 70 points in each of at least three consecutive years.
Performance	Firms' performance is related to innovation, growth and success either separately or in combination.
Small and medium sized enterprise **(SME)**	A firm is classified as an SME if its average workforce is < 250 persons, annual turnover ≤ 50 Million euro, total balance sheet value ≤ 43 Million euro, and capital ownership or voting rights held outside of the organisation ≤ 25%.
Rural area / Urban area	The definitions of a rural or urban area follow the Eurostat NUTS criteria: areas with population densities less than, or at least, 150 inhabitants per km², respectively.
Abbreviations	**Meanings**
SME	Small and medium sized enterprise
HGS	High growth and highly successful firm
IHGS	Innovative, high growth and highly successful firm
KIBS / T-KIBS	Knowledge intensive business service firm / Technology knowledge intensive business service firm
RA	Regression analysis
LRA	Logistic regression analysis
DA	Discriminant analysis

2 Literature review and conceptual framework

2.1 Entrepreneurship, innovation and performance research

In entrepreneurship and small business literature contemporary discussion still focuses on discovering and explaining differences in the performance of different firms. Performance analysis in this literature has historically concentrated mainly on growth rates, and been based on politico-economic theories such as Neoclassical, Schumpeterian, Post-Keynesian, Marxist and New growth theories. According to Coates (1999) these diverse economic and political approaches provide distinct explanations for the differences in market performance of firms, which are reflected in contrasting descriptions of firms' growth sources, triggers and barriers, expected growth paths and differences in growth rates (Table 2).

Table 2: Politico-economic theories (alphabetically ordered), and their conceptions of firms' growth sources, triggers and barriers, expected growth paths and differences in growth rates (Coates, 1999).

Politico-economic approach	Growth sources	Growth triggers	Growth barriers	Expected growth paths	Why do growth rates differ?
Marxist growth theory	*Labour exploitation and capital investment*	*Competition within the capitalist class and between capital and labour*	*Contradictions due to incompatible class interests*	*Combined but uneven development; inexorable undermining of successful economies*	*Differential balance and character of class forces*
Neoclassical growth theory	*Labour force; exogenous technical progress*	*Interplay of market and market forces*	*Limits on market processes imposed by trade unions and governments*	*Convergence through technology diffusion; diminishing capital returns*	*Uneven distributions of multiple growth sources*
New growth theory	*Factor quality, partly endogenously generated*	*Strategic public/private investment in human capital and knowledge*	*Excessive state intervention*	*Permanently differing growth paths, similar growth rates*	*Uneven distribution of social capabilities, rooted in institutional and cultural differences*
Post-Keynesian growth theory	*Size of manufacturing sector; level of market demand*	*Process of cumulative causation and exploitation of economies of scale*	*Restrictive government policies; unregulated markets*	*Virtuous and vicious growth cycles*	*Differential distribution of institutional arrangements triggering long-term trust relationships between industrial and financial capital sources*
Schumpeterian growth theory	*Gale of creative destruction stimulating technological change*	*Innovation by large corporations in search of temporary market advantage*	*Inappropriate structures of corporate governance and market behaviour*	*Shifting focus of growth in a world of changing systems and technology*	*Differentiating quality of factor creation and upgrading; institutional rigidities*

All these politico-economic theories seem to provide useful concepts for exploring the sources of firms' growth and factors affecting their performance. However, contemporary understanding of performance is more multidimensional, complex and more specific than the understanding offered by classical economic perspectives. Notably, the importance of the roles of single actors such as entrepreneurs, managers and owners of companies, the motives of these actors, resources, entrepreneurial actions, development paths and context have all been acknowledged more strongly in recent discussion of firms' performance (Barney, 1991; Barringer et al., 2005; Bhide, 2000; Chetty and Campbell-Hunt, 2003; Daviddson et al., 2009; Dobbs and Hamilton, 2006; Garnsey et al., 2006, Gibb and Davies, 1990; Kirby, 2005; Penrose, 1995; Storey, 1994).

The roles and motives of single actors, such as owners, managers and entrepreneurs, resources, loci of control and strategic management have been emphasised as drivers of firms' performance (McClelland, 1961; Rotter, 1966; Penrose, 1959; Young, 1961). McClelland's (1961) theory of the

need for achievement and Rotter´s (1966) locus of control of an individual have been widely used to explain entrepreneurial actions. A huge advance was made in 1979 when Birch published a report that recognized and empirically confirmed the importance of small firms in creating new jobs in the US. Birch (1979) also introduced the term "gazelle" to describe a firm that grew by at least 20% annually for four years, from a base of at least $100,000 in revenues, thus at least doubling its revenue over this period, and highlighted the importance of small businesses in creating new jobs in the US economy. Recent analysis by Acs et al. (2008) confirmed that both small and large firms make substantial contributions to the creation of new jobs in the US economy (of about 60% and 40%, respectively, in their study period). It could be argued that contributions from both small and large firms in the creation of new jobs are essential, but the factors and mechanisms involved in the creation of new jobs by small and large firms may differ.

Diverse themes related to ventures have been explored. One is the effects of networks on the performance and competitive advantages of firms. According to Jarillo (1989), entrepreneurial abilities are needed for exploiting external resources, such as networks, to maintain and develop firms' competitive advantages. In the 1980s the focus on growth continued to dominate in most performance studies (Davidsson, 1989), but some attempts were made to extend their scope by incorporating some aspects of financial success. Indeed, some performance models focused solely on success (Stuart and Abetti, 1987; Birley and Westhead, 1990; Capon et al, 1990). At the end of the 1980s more sophisticated theoretical modelling and concepts were developed in attempts to elucidate the performance of ventures (Sandberg and Hofer, 1987). One example is contingency theory (Gilad and Levine, 1986), which holds that the growth and success of firms cannot be examined in isolation from their specific situation and environment.

A further seminal advance in growth and entrepreneurship studies was the introduction of ideas regarding resource slack and the influence of management restrictions, initially by Penrose (1959). However, it was not until the 1990s that resource-based theories contributed strongly to performance discussion, when Barney (1991) highlighted the influence of resources on firms' growth performance and Heene and Sanchez (1997) found the maintenance and development of a firm's resources to be important for sustainable growth. The starting point of the so-called fundamental theory of resources is recognition of firms' continuous need to regenerate resources by exploiting changing circumstances. Optimal growth requires (*inter alia*) equilibrium between the utilization of existing

resources and the creation/development of new resources (Barney, 1991; Chatterjee and Wernerfelt 1991; Powell, 1992). Growth potential is based on diverse growth paths, which are influenced by the strategic choices firms make to maintain, create and develop their resource base (Arthur, 1994). It is believed that certain kinds of resource-based development paths may lead to growth diversity among firms. Life-cycle and development path perspectives have been included in performance studies by Greiner (1972) and more recently by Churchill (2000) and Abetti (2005).

Prior studies have also emphasised that high growth firms have continuously developed their resource bases by increasing know-how and knowledge reserves. Often, however, resource bases have not been fully utilized and this may cause resource slack problems, although resource slacks may also create opportunities for intra-firm growth in order to satisfy market needs (Penrose, 1959, 1995; Teece, 1982).

At the end of the 1990s the potential value of contextual strategic choices and actions as predictors of high performance was noted by Covin and Slevin (1998), Covin et al. (1999). However, several authors, including Delmar (1997) and Murphy et al. (1996), noted that there are substantial methodological problems in defining, measuring and comparing performance. Methodological problems and challenges have been further investigated by Davidsson and Wiklund (2000) and Wiklund et al. (2009). Murphy et al. (1996) suggested that most performance could be classified in the following eight dimensions: efficiency, growth, profit, size, liquidity, success/failure, market share or leverage. However, efficiency, growth and profit have been the most commonly considered and measured performance dimensions in entrepreneurship and small business research.

At the start of the 21st century understanding of high performance firms and their entrepreneurs has increased profoundly. In particular, empirical studies of gazelles and growth have shown that there are various kinds of high growth and success firms, but small proportions of entrepreneurial firms achieve and maintain high growth and high success status over long periods (Acs, et al., 2008; Autio and Hölzl, 2008; Delmar, 2003; Davidsson et al, 2005; Markman and Gartner, 2002; Steffens, et al., 2009).However, this small minority has a disproportionally strong economic impact (in the creation of new economic value and new jobs). Thus, these firms and their entrepreneurs are clearly worth close examination.

More recent research has examined the connections between high performance and innovation within industrial organizations (Autio, 2009; Coad and Rao, 2008; Freel and Robson, 2004). In the first decade of the 21st century theories of high performance processes and paths (Barringer, 2005; Garnsey et al., 2006; O'Gorman, 2001) and elaborate views of the

contextual advantages or disadvantages associated with institutional, social, economic and political factors have evoked intense academic discussion (Almus, 2002; Autio and Acs, 2010; Handelberg, 2012; Hoogstra and Van Dijk, 2004; Lerner, 2002; Levie and Autio, 2011; North and Smallbone, 2000; Venkataram, 2004). The complex nature of the phenomena has hindered progress in the field (despite intense international effort), but also opened opportunities for new, interdisciplinary research initiatives (Daviddson et al., 2005; Dobbs and Hamilton, 2006; Garnsey et al., 2006, Gibb and Davies, 1990; Parker et al, 2010; Penrose, 1995; Storey, 1994).

2.2 Innovativeness and growth

The relationships between size, innovations and performance have long been debated in entrepreneurship, innovation and growth studies. The innovativeness of growing firms has been discovered to be important for value and job creation (Acs et al., 2008; Autio, 2009; Autio and Hölzl, 2008; Bhide, 2000, Birch 1979; Delmar et al., 2003, Deschryvere, 2008, Henrekson and Johansson, 2008, Parker et al., 2010; Storey, 1994). Overall, small firms are widely regarded as promoters of economic growth (Westhead and Storey, 1994), partly at least because they are considered to have high capabilities for creating, transferring and exploiting innovations (Autio 1998; Fontes, 1997; Kuratko and Hodgetts, 2001). In addition, it is believed that innovative growth-oriented small firms have a strong positive effect on employment (Storey, 1994). However, prior empirical innovation and R&D studies have focused (quantitatively) mainly on innovations in large firms (Gudmunson et al., 2003; Woodcock et al., 2000).

2.2.1 Context, innovativeness and growth

Traditionally, there has been wide interest in environmental influences on firm performance, especially in academic fields such as management and regional studies. In these fields, prior studies attempted to identify the factors or determinants of regional growth, success and innovations from diverse thematic perspectives. Typically, these studies used endogenous growth theories as their theoretical basis (Bresnahan et al., 2001; Cooke, 2002; Marshall, 1920; Nijkamp and Stough, 2000; Porter, 1998, 2003; Storper, 1992). Endogenous growth theories explain growth from a micro-theoretical perspective, according to which consumers maximize utility and firms seek to maximize profit with respect to their budgetary constraints. In an endogenous growth framework, the development of human capital and new technology play significant roles. Because the theoretical focus is on

firm-level activities, this approach is viewed as suitable for studying regional growth as well as the role of public input into R&D activities.

Although the theory of endogenous growth starts from a micro perspective, it analyses growth of a certain region primarily as an aggregate (macro-) level phenomenon. However, this kind of approach is not sufficient to analyse businesses that grow even in regressive regions and declining branches of industry (Acs et al., 2008; North and Smallbone, 2000; Pasanen 2003; Vaessen and Keeble, 1995). Moreover, endogenous growth theories lack the ability to explain why certain firms operating within a specific region are highly innovative, grow rapidly and achieve and maintain high levels of success, but not others. Thus, the identification of explanatory and predictive factors for the innovativeness, growth and success of single businesses requires the creation of a more comprehensive analytical framework and understanding of firm-level adaptations, and both levels and types of dependence on location.

Since there is no all-embracing or clear-cut theoretical basis (Gibb and Davies, 1990; Storey, 1994) for analysing factors that affect the innovativeness of growing firms several theories and concepts have been used to build the framework applied in the studies this dissertation is based upon. Most of these theories and concepts are derived from considerations of the context, characteristics and strategic management of a firm, defined in various ways and using various parameters. Important factors may include the indigenous assets available in different locations and active roles of entrepreneurs. As Vaessen and Keeble (1995) concluded: '*Traditional regional theory does not really allow for firms taking counter measures against unfavourable territorial conditions. However, rapid growth of indigenous firms for example in peripheral regions cannot be understood without assigning a more active and autonomous role to the entrepreneur and his/her firm in terms of their relationship with their region's production environment.*

In the US and European contexts venture populations share several similar characteristics, from the perspective of high-growth entrepreneurship, and the following characteristics of high-growth firms and entrepreneurs have been identified by Acs et al. (2008) and Autio and Hölzl (2008):

- they are present in almost all regions
- are represented in all branches of industries
- are represented in all size and age classes
- are rare

- have a disproportionately strong economic impact relative to their numbers
- differ from ordinary entrepreneurs in terms of their demographic characteristics

It is concluded that high-growth tends to be a temporarily limited phenomenon and achieving high-growth can take a long time. It should be noted that there may be contextual differences between the US and Europe, related to institutional and business cultural differences that may affect the characteristics of high performance ventures in the two regions (Handelberg, 2012). Heimonen (2012, article I) discovered that in Finland only around 8% of firms could be classified as innovative (IPR-intensive), rapidly growing firms, and not all of these innovative companies could be classified as both high growth and highly successful ventures (Heimonen and Virtanen, 2012, article II). These findings are consistent with previous conclusions that innovations may not always be drivers of high growth and high success, in fact sometimes innovation activities may have little or no impact on sales growth (Siikonen et al., 2011, article IV).

The importance of contextual differences in the innovativeness and performance of a firm has been confirmed in several empirical studies (Almus 2002; Audretsch 1995; Covin et al., 1999; Hoogstra and Van Dijk 2004; Hölzl 2009; Keeble 1997; Mendonca et al., 2004; Vaessen and Keeble 1995). Mendonca et al. (2004) detected country-based differences in the production and exploitation of IPRs in European countries, while Keeble (1997) and Ritsilä (1999) found innovation and performance varied among different regions within countries. This is consistent with predictions based on resource-munificence and regional competitiveness theories that firms in urban areas should generally perform more strongly and generate more original innovations than those in peripheral regions (Covin and Slevin, 1998; Keeble 1997; Ritsilä, 1999). This is because firms located in urban areas are likely to have opportunities to access larger markets and resource bases than firms located in rural areas. Some empirical studies have not found any contextual differences in the production of innovations and achievement of high performance (Littunen and Tohmo, 2003 and North and Smallbone, 2000). Nevertheless, prevailing understanding supports resource-munificence and regional competitiveness theories, despite the mixed empirical evidence regarding the influence of location on firms' performance.

Friedman (1995) compared the number of rapidly growing firms (the most rapidly growing ventures listed by business magazines INC, Business Week, and Forbes) established in 208 urbanised areas in US. The cited

author identified several factors that may influence the generation of a number of high-growing firms in urban areas: industrial diversity, the extent of growth industries, economic growth, overall economic size and the extent of local venture capital. Moreover, urbanised areas with a major university, highly educated population, or sports organisations, seemed to have disproportionately high numbers of such firms.

Prior studies have also shown that the operating environment of the firm affects the relationship between sales growth rates and executives' propensity for risk taking (Covin and Slevin, 1998). In addition, there is some empirical evidence that an increase in annual sales growth may boost the propensity to create innovations from patents (Arundel and Kabla, 1998). These findings indicate that growth may affect firms' innovation activity. However, very few prior empirical growth studies have focused on environmental aspects of entrepreneurial firm growth, and little is known about companies that manage to be innovative and maintain high growth rates simultaneously. Moreover, comparative regional studies of innovative high growth firms are very scarce, even though small business and new venture growth have been intensively empirically researched (See e.g. Almus, 2002; Davidsson et al., 2009; North and Smallbone, 2000; Smith et al., 2000 and Vaessen and Keeble, 1995).

2.2.2 Characteristics of innovative growing SMEs

The influences of firms' characteristics, especially size and age, on innovations and growth performance have long been debated. Numerous empirical studies have tested the Schumpeterian hypothesis that large firms tend to have resource advantages for exploiting new technology compared with small ones (Acs and Audretsch, 1988; Battacharya and Bloch, 2004; Cohen, 1995; Freeman and Soete, 1997; Santarelli and Piergiovanni, 1996; Tether, 1998). Bouwer and Kleinknecht (1999) confirmed that large firms are more likely to seek patent protection than small firms. However, Kohn and Scott (1982) showed that a relatively strong resource base of R&D inputs does not necessarily imply the existence of scale economies in producing innovative output. Small firms are often structurally less complex or have less hierarchical organizations and management, and thus may have more flexibility and time advantages in adjusting their resources.

In prior studies the size of the firm and its connection to growth have also been examined by applying Gibrat's law of proportionate growth, which assumes that size is not correlated with growth and that growth follows a random walk. However, the results of numerous empirical studies suggest that relative firm growth generally decreases with increases in the size of the firm (Almus and Nerlinger, 2000).

Tether (1998) found that the average value of innovations introduced by a sample of firms in UK varied systematically with the size of the innovating firm. Large enterprises were responsible for almost all the high-value innovations, whilst most of the lower-value innovations were introduced by small businesses. However, Nelson (1993) noted that some new small firms have also introduced extremely high-value innovations. There is some evidence that the propensity to create innovations from patents increases with the firm's annual sales growth (Arundel and Kabla, 1998). Moreover, Virtanen and Heimonen (2011, article III) found that innovations that SMEs introduced in niche markets could be highly successful, even in global markets.

According to life-cycle theories, firms are likely to proceed through diverse stages of development during their lifetime. The development of new firms at the start-up stage may be heavily based on innovation, whereas more mature firms are likely to reach plateaus or even decline after growth stages. This implies that more mature firms are likely to produce decreasing numbers of innovations, including IPRs, if growth and innovations have a direct parallel relationship (See e.g. Churchill, 2000; Greiner, 1972, 1998; Scott and Bruce, 1987).

There is some empirical evidence that old firms grow less rapidly than young ones. Davidsson and Delmar (1997) found that organic growth constituted 58 to 96% of the total business growth in firms of a studied population that were less than 10 years old, but only 16% of the total growth among older firms. However, many mature firms seem to remain highly innovative and perform superbly in their respective markets (Huergo and Jaumandreu, 2004). Calvo (2006) argues that both product and process innovations stimulate survival and employment growth independently of the age of the firm.

2.2.3 Resources and innovative growing SMEs

Empirical evidence regarding the relationship between innovations and performance seems to be mixed. Some studies have found positive relationships between innovations and the growth of firms, generally concluding that innovation activities, R&D investments and public R&D funding stimulate the overall growth, success and survival of a firm (Branzei and Vertinsky 2006; Calvo 2006; Fabling and Grimes 2007; Freel and Robson 2004; Hölzl 2009; Koellinger 2008; Roper 1997; Thornhill 2006; Thornhill and Gellatly 2005). However, the impact of innovations on economic performance is highly uncertain (Bhide, 2000; Coad and Rao, 2008). Risky behaviour, including simultaneously pursuing growth and innovation activities, may lead to high variance in short-term income

(Bhide, 2000). Furthermore, growing, innovative SMEs may face greater financial challenges or pressures when IPR efforts and high growth periods coincide than other firms, since the generation of both IPRs and high growth requires abundant resources (Markides, 1998; Moskowitz and Vissing-Jørgensen, 2002). Other empirical studies have highlighted the complex nature of the relationships between innovations, growth and success of firms. Some of these studies have found that innovators have not experienced sales or employment growth, and the distribution of innovators' growth rates seems to be sometimes highly negatively skewed (Freel 2000). On the other hand, the correlation between sales of innovative products and patenting is far more positive (Brouwer and Kleinknecht 1999). These relationships also seem to be time dependent (Virtanen and Heimonen, 2011, article III). Moreover, growth and success seem to have varying effects on innovation in different branches of industries. Audretsch (1995) studied the effects of growth and profitability on innovation activity in diverse branches of industry, and concluded that profitability positively affects innovative activities of firms in high-technology industries, whereas growth generates more innovations in low-technology industries.

Markides (1998) and Moskowitz and Vissing-Jørgenssen (2002) discovered that the creation of new innovations seems to require a great deal of resources. It has been estimated that almost two-fifths (38%) of commercialisations of product innovations fail to progress from original ideas to commercially successful products. In addition, the time lags from invention to innovation may be very long, which causes a lot of uncertainty. It may take on average 10-12 years for new ventures' returns on investments to equal those of mature businesses, or 7-15 years to proceed from radical invention to financial success (Kanter 1985). Moreover, small size, longitudinal development efforts and limited available financial resources may cause financial challenges during innovative growth periods. The financial profile of innovative growing SMEs may often include low liquidity and high debt ratios; characteristics usually associated with failed firms.

Public R&D funding seems to be one of the most influential instruments for supporting and increasing innovation and the generation of IPRs in firms (Santarelli and Piergiovanni, 1996). Lerner (2002) concluded that public venture investments should focus especially on technologies that are not currently popular among venture investors and provide follow-on capital to firms that are already funded by venture capitalists or other finance providers during periods when venture inflows are falling. The role of government should be to encourage sharing of both the risks and returns

between the providers of finance and the entrepreneurs. In many circumstances financial support also has wider positive impacts. For instance, Santarelli and Piergiovanni (1996) found that spillovers from both private and public R&D expenditures are positively correlated with the development of product innovations at the regional level.

However, financial resources alone are not sufficient for successful innovation activities and high performance. Notably, large firms with adequate financial resources may require other specialized assistance to support their innovations. Tether (1998) argued that financial support may even lead to the selection of projects that may not be optimal from an innovations perspective, which is likely to increase the number of imitations with little genuine innovation. Moreover, as Venkataraman (2004, pp. 162-166) argued, "*There have to be also resources (apart from financial) that are engaged in the process of ensuring that good ideas are being developed, that somebody actually starts the firm, makes the prototype, gets the first customer, develops the product and places it into a competitive product situation*". Overall, from the above discussion we may conclude that important factors affecting innovativeness include a range of financial variables such as solvency, profitability, liquidity, public R&D finance, but numerous other factors are also important.

2.3 Characteristics of HGS SMEs and methodological challenges

2.3.1 Characteristics of HGS SMEs

Characteristics of small firm growth have been topics of rich empirical research and academic discussion (Acs et al., 2008; Barringer et al., 2005; Davidsson et al., 2009; Kiviluoto et al., 2011; Littunen and Virtanen, 2009; Parker et al., 2010), and a wide spectrum of entrepreneurship and management theories has been used in the applied theoretical backgrounds and frameworks. Penrose (1959) focused on firm-level analysis of economic performance, but stressed the critical roles of single actors and resource slacks in firm growth theory. Davidsson et al. (2005) noted that there have been numerous empirical studies on small firm growth, but few have investigated the crucial relationship between growth and profitability. Furthermore, as Birley and Westhead (1990) pointed out, success has even been conveniently (but erroneously) regarded as a substitute for growth.

The growth and success of small firms have been examined, singly and in combination, in several studies (Davidsson et al., 2009; Cowling, 2004; Glancey, 1998; Markman and Gartner, 2002; Steffens et al., 2009). The key

conclusion from the cited studies is that older firms seem to grow less rapidly than younger firms generally, and profitable firms are more likely to reach the desirable state of high growth and high profitability than firms starting from a high growth, low profitability configuration. However, in extraordinarily high growth cases the growth rates of sales and employment may not correlate with profitability. Another complication is that the causality in apparent relationships between these variables is not necessarily straightforward or uni-directional; recent studies by Davidsson et al. (2009), Kiviluoto et al. (2011) and Virtanen and Heimonen (2011, article III) indicate that profit seems to generate growth and growth enables future profits.

The relationship between sales and employment growth of the rapidly growing small firms that Birch (1979) called "gazelles" has been investigated by several authors. Birch found that they were the most important group of small firms contributing to the creation of new jobs in the economy. Acs et al. (2008) revisited and expanded Birch's findings and labelled firms that grow rapidly and make major contributions to growth in employment and revenues high impact firms (HIFs). They also found that HIFs represented just 2-3% of firms, and could be either small or large, but accounted for almost all private sector employment and revenue growth in the US economy. Thus, both small and large firms play vital roles in the creation of new jobs. In addition, Acs et al. (2008) found that HIFs tend to be younger than low impact firms, but still to have an average age of around 25 years.

It is commonly believed that several factors may have both main and interactive effects on the growth and success of a firm. Therefore, multidimensional frameworks based on statistical modelling have been applied in their analysis. Sandberg and Hofer (1987), who used return on equity as a performance variable, found no confirmation of the effects of the entrepreneur's characteristics on venture performance. However, they found support for the interactive effects of venture strategy and industry structure. Chrisman et al. (1999) extended the theoretical model of new venture performance proposed by Sandberg and Hofer (1987) by including several additional factors. The extended model incorporated numerous factors that may influence the performance of a firm, encompassing attributes of entrepreneurs, industry structure, business strategy, resources and organisational structure, processes and systems.

Several empirical studies have examined effects of various attributes of the entrepreneurs. Notably, Stuart and Abetti (1987) concluded that entrepreneurial experience is a predictor of performance. Cooper et al. (1994) found that both survival and high growth are positively associated

with the entrepreneur's education level, industry-specific know-how and initial financial resources. Smallbone et al. (1995) reported that one of the most important factors for achieving growth is the commitment of the firm's leader, and more recently Barringer et al. (2005) confirmed that founder characteristics influence the growth of firms.

Fabling and Grimes (2007) attempted to identify business practices that set successful firms apart from others. They discovered that both internal and external features of the firms they investigated were associated with business success. Statistically significant variables were investment in up-to-date capital equipment, labour-augmenting practices, R&D activities and market research. Littunen and Virtanen (2009) found that most of the factors that differentiated growing ventures from others were dependent on the strategic and operative choices of the entrepreneur. Parker et al. (2010) concluded that in order to become or remain large, firms needed to invest in marketing and have focused product strategies. This confirms results showing that strategy can act as a differentiator of growth firms (Littunen and Virtanen, 2009) and that a focused strategy is important for achieving both high growth and high success (Virtanen and Heimonen, 2011, article III).

There is evidence that the use of external resources through networking is of the utmost importance for rapidly internationalising ventures. Indeed, business networks offer the only vehicle for rapid internationalisation involving major increases in capability and specialisation, according to Chetty and Cambell-Hunt (2003), and lively interplay between entrepreneurs and external personal networks increases the odds of their businesses growing, according to Littunen and Virtanen (2009).

Complex statistical models have been applied by Wiklund et al. (2009) to evaluate integrative effects of entrepreneurs' and firms' characteristics, resources, entrepreneurial orientation and environment on small businesses' growth. Their two-stage modelling showed that adding direct factors such as attitudes towards growth, environmental dynamism and hostility increased the explanatory power of the model substantially. They concluded that entrepreneurial orientation and growth attitude have strong direct impacts on growth, together with firm age and several environmental factors. They found that resources only have indirect effects on growth, but it could be argued that at least in some cases resources have direct effects on growth (Virtanen and Heimonen, 2011, article III).

2.3.2 Methodological challenges of analysing HGS SMEs

Despite the extensive empirical research on growth and success many problems still appear to be linked to identifying and measuring

characteristics of growing and successful firms and analysing the data. Notably, Davidsson and Wiklund (2000), Delmar (1997) and Janssen (2009) have pointed out that prior performance research lacks justification of applied performance concepts, theory-driven choice of models and the use of single variables, modification of dependent variables and chosen time periods. Thus, methodological issues are likely to be major causes of the limited theoretical development in performance studies (Janssen, 2009; Shepherd and Wiklund, 2009), and (probably) the uncertainties or conflicting findings regarding some important relationships.

At the beginning of the first decade of the 21st century considerable methodological debate focused on operationalization and definitions of the applied concepts, sampling strategies and data (Achtenhagen et al., 2010; Almus, 2002; Birley et al., 1995; Bygrave, 2006; Delmar 1997; Janssen, 2009; Kiviluoto et al., 2011; Sexton et al., 2000; Davidsson and Wiklund 2000; Parker et al., 2010; Shepherd and Wiklund, 2009). However, despite the extensive research efforts very few prior studies empirically analysed whether success and growth are different or the same concepts. If these concepts are different, what kinds of factors may affect both of them? Very little is known about the applicability and possible problems of the most frequently used statistical methods. These problems include difficulties in gathering pertinent, high-quality data and the use of different, sometimes inappropriate, analytical methods (Almus, 2002; Chandler and Lyon, 2001; Delmar, 1997). The problems are particularly acute in multidimensional analyses of performance, for example growth and success studies (Davidsson et al., 2009).

Several factors may cause problems when using statistical methods, especially in high growth and high success (HGS) studies. In some studies exceptionally high values of the variables have been excluded (e.g. Siegel et al., 1993), while in others these “super-high” values have been the focus of the examination (Markman and Gartner, 2002). In addition, results obtained through basic regression analyses may be distorted because the basic assumptions regarding distributions and error terms may not be valid. The basic assumptions made in multiple linear regression analysis are that the relationships among the variables are linear, error terms are normally distributed, estimates are unbiased, variances of the error terms are equal (homoscedastic) and predictor variables are not correlated (i.e., there is no multicollinearity). These characteristics may not be valid for data related to the growth and success of firms operating in entrepreneurial markets. As Bygrave (2006) states, these markets continuously change and are characterised by substantial uncertainty, instability and discontinuity. In practice, distributions of variables related to high growth and high

success are often very heavily-tailed. Therefore, skewness of the data may result in constructed models having low explanatory power, and difficulties in calculating *a priori* probabilities of the characteristics of firms in a studied population may complicate the application or validity of diverse regression techniques (Tabachnik and Fidell, 2007).

The lengths of time that businesses may exhibit HGS are also uncertain (Parker et al., 2010; Steffens et al., 2009). Therefore, one of the problems in analysing growth and success, in order to identify high growth and high success firms or evaluate the factors involved, is in determining an appropriate time period to consider. Growth and success occur in a constantly changing world (and change the state of the world), thus their rates will inevitably substantially change over time. Many growth and success studies have used cross-sectional (often annual) data sets, but this may not be appropriate for capturing important trends. Furthermore, even in studies that have analysed longitudinal data the timeframes have rarely exceeded 3-5 years (Delmar, 1997), the few exceptions include studies by Acs et al. (2008), Smallbone et al. (1995), Delmar et al. (2003) and Littunen and Virtanen (2009).

There have been some attempts to solve the shortcomings of using cross-sectional data by using quarterly data and selected deflators (e.g. Weinzimmer et al., 1998). However, this does not solve all the timespan problems. Even if it is possible to control seasonality and justify the deflators, these selections could be biased. The use of a GDP deflator, for instance, does not reveal the branch-specific effects of cost changes, and it is difficult to identify a robust single indicator to correct data for seasonality, since some firms (especially medium and large firms) will be multi-branched businesses. Moreover, there are differences even within the same industry depending on the products offered and accessed markets.

In RA analyses it is difficult to operationalize any combined continuous variable intended to measure growth and success. Therefore, one solution for examining HGS by using RA is to construct separate regression functions, then test the dependent variables separately and analyse the possible similarities and differences of independent variables (e.g. Glancey, 1998; Markman and Gartner, 2002). Further, if we use discriminant analyses (DA) and/or other maximum likelihood methods, such as logistic regression analyses (LRA), the problem of explaining simultaneous high growth and high success demands the use of a dichotomous variable as a dependent variable (Tabachnik and Fidell, 2007). In DA and LRA analyses, distributions of the data and their characteristics should be taken into account. We should also acknowledge a priori probabilities in discriminant

and logistic regression analyses since uneven classification rates may cause practical problems if distributions of selected variables are uneven.

Furthermore, few prior empirical studies have considered problems associated with data quality in analyses of the growth and success of businesses. Ideally, problems in operationalization and measurement of variables should be identified, and the data should be refined accordingly. An important issue, for instance, is whether to use absolute or relative variables when estimating effects of the size of a firm (Davidsson and Wiklund, 2000). The size of studied firms is important because of possible imbalances in distributions of firms' sizes (Almus, 2002). If we use relative growth measures the distribution is skewed towards small firms and if we use absolute growth figures the distribution is skewed towards large firms. Branch of industry effects should also be recognised, as some branches (such as banking, insurance and holding companies) have disproportionately large assets compared to other companies with similar turnovers.

In prior studies, data refinement has included transformations of variables (both dependent and independent) to control the huge variance associated with absolute figures. However, Delmar (1997) pointed out that problems related to the content of data may arise from such transformation. Statistically, these problems may affect both the outputs of resulting models and their interpretation. For example, logarithmic transformation affects signs of single variables, and hence the detection and interpretation of their trends.

2.4 The development of HGS SMEs

Diverse theoretical backgrounds, and variables, have been applied in previous attempts to explain variations in performance, and developmental paths of firms. Recent performance studies have used founder characteristics, resources, motivation, personal capabilities, entrepreneurial orientation and networks as variables in models (Barringer, 2005; Baum et al., 2001; Cooper et al, 1994; Greiner 1972; 1998; Davidsson et al., 2009; Gundry et al., 2001; Smallbone et al., 1995; Littunen and Tohmo, 2003; Orser et al., 2000; Veronique et al., 2000; Wiklund et al., 2009). Moreover, strategic choices of entrepreneurs and firms connected to product and production policy, markets and customers, internationalisation, business opportunities and protection of competitive advantage seem to influence growth and success (Abetti, 2001; Baum et al., 2001; Birley and Westhead, 1990; Chetty and Cambell-Hunt, 2003: Cowling, 2004; Littunen and

Virtanen, 2009; O'Gorman, 2001; Roper, 1999; Smallbone et al., 1995; Steffens et al., 2009).

In recent meta-analyses of empirical small business growth, Davidsson et al. (2006) and Dobbs and Hamilton (2006) found that the literature continues to feature a wide range of growth measures and model specifications. Consequently, development of knowledge of the relationships involved appears to be fragmented rather than cumulative. Furthermore, Davidsson et al. (2006) argue that criticism of life-cycle and growth stage literature seems to have led, strikingly, not to better research but to no research at all, but there are some exceptions, including studies by Abetti (2005), Barringer et al. (2005) and Garnsey et al. (2006).

The main gap in contemporary understanding of growth is in the process of growth, i.e. what happens within organizations as they grow. However, there are several problems in contemporary growth studies that provide indications of new research avenues, notably regarding the periodicity of growth and the role of learning in the idiosyncratic development of small businesses. Some of these problems are related to a prevailing focus on uni-directional growth. Others are related to a lack of (or deficiencies in) conceptualization of organisational growth, high quality detailed studies, consideration of human capital issues, and combined analysis of phenomena at multiple levels (individual, team, organization, environment). The links between empirical findings and theory also need to be strengthened. Bygrave (2006) pointed out that explorative and inductive approaches may open opportunities for developing new theoretical perspectives that are needed to develop our understanding of the growth process in SMEs (Davidsson et al., 2006; Dobbs and Hamilton, 2006).

As Delmar et al. (2003) concluded, high growth firms are highly heterogeneous. However, most prior studies have focused on explaining differences in the degree of growth, neglecting other aspects such as long-term changes of businesses, the processes and paths of simultaneous growth and success (Abetti, 2001, 2005; Barringer et al., 2005; Birley and Westhead, 1990; Davidsson, et al., 2009; Garnsey et al., 2006; O'Gorman, 2001). Furthermore, there is a lack of studies combining quantitative changes of performance variables with developmental views of processes, paths and tracks of SMEs (Achtenhagen et al., 2010).

2.5 Innovation and growth policy support initiatives

Previous studies have emphasized that innovation is one of the most important sources of growth (Bhide, 2000; Drucker, 1985; Malecki, 1997; Schumpeter, 1934; Teece, 1986). Therefore, innovation policies globally

have been strongly targeted to enhance the creation and exploitation of innovation, particularly in small firms (Blakely, 1994; Bridge et al., 1998; Malecki, 1997). However, at the same time, many small, growth-oriented firms have become increasingly dependent on external knowledge sources due to their incapability to generate all the knowledge required for the creation and commercialisation of innovation (Cormican and O'Sullivan, 2004; Pellikka and Lauronen, 2007). Prior studies have pointed out that regional innovation support services have failed to generate such knowledge sufficiently, but there has been little research effort regarding the kind of support that is needed to foster innovation and how it should be provided (Blakely, 1994; Kaufmann and Tödtling, 2002; Klofsten and Jones-Evans, 1996; Pellikka, 2008; Pellikka and Virtanen, 2009).

It has been argued that the local service infrastructure should provide a nurturing environment for small technology-intensive firms in order to support and accelerate their innovation activities and growth, as well as the growth of local regional economies (Abetti and Rancourt, 2006; Höyssä et al., 2004; Phillips, 2002; Tidd et al., 2001). Major objectives of economic policies have included the provision of suitable infrastructure and enhancement of the availability of appropriate innovation support services (Heydebreck et al., 2000). In the absence of unlimited resources, it is necessary to make local choices between industries in order to support the creation and development of small technology firms efficiently (Cohendet and Meyer-Krahmer, 2001). Prior studies have shown that realising the potential benefits of innovation requires an effective commercialisation process (Andrew and Sirkin, 2003), whereby potential products are generated from ideas and transformed into market-competent products. Developing effective commercialisation processes is a complex and challenging task for small firms in the modern business environment, in which customer requirements are rapidly changing and the life-cycles of new products are shortening.

Small firms whose competitiveness is based on diverse information, such as knowledge intensive business service firms (KIBS), have become increasingly dependent on external knowledge sources. Prior studies have clearly indicated that small KIBS firms, in particular, face several challenges during the commercialisation of innovation (Pellikka and Virtanen, 2009). Most of the challenges are associated with the inability to acquire and exploit external resources that are often crucial for small firms (Blakely, 1994). Kaufmann and Tödtling (2002) stated that a key objective of local innovation support services should be to improve the innovation performance of firms, which can be achieved only by providing certain inputs to the creation and commercialisation of innovation.

2.6 Conceptual framework

Relationships examined in the studies this dissertation is based upon include those between:

1. Innovation and growth
2. Growth and success
3. Growth, innovation and support

Four studies have been conducted (as described in Articles I-IV), which collectively illustrate the characteristics of IHGS firms and form the conceptual framework of the dissertation (Figure 3). The starting point of the innovation and growth studies has been analysis of growing innovative SMEs in diverse locations. According to resource munificence and regional competitive theories, firms in urban areas should generally perform more strongly and produce more innovations than those in rural regions. To evaluate these hypotheses, the influence of location on innovation and growth has been tested and analysed in more detail in the studies, and the basic assumption of life-cycle theory has been tested by analysing the influence of age of the firms in the studied populations. The Schumpeterian hypothesis that large firms tend to have resource advantages over smaller firms for exploiting new technologies and producing innovations has also been tested. In addition, Gibrat's law, that growth follows random walks rather than being correlated with size, has been evaluated.

Other assumptions about the connections between innovation, growth and success applied and tested in the studies are derived from prior empirical studies. Previous research indicates that there is a positive correlation between innovation and growth, but there are mixed findings regarding the relationship between innovation and success. The impact of innovations on economic performance is seen as highly uncertain. Moreover, risky behaviour (including pursuing growth and innovation activities simultaneously) may lead to high variance in short-term income (Bhide, 2000). Both private and public R&D expenditures are believed to correlate positively with the development of new products, but the influence of R&D expenditure on simultaneous innovation and growth has not been tested in previous studies.

In the studies reported in Articles I-IV the connections between growth and success have been analysed within the constructed framework by examining the influence of selected variables on growth, success, and simultaneous growth and success. Whether the concepts of growth and success are the same, or different, was also assessed. Models, derived from prior theories, were constructed to assess the effects of age, branch of industry, innovation, location and size on growth and success. In addition, a longitudinal case study approach was utilized to elucidate behavioural

aspects of growing ventures more fully. Thematic items derived from theory and previous studies included in the content analysis of high growth and highly successful case firms included characteristics of entrepreneurs, management, ownership, markets and customers, strategies, financial parameters and future challenges. In addition, challenges associated with the use of regression, logistic regression and discriminant analyses in growth and success studies were addressed.

Finally, as mentioned above, it is widely believed that public support can promote the creation and exploitation of innovation, partly because small firms lack some of the diverse resources required to foster innovation and growth simultaneously. However, it is also believed that regional publicly offered innovation support services do not fully meet the needs or requirements of these ventures, but there has been little research on the kind of support that is needed and how it should be provided. Therefore, attempts were made: to identify high growth industry branches and the kinds of innovations that may promote high growth in these sectors; to assess the needs for innovation and support services; and to evaluate the services currently available (and their shortcomings). The conceptual framework of the studies is presented in Figure 3.

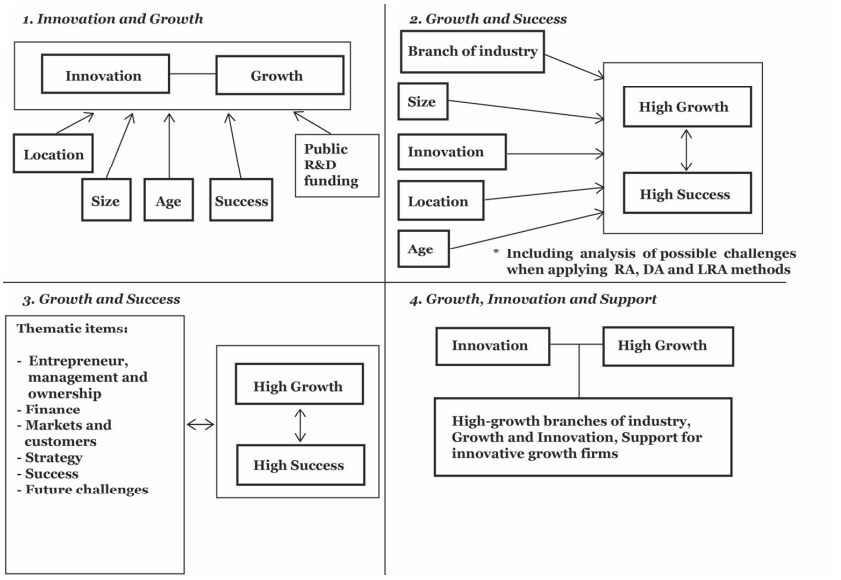

Figure 3: Conceptual framework of the studies

3 Research methodology

3.1 Methodology applied in the studies

The purpose of the presented research was to obtain holistic, in-depth understanding of the characteristics of innovative, high growth and highly successful SMEs, using a mixed approach, involving both qualitative and quantitative analysis of the data. This methodological choice is in line with recent theories of knowledge production and understanding of the entrepreneurship, innovation and performance of businesses. Leitch et al. (2010) pointed out that entrepreneurial actions and business performance are complex phenomena that require rich, elaborate and wide analysis. Hence, methodological heterogeneity is required to address the complexity and capture a richer body of knowledge and understanding of high performance entrepreneurship (Bygrave, 2006; Leitch et al., 2010).

Creswell (2003) stated that the initiating points of knowledge claims are the paradigms, philosophical assumptions, epistemologies, ontologies and research methodologies held, conceived or made by researchers when they start a project. Philosophically, researchers make claims about what knowledge is (ontology), how we know it (epistemology), the incorporated values (axiology) and the kinds of processes or opportunities available for studying it (methodology). However, in discussion of mixed methods research, epistemological and ontological issues have been marginalized to a significant degree as pragmatism has emerged as a major orientation for combining qualitative and quantitative research (Bryman, 2007).

The basic assumptions about knowledge claims underlying this dissertation (and the studies it is based upon) are rooted in pragmatism. Other philosophical bases for the knowledge claims that could have been adopted include post-positivism, constructivism or advocacy/participatory approaches. Post-positivism refers to a view of research that emerged following critiques of positivism, challenging the traditional notion of absolute truth of knowledge and recognizing that we cannot be positive (absolutely certain) about our knowledge claims, especially when studying the behaviour and actions of humans, because of our inherent biases.

Constructivism is based on the assumption that individuals seek understanding of the world in which they live and work. The goal of constructivist research is to rely as much as possible on the participants' views of the situation being studied. Researchers of advocacy and participatory knowledge claims have pointed out that the post-positivist assumptions imposed structural laws and theories that did not fit marginalised individuals or groups, or did not adequately address issues of social justice. These inquirers also felt that the constructivist stance did not sufficiently advocate an action agenda to help marginalised peoples. Thus, they concluded, research should include an action agenda for reform that may change the lives of participants and the institutions in which people work or live (Creswell, 2003). Creswell (2003) also stated that pragmatism provides an alternative basis for knowledge claims. Pragmatism (especially the mixed methods research approach) is not committed to any particular system of philosophy and reality. Johnson and Onwuegbuzie (2004) emphasised that philosophically the mixed method originates from the so-called third research movement, avoiding the paradigm wars by offering a logical and practical alternative. Mixed method inquiry includes the use of induction (e.g. discovery of patterns), deduction (testing theories and hypotheses) and abduction (uncovering and relying on the best of a set of explanations for understanding one's results). In practice, pragmatists do not see the world as an absolutely unity. Therefore, individual researchers have freedom to choose the research methods, techniques and procedures that appear to best meet their needs and purposes.

According to advocates of mixed method research, truth is what appears to pertain to given phenomena at given times and places, and they may use both qualitative and quantitative data to obtain the best apparent understanding of a research problem. Pragmatist researchers hold that research always occurs in social, historical, political and other contexts. They believe that we need to stop asking questions about reality and the laws of nature. Thus, for the researcher using mixed methods, pragmatism opens opportunities to exploit multiple methods, diverse worldviews, diverse assumptions and diverse forms of data collection and analysis (Creswell, 2003). The overall purpose and main premise of mixed methods is that use of combinations of quantitative and qualitative approaches may provide a better understanding of research problems than either alone. This is particularly pertinent to entrepreneurship studies, since as Molina-Azorin (2012) pointed out, researchers need to address the context of the studied phenomena and account for its complexity, uniqueness and richness. In this respect, studies using mixed methods may help in contextualising entrepreneurship research.

3.2 Research strategy and design

The research strategy and design applied in the studies is based on a model proposed by Crotty (1998), which addresses three central questions: 1) what knowledge claims, including theoretical perspectives are being made by the researcher, 2) what methodological strategies are applied, and 3) what methods of data collection and analysis will be used in practise? The inquiry strategies issue is related to the choice of assumptions about knowledge claims. The strategy selected provides direction for procedures in a research design. According to Creswell (2003) three main strategies, each with several variants, are associated with the mixed methods approach:

- sequential procedure
- concurrent procedure
- transformative procedure

In sequential procedure the researcher seeks to elaborate on or expand the findings obtained using one method by using another method. In concurrent procedure the researcher combines quantitative and qualitative data to address the research problem comprehensively. In transformative procedure the researcher uses a theoretical "lens" to provide an overreaching perspective within a design constructed to acquire, process and interpret both qualitative and quantitative data. This lens provides a framework for topics of interest, methods of collecting data, and analysing anticipated outcomes or changes. A data collection method that involves a sequential or concurrent approach, or both, could be incorporated within this lens (Creswell, 2003). The transformative procedure/strategy was principally applied in the studies this thesis is based upon. The mixed method design of the research follows transformative procedure logic by using previous research and theoretical understanding in the field to provide theoretical frameworks (lenses) for topics of interest.

3.3 Data and analytical methods

3.3.1 Data

Mixed method designs provide opportunities to capture the best of both quantitative and qualitative methods of data collection and analysis in a single study or series of studies (Creswell, 2006; Molina-Azorin, 2012). Both close-ended measures and open-ended observations can be used in attempts to obtain the best possible matches between research problems

and the methods used for addressing them. Creswell (2006) pointed out that quantitative data consist of close-ended information, on (for instance) attitudes, behaviour and/or performance instruments. Analysis of quantitative data commonly involves statistical analyses of scores (numbers) collected by survey instruments and/or from public documents to answer research questions and/or test hypotheses. Qualitative data often contain open-ended information that the researcher collects through interviews with participants. Open-ended questions asked during these interviews allow the interviewees to provide answers in their own words, which may provide much richer information than closed questions. Qualitative data may also be collected by gathering documents from private or public sources, observing participants, collecting audio-visual materials such as interview-records and videotapes or artifacts. Analysis of the qualitative data often involves aggregating the words or images into information categories and presenting the diversity of items collected during data gathering process (Creswell, 2006).

The data used in the studies underlying this dissertation were collected (then refined and restructured as required) using a purposeful sampling strategy (Miles and Huberman, 1994; Achtenhagen et al., 2010), from the following seven sources:

1. Accounting data for the years 2000-2009 from the extensive database stored in the Voitto+ CD-ROM (http://www.asiakastieto.fi/voitto), which includes financial statement data for around 200,000 Finnish companies (Suomen Asiakastieto Oy, 2006-2011).
2. The National Board of Patents and Registration of Finland, and the international registry of patent data esp@cenet (http://www.prh.fi/en.html).
3. Public R&D funding data from the Finnish Funding Agency for Technology and Innovation (http://www.tekes.fi).
4. Success index data for firms in Finnish provinces acquired from Balanced Consulting Ltd. (http://www.balanceconsulting.fi) (Appendix 2).
5. Data from surveys of 213 small knowledge intensive business service (KIBS) firms (NACE 72-74) located in Eastern Finland (North-Savo)
6. Data obtained from interviews of key informants of five HGS firms located in Eastern Finland
7. Data obtained from interviews of key informants of 12 small-technology based knowledge intensive business service (T-KIBS) firms located in Eastern Finland (North-Savo)

From the Voitto+ CD-ROM database, 567 growing businesses were identified – 466 in urban and 101 in rural areas. In order to obtain robust results, the sample was carefully analysed to ensure that it reflected the success data provided by Balance Consulting Ltd. In order to focus on high growth and highly successful SMEs the data were refined as needed. Because the full dataset included some figures for micro businesses, all businesses that had fewer than 10 employees were excluded. All firms that had more than 250 employees were also excluded, since these included several multinationals and their subsidiaries. The final step was to exclude data for investment banks, finance and holding companies, which have disproportionately large assets compared to other companies with similar numbers of personnel.

The full data set (n=567) was used when analysing branches of industry in Article IV. Altogether, 219 companies were eliminated prior to the analyses presented in Articles I and II. Thus, the refined data provided information regarding 348 growing SMEs (262 located in urban and 86 in rural areas) and were used in the analyses presented in Articles I and II. The growth and success data covered the period 2002-2005. Growth businesses were selected by applying a 10% threshold in annual turnover, corresponding to the definition of a growth company suggested by Smallbone et al. (1995), as one that doubles turnover within 10 years. High-growth firms (gazelles) were defined as those that increased turnover by at least 30% per year, and thus more than doubled their turnover during the examination period. The figures were not deflated, since the annual change in the consumer price index during the study period was less than 1%. Moreover, the closing month of the accounting period may vary among firms, which could skew the impact of the annual inflation rate as a deflator. Using these criteria, 273 non-high growth (NHG) and/or non-highly successful (NHS) and 75 high growth (HG) and high success (HS) businesses were identified.

In the study reported in Article III five HGS firms were selected from the longitudinal data, which included 348 growing SMEs. Altogether this data set included information on 49 HGS firms, nine of which were located in rural areas (Eastern Finland). The growth and success of those nine firms exceeded the industry average in 2002-2005. Four were excluded because they represented branches of industry where they had monopoly power because of legislation (motor-vehicle inspection) or could cause some bias in employment and job creation (labour leasing).

The remaining cases were classified as highly successful business if their sales increased by at least 20% on average and by at least 15% every year in the period 2002-2005, and their Success Index was at least 70 points out of the 100 maximum (Appendix 2).

The data used in Article IV included the original data set for 567 growing businesses from which 466 firms in urban and 101 in rural areas were identified. The data were used to identify the most rapidly growing industry sector and distinguishing characteristics of that sector relative to other sectors during the examination period of 2002-2005. High-growth and high success variables were used as dichotomous variables in order to find out distinguishing characteristics of diverse branches of growing firms. Firms were classified as high-growth and highly successful if their turnover grew by more than 30% in consecutive years in 2002-2005 and their Success Index was at least 80 points, respectively. In Articles I and II the lower value of the success index was used to meet the need for sufficient observations in different branches of industry and the group of HGS firms.

It was discovered that the most rapidly growing industry branch was services, including the KIBS-sector, hence survey data for KIBS firms were included in the analysis. These data were obtained from a questionnaire delivered to all of the 1,143 small KIBS firms located in Northern Savo (Eastern Finland) at the time. 213 firms returned questionnaires that could be used for identifying the kinds of innovations that have affected growth of the firms. Moreover, in order to identify the small KIBS firms' requirements for regional innovation support services data were collected from 12 small T-KIBS firms located in Eastern Finland. The key informants approach was used to collect data from case firms that used at least three different kinds of innovation support services during the preceding two years.

3.3.2 Analytical methods

In Article I the objective was to identify the factors that differentiate innovative growing SMEs from other firms. Five hypotheses, derived from previous theory and empirical studies, were constructed to test if location, age, size, success and public R&D funding differentiate innovative from non-innovative growth firms. Logistic regression analysis (LRA) was used to analyse the data because the dependent variable was dichotomic and in maximum likelihood modelling it is recommended to use LRA when the explanatory independent variables are not only nominal or ordinal but also scale variables. Moreover, results obtained through basic regression analysis (RA) can be misleading when dealing with data relating to growth and patent registrations (Coad and Rao, 2008).

The preliminary purpose of Article II was to analyse simultaneous growth and success characteristics of the firms. However, this inquiry also led to consideration of the methodological problems of the analysis. Thus, Article II focused on the characteristics of HGS SMEs and possible problems of different approaches and methods. Regression (RA), discriminant (DA) and

logistic regression analyses (LRA) were used to examine the data. The growth and success of the firms were used as dependent variables in the RA models. In the DA- and LRA-analyses the classification of simultaneous growth and success of firms was used as a dependent variable. First, both DA- and LRA-models were estimated, ignoring the *a priori* probabilities of the firms' growth and success (Model 1), then matched pair comparisons (cross-validation) were applied (Model 2). Explanatory variables included branch of industry, age and size of the firm, innovativeness (measured by IPRs), public R&D funding and region, as a dichotomous variable (urban vs. rural).

In Article III the purpose was to identify and understand potential prerequisites for, and consequences of, the HGS stage of SMEs. The empirical paths of the firms were followed, based on the entrepreneurs' judgement and perceptions of the processes. Thus, the unit of analysis was the owner/manager/entrepreneur rather than the firm, although financial development and job creation were analysed as firm level phenomena. Since the frequencies of HGS SMEs proved to be very small and no robust statistical analysis could have been performed, a multiple case approach was selected as the method of analysis. The primary data for the study was collected through thematic interviews. The themes (derived from prior research and theory) included the attitudes and behaviour of the entrepreneur, management, ownership, finance, markets and customers, strategic choices and growth strategies, success and future challenges. Content analysis was the primary method of analysing the acquired interview data.

Combined quantitative and qualitative analyses (mixed methods) were used in Article IV to examine the innovation support requirements of small, technology and knowledge-intensive, high-growth firms in Eastern Finland. LRA-analysis was used when studying the distinguishing factors of the service sector with other branches of industry. Moreover, the study identified innovation-related activities of one high-growth service sector (KIBS firms). Content analysis with categorization was the main method used when analysing the small T-KIBS case firms' requirements for regional innovation support services.

3.4 Models and operationalization of variables

Quantitative models were applied to meet the research aims and address the research questions posed in Articles I, II and IV. Descriptive statistics, including distributions of the variables, univariate statistics and factor analysis, were also used in the quantitative analyses.

In Article I, an LRA-model with a binary dependent variable combining innovation and growth was applied. The independent explanatory variables were location, branch of industry, size, age, success and public R&D funding. LRA-modelling was selected partly because it is appropriate for testing whether a firm belongs to a specific group characterised in at least two dimensions, and partly because LRA-models have fewer restrictive assumptions than regression analysis and discriminant analysis models.

In this article, LRA-models are estimated first, ignoring *a priori* probabilities, then matched pair comparisons (cross-validation) are introduced. The innovation variable is the numbers of IPRs a company produced and owned during the period 1988-2005, while the growth variable refers to turnover growth during the period 2002-2005. The relationship between a company's industrial sector and combined innovativeness and growth was analysed using univariate statistics, because of the small numbers of observations in some industrial sectors. All the other variables were included in the LRA-model.

Several models, including RA-, DA- and LRA-models, were used in Article II to analyse the characteristics of high growth and highly successful firms. Growth of the firms was used as the dependent variable, and success as an independent variable in the RA-growth model, and vice versa in the RA-success model. In the DA- and LRA-models a binary variable intended to describe simultaneous growth and success of the firms was used as a dependent variable. Both DA- and LRA-models were estimated ignoring the *a priori* probabilities of firms displaying high growth and high success (Model 1) and then matched pair comparisons (cross-validation) were introduced (Model 2). In Article II explanatory variables included location, branch of industry, age, size, innovation activity and public R&D funding. The stepwise processing (conducted using SPSS-software) included some other explanatory variables and factors (growth in personnel, growth of the branch of industry, liquidity, profitability and solvency) identified by factor analysis.

In the analyses presented in Article III, data acquired from detailed longitudinal case studies (2000-2009) were used. In Article IV mixed methods such as LRA-modelling and multiple case study methods were used to analyse three different data sets and address the research questions. The dependent variable in the LRA-model was the branch of industry,

based on the national-level data, and the model was estimated using matched-pair comparison, acknowledging *a priori* probabilities. The explanatory variables included success and growth, size and age of the firm, innovativeness, public R&D funding, growth of the branch of industry and number of auxiliary business names.

In the industry-level LRA-model the data for small KIBS firms located in Eastern Finland (North-Savo) were analysed. A dichotomous dependent variable for the model was constructed by classifying the firms into two groups, based on the effects of innovation activity of the firms on their turnover, as reported by key informants. CEOs of Group I and II firms stated that innovations, including renewal and development activities, accounted for more than and less than 25% of the increase in their turnover during the study period, respectively. Four variables were selected to measure the extent of innovation activities in the small KIBS firms: the rate of new product or service introduction, uniqueness of the new products or services, timeliness of new product introductions, and the success of new products or -services they launched. These variables were measured using 5-point Likert scales. Finally, in Article IV content analysis was applied to data obtained for the 12 T-KIBS case firms.

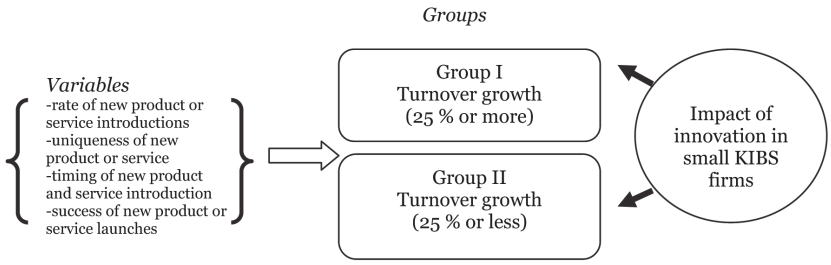

Figure 4: Variables used to small KIBS firms according to the impact of innovations on their turnover growth (Siikonen et al., 2011)

3.5 Validity and reliability in mixed method studies

Onwuegbuzie and Johnson (2006) stated that validity is not about singular truths and not limited only to quantitative measurements. Validity can have subjective, intersubjective and objective components and influences. The definitions of validity and reliability in quantitative research reveal two strands: validity is often understood to refer to the accuracy of the means of measurements, and whether the measurements really measure what they are intended to measure. Measurements obtained from a given instrument may be reliable, but not always valid, while others may be valid but not

reliable. Several items other than measurement instruments may also have influenced the validity of the study, including the following:

- the suitability of the main focus of the research
- the relevance of the approaches, methods, language and structure of the studies to the aims
- the aptness of the approaches, methods, language and structure of the studies for addressing the research hypotheses and/or questions
- the degree to which the units of analysis help to connect the findings to prior theory and possibilities to contribute to theory development

Reliability covers the following issues (Tabachnik et al., 2007):

1. Are the variables chosen and measured trustworthy?
2. Are the variables used derived from theories and previous studies?
3. Is it possible to execute another research project in the same way and get the same results (possibility of replication).

It should be noted that the concepts of validity and reliability are viewed differently by qualitative researchers. For example, the replicability of results does not concern them (Golafshani, 2003). Furthermore, while the terms validity and reliability are essential quality criteria in quantitative paradigms, in qualitative paradigms the terms credibility (qualitative concept of validity), confirmability (objectivity), neutrality, consistency, dependability (reliability), applicability and transferability (validity) are essential research quality criteria (Lincoln and Cuba, 1985).

Mixed research strategies involve mixing quantitative and qualitative methods, approaches and concepts that have complementary strengths and non-overlapping weaknesses. It has been stated that mixed methods are characterised by the problems of representation, legitimation and integration (Onwuegbuzie and Johnson, 2006). Representation here refers to the difficulty in capturing animated experiences using text in general as well as words and numbers. The problem of legitimation refers to the difficulty in obtaining results and/or making inferences that are credible, trustworthy, dependable, transferable and/or confirmable. In many cases, these problems are exacerbated in mixed research because both the quantitative and qualitative components of studies bring their own problems of representation and legitimation that complicate integration.

In one of the few studies on the topic of validity or quality criteria in mixed research, Teddlie and Tashakkori (2003) pointed out that inferences are made whether the associated interpretation is deductive or inductive in nature. These authors contended that the concept of inference transcends quantitative and qualitative research and they recommended that interference quality should be used as the term for validity in mixed research. They conceptualize inference quality as being associated with two research components: design quality and interpretative rigour. According to their integrative model of inference quality, design quality comprises:

1. Within-design consistency
2. Design suitability
3. Design fidelity
4. Analytic adequacy

Within-design consistency refers to standards used for evaluating the methodological rigour of mixed method studies. Design suitability refers to whether the methods used are appropriate for addressing the research question(s) and the design is consistent with them. Design fidelity refers to whether procedures: are implemented with rigour and quality; are capable of capturing meaning, associations and/or effects; and the sampling and data collection procedures are implemented adequately. Analytic adequacy refers to the appropriateness of applied data analysis techniques for addressing the research question(s) (Tashakkori and Teddlie, 2006). Interpretive rigour pertains to the overall standards for evaluating the validity of conclusions of the study. It consists of interpretative agreement, distinctiveness, interpretative consistency and theoretical consistency. Interpretative agreement means that people agree about interpretations, i.e. there is consistency of interpretations across people. Interpretative distinctiveness is the degree to which the inferences are distinctively different from other possible interpretations of the results, and rival explanations are ruled out. Interpretive and theoretical consistencies are connected to the inferences that closely follow from relevant findings in terms of type, intensity, scope, and multiplicity. Interpretive consistency refers to whether the inferences are consistent with each other, and theoretical consistency to whether the inferences are consistent with theory and current knowledge in the field, and whether meta-inferences adequately incorporate the inferences from quantitative and qualitative phases of the study (Tashakkori and Teddlie, 2006).

Onwuegbuzie and Johnson (2006) extended the model proposed by Tashakkori and Teddlie (2006) of the validity of mixed methods. They

concluded that the problems of representation and integration in mixed methods research imply the need to identify specific legitimation issues that are not associated with mono-method research designs but could be used in combined quantitative and qualitative investigations. They also identified the following nine legitimation types:

1. Sample integration
2. Inside-outside
3. Weakness minimization
4. Sequential
5. Conversion
6. Paradigmatic mixing
7. Commensurability
8. Multiple validities
9. Political

Sample integration shows the relationship between quantitative and qualitative sampling designs that yield possible quality meta-inferences. The inside-outside type refers to accurate presentation and appropriate utilization of insiders' and observers' views of the purposes (description and explanation) of the research. Weakness minimization refers to the compensation of weaknesses of one approach by the strengths of the other approaches. Sequential legitimation is based on the extent to which one has minimized the potential problem of meta-inferences being affected by reversing the sequence of the quantitative and qualitative phases. Conversion is related to the extent to which the quantitizing or qualititizing yields quality meta-inferences. Paradigmatic mixing is based on the researcher's epistemological, ontological, axiological, methodological and rhetorical beliefs underlying the quantitative and qualitative approaches that are successfully combined or blended into a usable package. Commensurability is based on the meta-inferences made to reflect a mixed worldview based on the cognitive process of switching and integration. Multiple validities address the legitimation of the quantitative and qualitative components of the results from the use of quantitative, qualitative and mixed validity types, yielding high quality meta-inferences. Political in this context refers to the consumers of mixed methods research who value the meta-interferences stemming from both the quantitative and qualitative components of the study.

Validity and quality criteria are examined here, and in the underlying studies, following the recommendation by Teddlie and Tashakkori (2003) that interference quality should be used as the mixed research term for

validity. They conceptualized inference quality as being associated with two research components: design quality and interpretative rigour. To achieve good design quality for the studies several items have been considered. To ensure within-design consistency the methodological rules and guidance for conducting such research have been strictly followed. Possible methodological issues of the studies have been discussed in the research community and corrections have been made based on referees' comments about Articles I-IV. The designs of the four research constructs have been approved by the international referees, implicitly accepting that the methods applied in the studies are appropriate for addressing the research questions/hypotheses and that the design of each framework is consistent with the research questions/hypotheses. The possible assumptions and problems with the methods used in the sampling, data gathering and analytical procedures have been acknowledged. The quality of the data has been improved by acquiring new data to fill gaps, and refining the data according to the research aims and possibility to answer the research questions and test the hypotheses.

Interpretative rigour refers to the standards for evaluating the validity of conclusions of a study. In the studies this dissertation is based upon, interpretations of diverse results of applied constructs have been agreed, but the interpretations of the results of the whole study have not been agreed. This seems to be an important issue when evaluating the interpretative agreement of the results. Other issues associated with evaluating the validity are the fit with multiple interferences based on the findings, and whether the interferences are consistent with theory and current knowledge of the characteristics of IHGS SMEs.

4 Results, evaluation of the studies and concluding remarks

4.1 Summary of the results and conclusions

In this section, the main results and conclusions presented in Articles I, II, III and IV are summarised, then the contributions (theoretical and practical) and limitations of the study are evaluated, and finally possible avenues for future research are suggested.

The main research question addressed in Article I was: What factors affect innovation in growing SMEs? Five hypotheses were formulated and tested, based on the theoretical background and previous literature: that location, age, size, success and public R&D finance affect it. The results indicate that location, age and size of the firm do not statistically significantly differentiate innovative growing SMEs from non-innovative counterparts. These findings are consistent with previous conclusions that there is relatively little difference in the level of innovation and performance between SMEs in different areas (North and Smallbone, 2000), and that innovative output is not strongly related to either economies of scale (Kohn and Scott, 1982) or age of the firm (Huergo and Jaumandreu, 2004). The last of the cited studies showed that many mature firms seem to remain highly innovative and exhibit superb market performance.

The results suggest that in a 3 – 5 year timeframe success may be negatively related to innovation and growth, in accordance with expectations that growing innovative SMEs may be subject to greater financial pressures than growing firms that do not produce IPRs (Bhide, 2000; Freel and Robson, 2004).

The overall classification rate of innovative HGS SMEs improved when the variables location, size and age were excluded from LRA-analysis. The explanatory variables used in the best statistical model were success, public R&D funding and the turnover/employee ratio. Of these variables, the success index and public R&D funding had significant effects at the $p \leq 0.1$ and $p \leq 0.01$ levels, respectively. The turnover/employee ratio was not statistically significant, but its inclusion improved the overall classification

rate. These results support the hypotheses that financial success and public R&D funding affect the innovation activity (as measured by the generation of IPRs) of growing SMEs. It was found that the lower the success, the greater the probability of a firm being classified as an innovative growth SME. This implies that innovative growing firms are probably less successful than non-innovative growing SMEs. The observed direction of the impact reflects the expected associations between innovation and high variance in short-term revenue and profitability (Bhide, 2000; Freel and Robson, 2004). The turnover/employee ratio correlated positively with innovation, indicating that high ratios are associated with innovative high growth SMEs. This is consistent with suggestions that rapidly growing businesses with high productivity tend to be more IPR intensive than other businesses (Coad and Rao, 2008). Public R&D funding was found to increase the odds of a firm being classified as a growing innovative firm, partly supporting the views of Santarelli and Piergiovanni (1996) that both private and public R&D expenditures are positively correlated with product innovation and the development of IPRs. However, the dependent variable also contains a growth element, and the relationships of the two variables with innovation cannot be separated.

The purpose of Article II was to address the following questions. What factors are associated with simultaneous growth and success according to selected statistical procedures (RA, LRA and DA)? Are the concepts of growth and success surrogates? What problems are connected with different methods of analysing HG and HS SMEs? In the RA-analysis two independent regression models for growth and success were constructed. The former showed that age, branch of industry, growth in the number of personnel, innovativeness, location and profitability influenced the growth of the firms. In the regression equation the sign of age is negative but since the variable is logarithmic transformation the impact is positive. This means that older firms are growing faster. Both innovation and urban area location have positive influence on growth which presupposes better odds ratios for firms in urban area being innovative growing ventures. This is parallel with the assumptions of resource munificence and regional competitiveness theories (Almus, 2002; Covin and Slevin, 1998, Keeble, 1997; Ritsilä, 1999). Branch of industry dummy (other industries=0 and trade=1) and profitability factors have negative relationship with growth. This result proposes that firms within trade sector as well as ventures with higher profitability will have lower growth. Naturally the growth of the personnel is associated with higher growth of the turnover.

The RA-model for success indicated that the number of auxiliary business names, branch of industry growth in the number of personnel and

profitability, are all related to success. In the Success-model the amount of the auxiliary business names, growth of the number of personnel and branch of industry have negative influence on success. Lower success in the case of larger number of auxiliary business names could suggest that the ventures of portfolio entrepreneurs could be less successful than the other ventures. According to the results of RA-model for success increase in the number of personnel would mean lower success rate. Profitability factor will have a positive impact on success which is natural since success index includes also elements of profitability. Both firms in trade and transportation and communication sector seem to be less successful than the businesses in other industries.

Branch of industry, growth in the number of personnel and the profitability factor were the statistically significant variables in the regression models of both growth and success. It should be emphasised that the signs of the growth of the number of personnel and the profitability factor are different in growth and success models. Growth in the number of personnel seems to influence growth positively and success negatively, while profitability positively influences success and negatively influences growth. This could be interpreted so that when businesses grow fast and increase the number of employees they will suffer from lower profitability and success.

The results from the RA modelling suggest that growth and success are not the same phenomenon and, indeed, may even be inversely related in the context of growing SMEs. Thus, the findings support the suggestion that when analysing the growth of firms researchers should simultaneously consider their success (Davidsson et al, 2009; Sexton et al, 2000).

The explanatory variables for simultaneous high growth and high success, in both LRA- and DA-models, were the number of auxiliary business names and branch of industry. Variables that were not included in the LRA-model were growth in the number of personnel, while solvency was excluded from the DA-model. Overall, branch of industry and business size are factors that seems to be important for (and should be included and tested in future models of) combined high growth and high success.

The number of auxiliary business names, industry branch and solvency factor were statistically significant variables in the DA-model, and allowed the correct classification of almost two thirds (64%) of the firms. Prior to cross-validation, the model also included age as a statistically significant variable. The total correct classification rate of this model was 78%, demonstrating that skewness of the distribution distorts the results quite substantially and cross-validation improves the results.

Combined growth and success was analysed in the LRA, results of which showed that branch of industry, growth in the number of personnel, number of auxiliary business names, and liquidity factor differentiated high growth and high success firms from their non-high growth and non-high success counterparts. In LRA the overall correct classification rate without taking into account *a priori* probabilities was almost 80%, but the correct classification rate for the HG and HS businesses was only 27%. When *a priori* probabilities were taken into account the classification rate of HG and HS businesses improved to 65% and the model's overall correct classification rate was around 64%.

Regression analysis is not appropriate for analysing characteristics of HG and HS firms when time series analysis is not possible, because in the entrepreneurial market, growth and success are dynamic, hence there are likely to be substantial discontinuities in the data and uncertainties in the environmental factors. Moreover, the explanatory power of success models will probably be quite modest if their specifications meet all statistical requirements. Both discriminant and logistic regression analyses produce unsatisfactory results *if a priori* probabilities and skewness of the data are not taken into account, even if the statistical indicators of the fit of the resulting models and their characteristics are satisfactory. However, matched pair comparison improved the robustness of the models and both methods differentiate rather well HGS firms from the other businesses.

The objective of Article III was to examine the longitudinal development of five HGS Finnish firms before, during and after their HGS periods, in order to: identify factors that may affect growth, success and job creation; and characterise the development paths of high growth and highly successful SMEs. Based on the financial statement and annual figures for 2000 to 2009 it seems that growth and success (measured by profitability) seem to fluctuate substantially. However, during the HGS period the growth and profitability of the case firms followed parallel trends, declining or rising simultaneously, in accordance with findings by Cowling (2004).The case firms more than quadrupled their overall workforce in the 2000s and could be considered high impact (HIF) firms from the perspective of job creation (Acs et al., 2008).

Two different start-up categories were identified: family businesses and firms established by former classmates. Analysis of these cases demonstrated that start-up entrepreneurs with university backgrounds seek venture capital investments, but family businesses rely on internal sources and retained earnings. The family firms also followed a strategy of seeking profitability before growth (cf., Abetti, 2005). Moreover, all the case firms applied focused strategies that changed because of critical events (cf.,

Littunen and Virtanen, 2009; Smallbone et al., 1995), including changes in leadership and organisational structure. It should be emphasised that even if the strategies of the ventures focus on very niche markets they may be very successful in the international market. For example, one case firm (Blancco Oy Ltd.) concentrates on data erasure and is a globally leading company in this niche. Entrepreneurs cite subjective measures of success, including independence, professional pride, family values and external recognition as their major motives and incentives for their entrepreneurial careers. These findings support the suggestion by Achtenhagen et al. (2010) that entrepreneurs give several meanings for growth and success, including both traditional performance indicators and others.

The emphasis of the case SMEs is on customer needs and listening to customers. This finding is in line with the proposal by Barringer et al. (2005) that customer knowledge could be a useful new variable for analysing business practices. Sales organisation and distribution channels in international markets were seen to be the most important, especially for exports. This is consistent with findings by Chetty and Cambell-Hunt (2003), and it is not surprising since most sales of some case companies (e.g. Blancco Ltd) are generated in the international market. A resource-based view and direct impact of resources were also evident in some cases, and major future challenges perceived by the case firms are connected with management of growth and internationalisation. Therefore, their management should adopt an agile strategy and be prepared to delegate and share responsibilities.

Article IV addresses the following questions. What are the highly growing industrial branches in Eastern Finland? What characteristics distinguish firms in high-growing industrial branches from those in other branches, and what do these small firms require from regional innovation support services? In order to answer these questions the connections between innovation activity and high-growth were examined using three data sets, LRA and case study methods of analyses. The absolute and relative growth rates of firms representing diverse branches of industry were initially explored (using industry branch as a dependent variable in LRA), then the study focused on analysing one high-growth sector, KIBS firms.

Analysis of the national-level data showed that the service sector was the fastest growing branch of industry from 2002 to 2005 in Eastern Finland. LRA identified several factors that differentiate the service sector growth firms from companies in other sectors. Firms that were successful and highly-growing were over-represented (relative to a priori probabilities) in the service sector, as were firms that had several auxiliary business names, young or had received public R&D funding. More specific analysis of the

service sector showed that KIBS firms were very well represented in the set of rapidly growing firms. Therefore, fine-grained analysis of the service sector focused on the KIBS firms.

The results of the survey (n=213) showed that: the KIBS sector is relatively heterogeneous in terms of growth-targeted innovation activity, innovations were mainly incremental and imitation seemed to be the main competitive strategy of the KIBS firms. Of all respondents, 40% and 25% claimed that innovation had less than 10% impact and a marked influence (≥ 25%) on their firm's turnover growth, respectively. Enhancement of products or services, the implementation of new products or services and accessing new markets or marketing-related innovation increased the probability of KIBS firms being classified as innovation-driven growth companies by the LRA-model. Innovation-related partnerships and networking seem to have had only minor effects on KIBS businesses. This might be explained by the finding that small firms are less often engaged in innovation networks than large firms. Furthermore, the innovation partnerships that the KIBS businesses formed were primarily with other businesses; relationships with science and technology transfer organisations were rare. Thus, SMEs appear to make limited use of the full potential of the available regional innovation systems.

Results of the T-KIBS case studies (n=12) suggested that these firms simultaneously use diverse innovation services, including market-, finance-, technology- and internationalisation-related services. Market services, such as building distribution and retail networks, seem to be critical for selling products and services to end-users. Finance services were used primarily to obtain assistance with the funding of innovation projects organised by public and private organisations. Further, venture capitalists and business angels have been used by some of the firms. The firms that have experience of venture capitalists' inputs stressed that they would like the venture capitalists to play a more active role in supporting activities for daily business, especially development of internationalisation. The respondents also stated that the venture capitalists should ideally have more experience of their industry. The technology services required included mainly scientific and professional knowledge of technology. External knowledge resources seemed to have particularly major importance during the commercialisation of technology.

Internationalisation services played a vital role because the firms often produced highly differentiated products and/or services, and thus concentrated their activities in narrow market segments. Firms have to find international customers to secure their continued existence. However, internationalisation requires resources and limited knowledge-based

resources especially have caused challenges when going to international markets. Some other factors, such as low levels of manufacturing competence, product differentiation and information regarding international markets have been key deficiencies that firms have tried to address when using internationalisation services. T-KIBS firms emphasise that the basic infrastructure and facilities of these organisations are commonly regarded as being suitable for small high growth technology firms, but support services (privately and publicly provided) could still be improved. Overall, the services provided are sometimes too bureaucratic and inflexible to help firms successfully meet all the challenges they confront during commercialisation of their technologies.

4.2 Theoretical and practical contributions and implications

The contributions of the studies can be examined through the framework proposed by Edmonson and McManus (2007) for assessing contributions of empirical research projects from the following perspectives:

- How has the study advanced theory?
- What are the new ideas that contest conventional wisdom, challenge prior assumptions, integrate prior streams of research to produce a new model, or refine understanding of the investigated phenomena?
- What practical insights drawn from the findings can be suggested by the researcher?

The results indicate that the relationships between innovation, growth and success of SMEs have many dimensions. The Schumpeterian (size) hypothesis and hypotheses based on the resource-munificence, regional development (location), and life-cycle theories are not supported by the analysis of innovative growing SMEs. Gibrat's law that size is not correlated with growth is supported, but it should be remembered that the data set used to test it includes only SMEs. A possible contribution of the studies is the suggestion that innovative growing firms are financially less successful than their non-innovative counterparts, implying that in the short term success may be negatively related to innovation and growth. However, a positive correlation between innovativeness and growth was found, in accordance with suggestions that rapidly growing businesses with high productivity tend to be more IPR intensive than others (Coad and Rao, 2008). The results also indicate that public R&D funding increases the likelihood of an SME being rapidly growing and innovative, in line with the

finding by Santarelli and Piergiovanni (1996) that public R&D expenditure is positively correlated with the development of innovations and growth.

Regarding the methodological challenges that may arise when analysing the characteristics of HGS SMEs statistically, the following conclusions can be drawn from the studies. Regression analysis is not appropriate for analysing characteristics of HG and HS businesses when time series analysis is not possible. Moreover, skewed data distributions and *a priori* probabilities should be acknowledged to increase the validity and reliability of the results of studies focusing on innovative HGS firms. The reason for this is that in the entrepreneurial market, growth and success are dynamic, hence in most cases discontinuities will be present in data, the environment vague, and a holistic approach will be required (Bygrave, 2006). Both logistic regression and discriminant analysis produce unsatisfactory results if *a priori* probabilities are not taken into account. If we ignore *a priori* probabilities and skewness of the data we may obtain biased results, even if the statistical indicators of the fit of the resulting models and their characteristics seem to be satisfactory. Before using certain methods for analysing performance data, one should carefully investigate the characteristics of the data and be aware of the assumptions and aims of the selected analytical methods. Moreover, it is appropriate to use statistical procedures that take account of skewed data characteristics, uncertainty and the discontinuity of variables.

Regarding the kinds of factors may influence the development of HGS SMEs, the results indicate that ownership type may influence firms' prioritisation of growth and success. Family firms seem to rely on internal resources and retained earnings, concentrating first on achieving profitability before managing growth. In contrast, start-up entrepreneurs with university backgrounds appear to seek venture capital, use external resources and focus more strongly on achieving growth than family firm entrepreneurs. All the five HGS case firms have applied focused strategies that have changed because of some critical event connected with leadership and organisational structures. Focused strategies preceded their HGS periods and critical events have triggered strategic changes in them. In addition, even if they focus on very narrow niche markets they may be very successful in the international market. This suggests that performance may strongly depend on strategy choices (cf., Littunen and Virtanen, 2009; Roper, 1999; Smallbone et al., 1995).

Regarding ways in which innovation-driven high growth could be supported the results indicate that there are differences in requirements (and strategies) among branches of industry as well as among firms. Most rapidly growing firms were found in the service sector during the

examination period, 2002 to 2005. The results also show that the main strategy in the KIBS sector was imitation, and that innovation only partially explains the high-growth performance of given firms. Around 25% of the respondents estimated that innovation had had a marked influence on the turnover growth of their firms. It could be concluded that many kinds of innovation may be drivers of high growth. Enhancement of products or services, implementation of new products or services and accessing new markets or marketing-related innovation increased the likelihood of a firm in the KIBS sector being classified as an innovative high growth firm. These results indicate that many kinds of innovations may be linked to high growth, thus supporting organisations should acknowledge this by designing and exploiting diverse opportunities for supporting innovation-driven growth. Furthermore, innovation seems to only partially explain high growth, therefore the importance of other factors, associated to varying degrees with innovation, must be acknowledged to provide the full range of support services that firms require.

Regarding the enhancements to regional innovation support services that could be made to foster the growth of innovative ventures, to date they have commonly focused on facilitating technology development, transfer and protection, as well as providing basic business support services, including office infrastructure. However, current innovation support services do not seem to be designed for commercialisation of technologies, although the results indicate that entrepreneurs recognise that commercialisation is most vital when striving for high innovation-driven growth. Furthermore, the results indicate that the funding and innovation support services provided by the government are sometimes too bureaucratic and inflexible to rapidly react to the changing requirements of firms during the commercialisation process. Therefore, support services have to be more flexible to help small innovative firms to solve the problems they confront during their specific commercialisation processes. In addition, since knowledge-based resources (including scientific, technology transfer and technology commercialisation competence) seem to be rare within SMEs, the opportunities for SMEs to access relevant services of regional innovation systems provided by diverse stakeholders need to be improved.

Practical insights drawn from the results include the following:

- Allocation of resources to R&D has been an appropriate strategy for increasing the number of IPRs generated by growing SMEs
- Firms' growth and success should be investigated simultaneously
- Pragmatic modelling of HGS SMEs should be developed further

- Robust analyses of innovation, high growth and high success datasets require careful refinement of the data, accurate model specification and competent interpretation of the results
- Future studies should focus on periods longer than 3-5 years since the duration of HGS periods is uncertain,
- Possible uncertainties and discontinuities of variables have to be acknowledged
- When analysing HGS firms the fit of the assumptions underlying the applied methods with the research questions and data must be verified'
- A mixed method approach is needed to include behavioural and management issues, and their longitudinal effects and meanings, in the analysis
- The dominant logic of creating and profiting from innovation are vital elements when creating efficient and effective support initiatives that may foster innovation driven high-growth

Implications of the results are important for policy makers since they show that the allocation of resources to R&D is an appropriate strategy for increasing the amount of IPRs of growing SMEs. Moreover, venture capitalists and business angels should consider the time frames of their investments if they want to take advantage of the introduction of innovation (e.g. IPRs), they should be patient and wait for the benefits of commercial exploitation. The contribution and main implications for SME owners and family businesses are that firms should first have the patience to take care of profitability and thereafter strive for growth. Focused strategy may ensure more effective concentration on core activities and thus generate a more profitable outcome. For the educators and researchers the implication is that the heterogeneity of branches of industry, types of businesses and discontinuities should be taken into account when formulating programmes and planning studies about SME performance. Moreover, when trying to influence on profiting from innovation paradox regional innovation support services should focus more on commercialisation of technologies in order to foster growth of innovative ventures.

4.3 Limitations

The findings of the studies need to be reviewed critically in the light of their limitations, which include the use of small, skewed and cross-sectional longitudinal IHGS SME datasets. The results cannot be directly generalised to a whole firm population since SMEs have been selected from the

population of firms that were growing in Helsinki region and Eastern Finland in 2002-2005. Thus, comparing the results with those of studies of sets of firms that included declining firms is not straightforward. Furthermore, the definitions of key concepts (innovation, high growth and high success) applied may limit international comparison of the results. These limitations could be avoided in future studies by using larger national and comparative international research samples and acknowledging the methodological problems of defining and measuring innovation, growth and success of SMEs in diverse contexts.

Both limitations and strengths of the mixed method approach include the diverse research scope it allows. A broader set of behavioural, management and innovation activity issues could be included in future studies of the selected (and other) SMEs. While strategic behaviour and management issues were explored to some extent in the case studies, several neglected aspects may also influence innovation, growth and success. These include: open innovations, diverse business models, corporate governance, institutional influences, dynamic capabilities and knowledge systems, all of which should be included in future studies.

Finally, it should be noted that the limitations of the study should be seen in the context of prior understanding and theory related to the addressed research questions. As Bygrave (2006) pointed out, entrepreneurship research is still an emerging paradigm, there are few relevant theoretical models, and more empirically derived models and theories of entrepreneurship are required. Indeed, some aspects of the field are still in a pre-theory stage, despite the long history of discussion focused on these themes independently in economics. Therefore, design quality, interpretative rigour and legitimation should be examined, as components of validity in mixed method research, in relation to existing theoretical understanding and empirical research (Edmunson and McManus, pp. 1156, 2007).

4.4 Avenues for future research

Several possible avenues for future research could be elaborated. The concepts of combined views of innovation, high growth and high success could be developed further by focusing on specific branches of industries and/or using larger samples and international comparative data. Methodological aspects and data will continue to be important in future studies. Longitudinal data provide opportunities for time series analysis and analysis of business changes, development paths and tracks of ventures and their entrepreneurs. More in-depth information is needed on firms'

strategic entrepreneurship, behavioural aspects and innovative growth processes. In addition, from the perspectives of regional development and growth policy initiatives it seems to be important to explore the roles of business models and open innovations for fostering the innovation, growth and success of SMEs. Finally, other factors that may contribute to the high growth and high success of SMEs need to be identified and characterised.

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Appendixes

Overview:

Appendix 1: Key definitions used in the studies
Appendix 2: Construction of the success index used in the studies (source: Balanced Consulting Ltd)
Appendix 3: Firm population and workforce characteristics of Finland, Eastern Finland and the Helsinki Region during 2002-2005

Article I:

Appendix 1: Corporate population characteristics of Finland, Eastern Finland and the Helsinki region in 2002-2005
Appendix 2: Scoring table of SI and Success Index
Appendix 3: Distribution of personnel (%) by branch of industry in Eastern Finland and the Helsinki region during 2002-2005

Article II:

Appendix 1: Characteristics of different methods
Appendix 2: Success index
Appendix 3: Variables used in regression equations

Article III:

Appendix 1: Characteristics of case firms
Appendix 2: Scoring table of SI
Appendix 3: Characteristics of variables of case firms

Article IV:

Appendix 1: Variables used in regression equations
Appendix 2: Background information on the interviewees and the firms

Appendix 1 Key definitions used in the studies

Key concepts in this dissertation are innovation, high growth, high success, SME and definitions of rural and urban areas. These key concepts, as used here, are defined as follows:

Innovation

Two contrasting definitions of innovations have been used. In Articles I and II the focus was on innovation inputs, hence intellectual property rights (IPRs), such as patents, utility models, registered designs and trademarks, were used as proxies for innovation and innovative activities of the studied firms. The IPRs were used as proxies because relevant data (broken down into very detailed technological sectors) are available for many countries. This information allows the most precise and reliable classification of innovation and R&D activities, commercial inputs and technological outputs in diverse branches of industry (Archibugi, 1988). Previous innovation investigations that have used IPRs have mainly used patents in focused branches of industries. In Articles I, II and IV broader definitions of IPRs have been applied and their inputs and outputs in all branches of industries have been explored. The possible problems associated with comparisons of innovation and R&D activities in different branches of industry have been decreased, as far as possible, by following recommendations in the OECD (2005) Oslo Manual and using broad definitions of IPRs. It should be emphasised that both the strength and weaknesses of this definition of innovation are based on its narrow and highly focused scope.

The second definition of innovation follows West and Farr's (1990) broad definition of the term innovation, which was applied in Article IV. According to this definition, innovation is understood as "the intentional introduction and application within a role, group or organisation of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group, organisation or wider society". West and Farr's definition of innovation both widens the perspective and is in line with the OECD (2005) Oslo Manual definition of innovation, which emphasises the diversity of innovation, including product-, process-, organizational- and market-innovations and wider stakeholder influences of innovation. It should be noted that both the strength and problems of this definition of innovation are based on its broad and highly fragmented (subjective) view of innovation. In addition, in Article III entrepreneurs defined the concept of innovation and raised possible meanings of innovation in relation to their business development.

High growth

When examining growth from the economic perspective (Weitzman, 1996) the analysis level used is a firm (organization). However, there is no single, universally agreed definition of the growth of a firm (organization), or agreed measure of growth. From the economic, owner's and managerial perspectives the growth of a firm is usually seen as a defined change in business size during the timespan under examination and the primary focus is on output indicators of growth. Longitudinal data have been used in several previous cross-sectional growth studies, but the timespans usually considered have been 3-5 years (Delmar, 1997). In the studies this dissertation is based upon the growth of a firm is based on the most widely used empirical growth indicator in the field of entrepreneurship and small business research; sales turnover growth of the firm (Murphy et al., 1996). However, other definitions have been applied in some of the analyses, for example, Eurostat-OECD (2007) growth definitions, which are based on both input and output parameters of firm growth, such as changes in numbers of employees as well as changes in sales turnover. From the social and socio-economic policy points of view this kind of definition (and measurement) of growth is highly important and understandable. In prior growth studies both sales and employment growth have been used, separately or simultaneously, and some studies have even combined these aspects for example by using specific indexes such as the Birch Index (Birch, 1987).

Prior empirical high growth studies (Acs et al., 2008; Almus, 2002; Autio et al., 2000; Birch, 1979; Barringer et al., 2005; Bhide, 2000; Deschryvere 2008; Markman and Gartner, 2002; Parker et al., 2010) have confirmed that a very small proportion of growing firms creates most new value and jobs in markets and societies. Therefore, it is important to define the concept of high growth firm in order to identify, differentiate, analyse, understand and support these kinds of high performance firms and their entrepreneurs. In this dissertation, and the studies it is based upon, a high growth firm is defined following Parker et al. (2010), as a firm with at least 10 employees initially that increases sales turnover by at least 20% per year, on average, over at least three years. This definition of a high-growth firm has been applied in appended articles II, III and IV. However, in the analyses of the effects of the size of firms in relation to branch of industry, and the case studies presented in Article IV, data for some firms with less than 10 employees (micro-firms) have also been used.

High success

In spite of the large numbers of studies of small- and medium sized enterprises that have focused especially on growth businesses, there have been few simultaneous analyses of profitability, which could be used as a measure of success (Davidsson et al., 2009). Previous performance studies have highlighted the multidimensionality of the success concept (Kirby, 2005), and several definitions of success have been applied (Capon et al, 1990), but at the moment there is no single universally agreed definition of success in the field of entrepreneurship and small business research. Furthermore, success has even been seen as a parallel phenomenon with growth (Birley and Weshead, 1990) in prior entrepreneurship and small business studies. The most frequently used parameters of success in previous studies of the performance of small businesses are quantifiable indicators of financial success, such as sales, revenue and profitability measures or non-financial measures such as employment or market share growth, firms' learning processes and the degree to which firms meet defined expectations or subjective assessments of success, and survival (Capon et al., 1990; Murphy et al., 1996; Pasanen, 2003; Stuart and Abetti, 1987).

Kiviluoto et al. (2011) emphasise that defining and analysing firms' success within entrepreneurship research are complex, unresolved problems, with inconclusive results, partly because studies on the growth, profitability and performance of privately owned SMEs are extremely rare. Further, the scarce use of profitability measures may be due to financial data for small firms not always being readily available (Kiviluoto et al., 2011). Financial success has been mainly used as a supposedly objective measure of success in prior empirical studies, although in practice indirect measures of the entrepreneurs' experience of success appear to have been used most frequently (Stuart and Abetti, 1987). However, even though financial success seems to be a biased and narrow view of the success of firms it is focused and represents the most precise, comparative, objective and reliable indicator of success in diverse branches of industry and of small firms' success.

In this dissertation and the studies it is based upon a financial success index (SI) is used as a proxy for the success of the studied firms. This success index provides a broader view of financial success than the profitability used in previous empirical entrepreneurship and small business studies (Kiviluoto et al., 2011), which is important because in order to determine financial success holistically, not only profitability, but also other aspects such as capital structure and liquidity of the firm should be taken into account. As Altman (1968) has emphasized, business

profitability, liquidity and solvency collectively are the most relevant financial predictors of financial success and problems of a firm. Another reason for using the SI index is its fit with the databases used in the studies provided by Balanced Consulting Ltd. A highly successful firm is defined using the SI index as one scoring at least 70 points out of 100 annually for at least three consecutive years. The success index of firms follows a normal distribution, with around 15.6% of the firm population scoring at least 70 SI points, around 65 % scoring 30 to 69 SI points, and 17.6 % scoring less than 30 SI points (Source: Success of firms in provinces of Finland database; Balance Consulting Ltd. 2007). The fine-grained content and construction of the success index is defined in Appendix 2. The success index has been applied in Articles I, II and IV. In addition, subjective meanings of success raised by entrepreneurs themselves are cited and applied in Articles III and IV.

Appendix 1 Continued (Key definitions used in the studies)

The definition of small and medium sized enterprises (SMEs) used in the studies is based on the following European Commission criteria for small and medium sized firms (organizations): average workforce < 250 persons, annual turnover ≤ 50 million (euro), balance sheet (asset and capital total values) ≤ 43 million (euro) and capital ownership or voting rights held outside of the organization ≤ 25 % (Table A1).

Table A1: European Commission definitions of Small and medium-sized enterprises (SMEs) (Source: European Commission Recommendation 2003/361/EC of 6 May 2003)

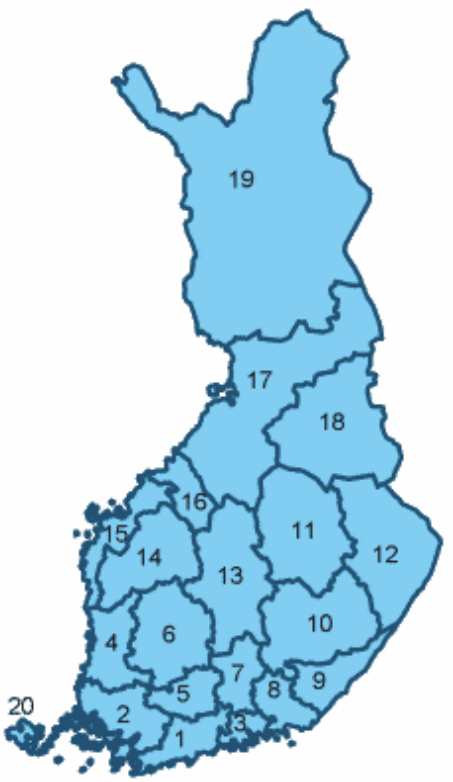
Enterprise category	Headcount	Turnover	Balance sheet total
Medium-sized	< 250	≤ € 50 million	≤ € 43 million
Small	< 50	≤ € 10 million	≤ € 10 million
Micro	< 10	≤ € 2 million	≤ € 2 million

In Finland around 5.3% of all enterprises are small or medium sized (Statistics Finland, 2011). Further, if micro firms are included these firms account for 99.8% of firms and the share of large firm is around 0.2%. According to the European Commission (2011) micro, small and medium sized firms comprise around 99% of the total firm population in European countries. Currently, up to 23 million enterprises in the EU fall within the definitions of micro-, small and medium-sized enterprises. Moreover, these enterprises provide around 90 million jobs and contribute strongly to entrepreneurship and innovation. Moreover, these enterprises provide around 90 million jobs and contribute strongly to entrepreneurship and innovation. It should be noted that there are country-based differences in definition of SMEs For instance, in the US and Japan they are defined as enterprises with < 500 persons and < 300 persons, respectively (sources: European Commission 2005, definition

of SME; European Commission 2009, Working document on the implementation of Commission recommendation of 6 May 2003 concerning the definition of SME).

Appendix 1 Continued (Key definitions used in the studies)

The Nomenclature of Finnish Territorial Units for Statistics (NUTS) criteria



1. Uusimaa (Helsinki Region)
2. South-West Finland
3. Itä-Uusimaa
4. Satakunta
5. Häme
6. Tampere Region
7. Päijät Häme
8. Kymenlaakso
9. South Karelia
10. Southern Savo (Eastern Finland)
11. Northern Savo (Eastern Finland)
12. North Carelia (Eastern Finland)
13. Central Finland
14. South Ostrobotnia
15. Ostrobotnia
16. Central Ostrobotnia
17. Northern Ostrobotnia
18. Kainuu (Eastern Finland)
19. Lapland
20. Åland

Figure 1: Regions of Finland (Source: Regional Councils of Finland, (Http://www.reg.fi))

The data analysed in the studies this dissertation is based upon pertain to firms in two Finnish regions, Eastern Finland (rural) and the Helsinki region (urban). The definitions of rural and urban areas are based on Eurostat NUTS population density criteria (Http://ec.europa.eu./eurostat/Ramon/nuts/introduction_regions_en.html). Eastern Finland includes the regions Etelä-Savo, Kainuu, Pohjois-Karjala and Pohjois-Savo, which have a population density of slightly less than 8 inhabitants per km² (NUTS classification FI13; rural areas). The Helsinki region includes the capital city of Finland and has a population density of around 222 inhabitants per km² (NUTS FI181; urban area).

According to Eurostat, at the local level (NUTS 5), a rural community is defined as an area with a population density of less than 150 inhabitants per km^2. At a regional level (NUTS 3), a community is classified as significantly rural if 15% to 50% of the population live in rural areas, and as predominantly urban if less than 15% of the population live in rural areas. Thus, in this study, the Helsinki region was classified as an urban area and Eastern Finland as a rural area (**Appendix 3**, Firm population and workforce characteristics of Finland, Eastern Finland and the Helsinki Region during 2002-2005).

Appendix 2 Construction of the Success Index (Source: Balanced Consulting Ltd.)

Success index

The measure of firms' financial success used in the studies is the success index (SI) developed by Balanced Consulting Ltd. The reasons for using this index are that it fits the database provided by Balanced Consulting Ltd. and takes into account other important aspects, such as capital structure and liquidity, which should be considered in a holistic analysis of financial success in addition to profitability.

Content and construction of the success index

Firms are classified in 10 SI categories based on parameters listed in financial statements of the firms after adjustment following instructions of the International Accounting Standards of Financial Statements (IAS) and Finnish Advisory Board of Corporate Analysis (YTN), to: a) avoid effects of random capital gains distorting annual growth and success classifications, b) increase the reliability of comparisons across different branches of industry, and c) obtain a more holistic view of the financial success at the firm level.

The following variables are used in constructing the SI: return on investment, earnings before taxes, current ratio, equity ratio, net gearing, repayment period of liabilities and business growth. The selected financial figures are not dependent on the branch of industry. Each of the financial parameters is scored in values ranging from 0 to 10 points (Table 1).

Table 1. Scoring table of the success index

Classification points Parameters	1	2	3	4	5	6	7	8	9	10
Return on investment (%)	-1.9	0	1.8	2.7	5.8	8.9	13	16.4	21.9	27.4
Earnings before taxes (%)	-6.3	-4.7	-3.1	-1.8	-0.5	0.5	2	3.6	5.2	6.7
Current ratio	0.7	0.9	1	1.1	1.3	1.5	1.7	2	2.2	2.5
Equity ratio (%)	0	7	11	15	22	30	38	45	51	57
Net gearing (%)	785	536	411	287	191	94	58	21	0	-12
Repayment period (years)	100	60	40	20	12	5	3	1	0.5	0

The overall success index of a firm is obtained by summing its classification points for each parameter and multiplying by 100/60, hence the SI is a relative value ranging from 0 to 100.

The key parameters have been calculated using the following formulas:

Return on investment (%)

= 100 x earnings after interest + cost of finance (12 months) / average return on investment (accounting period)

Earnings before taxes (%)

= 100 x earnings after interest / turnover

Current ratio

= Inventories + short term receivables + liquid assets / short term debts

Equity ratio

= 100 x equity + voluntary provision + minority share / total sum of balanced sheet + advance payment

Net gearing (%)

= 100 x debt with interest charges – liquid assets / equity + voluntary provision + minority share

Repayment period (years)

= debt with interest charges – liquid assets / earnings after interest – taxes + depreciation (12 months)

Appendix 2 Continued (Construction of the Success Index: source, Balanced Consulting Ltd.)

Table 2 SI classifications and proportions of firms.

SI points	Classification	Proportion of firms (%)
0 – 9	D	1.9
10 – 19	C-	6.2
20 – 29	C	11.4
30 – 39	C+	14.1
40 – 49	B-	17.3
50 – 59	B	17.8
60 – 69	B+	15.8
70 – 79	A-	11.5
80 – 89	A	3.9
90 – 100	A+	0.2

The success classifications follow a normal distribution (Figure 1). The success index ranges between 0-100 points, and a firm scoring ≥ 70 points is classified as a highly successful (category A) firm. Around 2/3 of the total firm population is classified between 30-70 points (C- and B-category businesses).

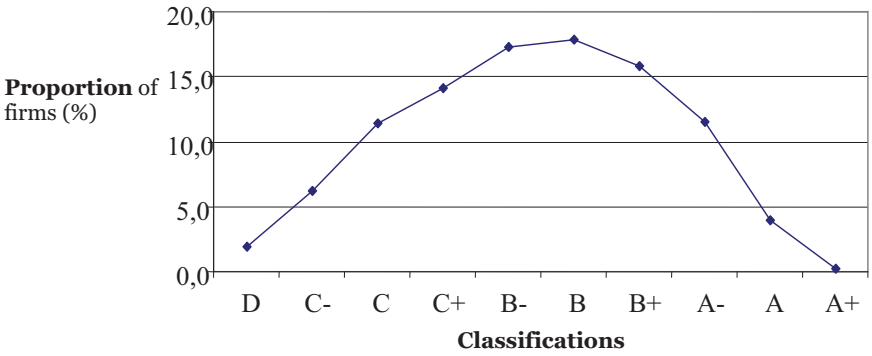


Figure 1. Distribution of SI scores, which take into account cyclical fluctuations (thus longitudinal firm-level comparisons of SI are not valid). During the study period 2002 – 2005 the table of classification points was not changed.

Appendix 3

Firm population and workforce characteristics of Finland, Eastern Finland and the Helsinki Region during 2002-2005

Finland is one of the most rural of the OECD countries; ranking fifth in terms of the proportion of territory covered by predominantly rural regions (89%) and second in terms of both the proportion of the country's population they host (53% of a total population of around 5.3 million) and proportion of GDP (gross domestic production) produced within these regions (45%) (Rural Policy Reviews: Finland, OECD 2008).

Finland is strongly characterized as rural and peripheral both from the European and national point of view. The differences, relative to EU-25 countries, are obvious in all regions. Based on Eurostat regional definitions (NUTS criteria) almost 93% of Finland's land area is classified as predominantly rural, only 5% as intermediately rural and 2% as predominantly urban. The only predominantly urban region is the Helsinki region (which includes the capital city of Finland). (Source: Rural development in the European Union – Statistical and Economic information – Report 2007).

Jussila and Malinen (1993) note that rural areas in Finland differ from the Western European countryside in three major respects: the population density is much lower, the logistical distances are much longer and the climate is colder (thus natural conditions, for agriculture for example, are very challenging).

Nationally, the rural territory in Finland is heterogeneous along two dimensions; the populations in Eastern and Northern regions are more scattered and higher proportions of people live in rural municipalities than in Southern and Western regions. Eastern and Northern parts of Finland are the most sparsely inhabited regions in Europe, with less than 8 inhabitants per km^2 (while the average population density in Finland is 17.3 inhabitants per km^2). Furthermore, Eastern and Northern parts of the country are characterised by high unemployment rates and negative net migration, which has resulted in further reductions in the population density and ageing of the population. In addition, concentration of development generally occurs when people move from remote areas to regional centres. (EU Fourth Cohesion Report 2007).

The Helsinki region hosts twice as many people as Eastern Finland in an area that is an eighth of the size, implying that there are more market opportunities, larger markets and more opportunities for firms to exploit human resources. Furthermore, the private sector workforce is almost three times greater in the Helsinki region, but the total available workforce has

not increased compared to Eastern Finland. The firm population density in the Helsinki region is 14 times higher than in Eastern Finland, and the relative growth of the total firm population has been higher in the Helsinki area. Furthermore, R&D investments are higher in the Helsinki region, implying that it is more favourable for the creation of innovations and innovation-driven growth of firms (See Table 1).

Nearly every high growth SME (around 95%) in both Eastern Finland (rural area) and the Helsinki region (urban area) are located in towns, municipality centres or close neighbourhoods. In terms of industry branches, Eastern Finland is heavily reliant on manufacturing (around a third of private sector employees work in manufacturing in this region). The manufacturing sector is also important for employment in the Helsinki region. However, it is one of the industry branches where employment decreased most strongly during the study period, in both areas. The other sectors in which employment declined during the study period in both areas include transportation, storage and telecommunications. In contrast, contributions to total private sector employment made by branches of industries such as wholesale and trade, construction, health and social work, real estate, renting and other business activities increased in both areas during the study period.

Appendix 3 (Continued)

Firm population and workforce characteristics of Finland, Eastern Finland and the Helsinki Region during 2002-2005

Table 1. Regional characteristics of Finland, Eastern Finland and the Helsinki Region in 2002-2005.

Regional characteristics	**Finland**	**Eastern Finland** (Classified as Rural area; Eurostat NUTS criteria)	**Helsinki Region** (Classified as Urban area; Eurostat NUTS criteria)
Population	*5 246 000*	*664 000*	*1 350 000*
Area	*390 920 km²*	*85 200 km²*	*10 559 km²*
Population density	*17.3 inhabitants / km²*	*7.8 inhabitants / km²*	*222.6 inhabitants / km²*
Average age of population	*40.5 years*	*42.2 years*	*38.0 years*
Total private sector workforce	*1 328 451*	*153 416*	*455 461*
Change in total workforce during 2002-2005	*1.0%*	*3.0%*	*0%*
Average unemployment rate during 2002-2005	*8.8%*	*12.5%*	*6.2%*
Total number of firms	*236 435*	*35 056*	*73 573*
Change in number of firms during 2002-2005	*4.3%*	*2.7%*	*5.4%*
Firm population density	*0.6 firm/ km²*	*0.4 firm / km²*	*7 firm / km²*
Locations of firms	*Around 60% of firms located in towns and 40% in countryside*	*Around 70% of firms located in towns and 30% in sparsely populated areas*	*93% of firms located in towns and 7% in municipalities*
Number of SMEs (size 10-249 employees)	*15 672*	*2 348*	*4929*
Number of continuously growing (> 10%) SMEs	*595*	*86*	*262*
Proportion of continuously growing SMEs of total SME population	*3.8%*	*3.6%*	*5.3%*
Total R&D costs including private and government R&D funding	*5648 million USD*	*Total area R&D costs around half the national average (1077 USD/ inhabitant) per region*	*Total area R&D costs over 42 % of total national R&D costs*
GDP (EU average 100)	Below** EU average (GDP classification group 100 – 119) during study period 2002-2005	Under EU average (GDP classification group 80-99) during study period 2002-2005	Above EU average (GDP classification group 120 –) during study period 2002-2005

(Table 1. Sources: OECD 2008; Rural Policy Reviews. Finland; Regional Councils of Finland, (Http://www.reg.fi); Statistics Finland, Business Register (http://www.stat.fi), Statistical Yearbooks of Finland 2004; 2005; 2006; 2007; Suomen Asiakastieto oy Voitto+ CD-ROM, 2006)

PART 2: ARTICLES

I

Heimonen, T. (2012). What are the factors that affect innovation in growing SMEs? European Journal of Innovation Management, Vol. 15, Issue 1, pp. 122-144.

WHICH FACTORS AFFECT THE INNOVATIVENESS OF GROWING SMEs?

Abstract

Purpose – The purpose of this paper is to find out which factors affect the innovativeness of growing small and medium- sized firms (SMEs). Intellectual property rights (IPRs) are used as a proxy for innovations. The IPRs used include patents, trademarks, utility models and registered designs.
Design/methodology/approach – A theoretical model was developed and tested on longitudinal sample data consisting of 348 continuously growing SMEs that were located in two diverse regions in Finland. The firms in the sample represented various industries. Logistic regression analysis was used to analyse the data.
Findings – About 8%of the firms in the sample could be defined as innovative growth SMEs. Most of these firms belong to the branches of services and manufacturing. These businesses are small in size, employing 10-49 people, and their age range is 5–19 years. These firms are less likely to be successful in the short run. The results of the study seem to respond to the expected preconception that IPR-intensive growth firms may confront more financial pressures than those without IPRs. Public R&D funding seems to increase the probability of innovations.
Practical implications – From the policy perspective the allocation of resources to R&D has been an appropriate strategy to increase the amount of IPRs within growth SMEs.
Originality/value – The paper is one of the few attempts to explore the factors affecting the innovativeness of growing SMEs.
Keywords – IPRs, growth, success, location, R&D funding, Finland
Paper type – Research paper

1. Introduction

In entrepreneurship and management studies the innovativeness of growing firms has been discovered to be important in value and job creation (Acs et al., 2008; Autio, 2009; Autio and Hoeltzl, 2008; Bhide, 2000; Birch, 1979; Delmar et al., 2003; Deschryvere, 2008; Henrekson and Johansson, 2008; Parker et al., 2010; Storey, 1994). It is stated that innovations do not arise randomly but are the results of intentional and systematic processes (Barringer et al., 2005; Teece, 1986; Markides, 1998; Santarelli and Piergiovanni, 1996; Thornhill, 2006; von Hippel, 1982). The capability to create, transfer and exploit innovations is thought to have a positive impact in different regions and economies (Fontes, 1997; Kuratko and Hodgetts, 2001; North and Smallbone, 2000; Storey, 1994). The main idea behind these studies is that innovativeness and growth are positively correlated.

There is a lack of studies that have examined simultaneous innovativeness and growth longidutinally. It is a widely accepted view that urban areas have higher performance and more original innovations than pheriperal regions. Some empirical studies have shown that the operation environment of the firm moderates the relationship between sales growth rate and executives'

propensity for risk taking (Covin and Slevin, 1998). There is some empirical evidence that an increase in annual sales growth may boost the propensity to create innovations from patents, too (Arundel and Kabla, 1998). These findings could indicate that location may affect the innovativeness of the growing firm.

The relationship between size, innovations and performance has long been debated in former studies. Many empirical studies test Schumpeterian hypothesis that large firms tend to have a resource advantage to develop and commercialize new technology compared with small ones. Small firms are widely regarded as promoters of economic growth (Westhead and Storey, 1994). These firms are considered to be capable of creating, transferring and exploiting innovations (Autio, 1998; Fontes, 1997; Kuratko and Hodgetts, 2001). In addition, it is believed that innovative growth-oriented small firms have a strong positive effect on employment (Storey, 1994). However, prior empirical studies have focused mainly quantitatively on innovations in large firms (Gudmunson et al., 2003; Woodcock et al., 2000). Only a few studies have investigated the IPRs and research and development (R&D) activities of growth SMEs (Autio, 2009).

Life-cycle theories link age to the innovation activity and growth characteristics of the firm. Basic assumption of the life-cycle theories is that the development of new and young firms is based on innovation (Churchill, 2000; Daviddson and Delmar, 1997; Scott and Bruce, 1987). The life-cycle theories also include the connection between age and size referred to as liabilities of 'smallness' and 'inexperience' (Wright et al., 2007). This could imply that both age and size have an influence on innovativeness of growing firms.

The impact of innovations on economic performance is highly uncertain (Bhide, 2000; Coad and Rao, 2008). Risky behaviour including both growth and R&D activities simultaneously may lead to high variance in short-term income (Bhide, 2000). These arguments and prior empirical findings emphasize that financial success may affect innovativeness. Firms might experience even more financial challenges or pressures during their simultaneous IPR efforts and high growth period than other firms since the generation of both IPRs and high growth require plenty of resources (Markides, 1998; Moskowitz and Vissing-Jørgensen, 2002).

Public research and development funding is one of the most influential instruments for supporting and increasing innovation and the generation of intellectual property rights in firms (Santarelli and Piergiovanni, 1996). Based on this statement and empirical finding it could be argued that public R&D funding also has a positive influence on the overall development of growing firms.

This study contributes to the prevailing discussions by analysing the factors that affect the innovativeness of growing SMEs. The following questions are examined:

1. How does location affect innovativeness?
2. What is the impact of firm size and age on innovativeness?
3. How does success affect innovativeness?
4. What is the impact of public R&D funding on innovativeness?

Since there is no all-embracing or clear-cut theory base (Gibb and Davies, 1990; Storey, 1994) for example, the resource-munificence, regional competitiveness and life-cycle theories are used to build the framework. In addition to these theories former empirical studies on innovations, growth and performance are used to support the derivation of hypotheses.

In order to answer these questions five hypothesis are derived and tested using logistic regression analysis. IPRs are used as a proxy of innovations since they could be seen as an objective measure for innovative activity (McGahan and Silverman, 2001). The paper proceeds as follows: first I will examine some former studies from which the research questions and hypothesis are derived; thereafter, the data and methodology will be explained; then the results will be analysed and interpreted; and finally the conclusions and implications will be presented together with the limitations of the study.

2. Former studies and derivation of the hypotheses

2.1 Location, branch of industry and innovation activities

Some studies emphasize the regional differences in the innovations and performance of a firm (Almus, 2002; Audretsch, 1995; Covin et al., 1999; Hoogstra and Van Dijk, 2004; Hölzl, 2009; Keeble, 1997; Mendonca et al., 2004; Vaessen and Keeble, 1995). However, relatively little or no regional differences in innovation activities and performance were discovered by Littunen and Tohmo (2003) or by North and Smallbone (2000).

According to the resource–munificence and regional competitiveness theories it is believed that urban areas have higher performance and more original innovations than peripheral regions (Covin and Slevin, 1998; Keeble, 1997; Ritsilä, 1999). Mendonca et al., (2004) discovered country-based differences in producing and exploiting IPRs in European countries. Keeble (1997) and Ritsilä (1999) found national innovation and performance diversity in different regions.

It could be argued that locational diversity would create diverse opportunities to innovate and to exploit the innovations. The prior discussion about R&D activities, performance and regional development has pointed out the role of context and its specific structural and situational characteristics. One fallacy comes from the genre of venture capital research where innovation activities are usually seen as typical characteristics of those businesses backed by venture capital. However, the share of those companies that succeed in receiving venture capital is very low (2-5 %) and regional distribution is biased to the most developed regions, usually defined as urban areas. This could lead to a conclusion that the location of the firm may have an impact on the probability of being an innovative SME.

Previous studies (Smallbone et al., 1995; Vaessen and Keeble, 1995) have raised the influence of the branch of industry on regional innovation activities and performance outcomes. Brouwer and Kleinknecht (1999) found that the branches of industries such as manufacturing with high-tech potential tend to have a higher propensity to patent than the other sectors. Nelson and Winter (1977) pointed out that the underlying knowledge conditions and the development phase vary from branch to branch. According to Thornhill (2006), innovation is more common when industry dynamism is high, and innovative firms are likely to enjoy revenue growth, irrespective of the industry in which they operate.

Arundel and Kabla (1998) state that patents may be a poor measure of innovations in branches of industry where IPR activity is low or the quality of R&D outputs is mainly incremental since the large majority of R&D results are not patented. These sectors include for example food, tobacco, petroleum refining and basic metal industries. On the other hand, the amount of patents may be a

good measure of IPR activity in metal products and motor vehicles, car and motor industries where firms clearly show an above-average propensity to introduce product and process innovations (Huergo and Jaumandreu, 2004). In this study, branch of industry will be analysed through univariate statistics because of the small amount of observations in some branches of industry (Table 1). Thus, based on the assumptions of resource–munificence and regional competitiveness theories, it is believed that firms in urban areas produce more IPRs than their counterparts in rural areas. This leads to the following hypothesis:

H1.Firm location has an impact on the innovation activity (IPRs) of growing SMEs.

2.2 Size, age and innovativeness

The relationships between size, age, innovations and performance of a firm have long been debated in innovation and growth studies. Many empirical studies test the Schumpeterian hypothesis that large firms tend to have a resource advantage to exploit new technology compared with small ones (Acs and Audretsch, 1988; Battacharya and Bloch, 2004; Cohen, 1995; Freeman and Soete, 1997; Santarelli and Piergiovanni, 1996; Tether, 1998). Bouwer and Kleinknecht (1999) confirmed that large firms have a greater probability of seeking patent protection. Kohn and Scott (1982) showed that a relatively strong resource base of R&D inputs does not necessarily imply the existence of scale economies in producing innovative output. Small firms are often structurally less complex or have less hierarchical organizations and management, and thus they may have more flexibility and time advantages in adjusting their resources.

Tether (1998) found that the average value of innovations varied systematically with the size of the firm. Large enterprises were responsible for almost all the high-value innovations, whilst most of the lower-value innovations were introduced by small businesses. Nelson (1993) proposed that new and small firms have introduced extremely high- value R&D outputs, too. There is some evidence that the propensity to create innovations from patents increases with the firm's annual sales growth (Arundel and Kabla, 1998). This finding links the size, innovations and growth of the firm.

In prior studies, the size of the firm and its connection to growth, have been tested separately by applying the Gibrat's law of proportionate growth. Gibrat's law assumes that size is not correlated with growth and that growth follows a random walk. However, the results of numerous empirical studies suggest that firm growth decreases with the size of the firm (Almus and Nerlinger, 2000). Based on the assumption that the propensity to create innovations from patents increases with the

firm's annual sales growth (Arundel and Kabla, 1998), the second hypothesis is concluded as follows:

H2. Firm size has an impact on the innovation activity (IPRs) of growing SMEs.

Life-cycle theories link age to the innovation activity and growth characteristics of the firm (Churchill, 2000; Scott and Bruce, 1987). Life-cycle theories emphasize that firms are expected to develop through diverse development stages during their lifetime. The development of new firms at the start-up stage may be based on innovation whereas more mature firms are supposed to reach more plateau or even declining periods after growth stages. This could imply that more mature firms are supposed to produce decreasing amount of IPRs if growth and innovations have a direct parallel relationship.

Calvo (2006) analysed whether small, young and innovating firms experienced greater employment growth than other Spanish firms over the period of 1990-2000. The results showed that old firms grow less than young ones and both new products and new processes stimulate survival and employment growth independently of the age of the firm. Davidsson and Delmar (1997) referred to these empirical findings connecting the age and growth of businesses. They discovered that organic growth constitutes 58 to 96% of the total business growth in the firms less than 10 years old and only 16% of the total growth among older firms.

However, many mature firms seem to remain highly innovative, representing superb performance in markets (Huergo and Jaumandreu, 2004). It could be argued that the role of high performance in mature businesses can give us new insights into the process of techno-economic change and entrepreneurial functions of developmental activities and IPRs. The hypothesis derived for the age of the firm is:

H3. Firm age has an impact on the innovation activity (IPRs) of growing SMEs.

2.3 Success and innovativeness

The empirical evidence of the relationship between innovations and performance seems to be mixed. Some studies emphasise the positive relationships between the innovations and the growth of the firm. These studies usually bring to attention the creative activities and the role of R&D investments and public R&D funding as positive stimulating indicators to the overall growth, success and survival of a firm (Branzei and Vertinsky, 2006; Calvo, 2006; Fabling and Grimes, 2007; Freel and

Robson, 2004; Hölzl, 2009 ; Koellinger, 2008; Roper, 1997; Thornhill, 2006; Thornhill and Gellatly, 2005).

However, several empirical studies have impugned or pointed out the complex nature of the relationship between success, innovations and growth of the firm. Some of these studies showed that innovators have not experienced sales or employment growth. The distribution of their growth rates is highly negatively skewed (Freel, 2000). On the other hand, the correlation between sales of innovative products and patenting is far more positive (Brouwer and Kleinknecht, 1999). These relationships seem to be time dependent, too. For example, Freel and Robson (2004) discovered that at least in the short term, a negative relationship between product innovation, growth and profitability of a firm. Further, Bhide (2000) argued that risky behaviour should lead to higher performance in the longer run because in spite of high variance in short-term income, it may lead to greater mean values in the long run.

Coad and Rao (2008) pointed out that on average a firm experiences only modest growth of sales. The firms grow for a number of reasons, which may or may not be related to IPR activity. They discovered that the returns from IPRs are highly skewed and the distributions rates of growth are heavily tailed. Moreover, they observed that IPRs are of crucial importance to growing firms, especially for a handful of superstars i.e. high-growth firms.

Markides (1998) and Moskowitz and Vissing-Jørgenssen (2002) discovered that the creation of new products seems to demand a great deal of resources. It has been estimated that almost two-fifths (38 %) of commercialisations of new products fail to progress from original ideas to commercially successful products. The impact of innovations on economic performance is highly uncertain. For example, it may take on the average 10-12 years for the return on investment of new ventures to equal that of mature businesses, or 7-15 years from radical invention to financial success (Kanter, 1985).

The financial profile of growing innovative SMEs could be seen as low liquidity and high debt ratio, the characteristics, associated usually with failed firms. A Small size and financial resource base may cause constrained financial management opportunities during the simultaneous R&D and growth period. This could indicate that the financial success of the firm will have an impact on its innovation activity. The following hypothesis 4 is based on the assumption that growing SMEs might experience even more financial challenges or pressures during their simultaneous IPR efforts and growth period than other firms since the simultaneous generation of IPRs and growth business activities requires plenty of resources.

H4. Firm success has an impact on the innovation activity (IPRs) of growing SMEs.

2.4 Public R&D funding and innovativeness

Investment in R&D is one of the most powerful indicators of IPR activity (Archibugi, 1988). Usually, investments in innovation inputs precede the potential outputs. Investment in R&D creates the opportunity platform for the commercialization of new product and processes. However, Venkataraman (2004, pp. 162-166) pointed out that finance as a single resource does not generate other prerequisites for business growth and success. "*There have to be also resources that are engaged in the process of ensuring that good ideas are being developed, that somebody actually starts the firm, makes the prototype, gets the first customer, develops the product and places it into a competitive product situation"*.

Since IPRs require plenty of resources SMEs especially might experience financial challenges or pressures in their R&D activities. North et al., (2001) emphasize that finance in SMEs is the most commonly identified barrier to innovations, with some sectorial differences. The incidence of business failure seems to be greater in firms with smaller assets than in larger, publicly traded firms (Moskowitz and Vissing-Jørgensen, 2002). Moreover, difficulties in obtaining capital or the existence of unfavourable demand conditions have been used to explain why some firms fail to grow or disappear entirely (Penrose, 1955).

Some prior studies have shown that SMEs in unfavourable rural areas may not be disadvantaged in raising funds for their R&D activities (Storey and Westhead, 1997). This means that the location of the firm does not significantly affect the presence of financial constraints. Moreover, North et al., (2001) pointed out that the problem is not the availability of financial sources since most small firms do not seek external finance at all.

Public R&D funding is one of the most influential instruments for supporting and increasing overall innovativeness of firm and the generation of intellectual property rights (IPRs) in firms (Santarelli and Piergiovanni, 1996). Lerner (2002) pointed out that public venture investments should be focused especially on technologies that are not currently popular among venture investors and provide follow-on capital to firms already funded by venture capitalists or other finance providers during periods when venture inflows are falling. Government's role should be to encourage the sharing of both the risks and returns between the providers of finance and the entrepreneurs.

Financial resources are not a sufficient condition for successful R&D activities and high performance. For example, large firms with adequate financial resources may require other

specialized assistance to support their innovations. Tether (1998) argued that financial support may even lead to selection of such projects which may not be optimal from the point of view of the innovations. This is likely to increase the number of imitations with little genuine innovation. However, in many circumstances financial support may have positive impacts, too. Santarelli and Piergiovanni (1996) discovered that the presence of spill-overs at the regional level from both private and public R&D expenditures is positively correlated with the development of new products. Moreover, firms that have R&D collaboration agreements have a higher probability of applying at least one patent, and they also apply for a higher number of patents (Brouwer and Kleinknecht, 1999). Based on these prior findings and the assumption that public R&D funding increases the overall innovativeness of the firm, the fifth hypotheses will be defined as follows:

H5. Public R&D funding has an impact on the innovation activity (IPRs) of growing SMEs.

3. Data and methodology

The data were collected using the purposive sampling procedure (Miles and Huberman, 1994). Recently, purposeful sampling strategy has been recommended for use especially in studies where specific types of firms are of interest (Achtenhagen et al., 2010). The total size of the sample data is 348 continuously growing SMEs from the period of 2002-2005. From these firms 262 are located in urban areas and 86 in rural areas (Table 1); 28 of these firms have produced and owned at least 1 IPR during the period 1988-2005 whereas 320 of the businesses were classified as non-IPR growth SMEs.

The study analyses SME data from all the branches of industry in two Finnish regions, Eastern Finland (a rural area) and Helsinki Region (an urban area). The Helsinki region has twice as many people as Eastern Finland living in a spatial area that is 8 times smaller. This would indicate more market opportunities and larger markets as well as better possibilities for recruiting human resources. The corporate population density is 14 times higher and its relative growth has also been higher in the Helsinki area than in Eastern Finland (Appendix 1). Moreover, private and public R&D investments have been around 3 times higher in the Helsinki region compared with those in Eastern Finland. This difference could indicate that the Helsinki region has been a more favourable area for the creation of new products and innovation-driven growth.

Almost all the growing firms (around 95 %) in both Eastern Finland and the Helsinki region are located in towns, municipality centres or their close neighbourhood. Manufacturing is the dominant branch of industry in Eastern Finland, employing one-third of the total number of private sector employees (Appendix 3). In both areas the employment has decreased mostly in manufacturing. The

other branches in which employment has declined in both areas include transportation, storage and telecommunication. Wholesale and trade, construction, health and social work, real estate, renting and other business services have increased their employment in both regions (Appendix 3).

The data analyses were executed during the years 2010-2011. The data were collected from four different sources:

1) Accounting data from the years 2002-2005 from the Voitto+ CD-ROM (Http://www.asiakastieto.fi/voitto). The Voitto+ database is an extensive database including financial statements data of around 100 000 of Finnish companies (Suomen Asiakastieto Oy, 2008).

2) IPR data were collected from the National Board of Patents and Registration of Finland and from international register for patent data esp@cenet (Http://www.prh.fi/en.html).

3) Public R&D funding data were provided by the Finnish Funding Agency for Technology and Innovation (Http://www.tekes.fi).

4) Success index data were acquired from Balanced Consulting Ltd (Http://www.balanceconsulting.fi) (Appendix 2).

From the Voitto+ CD-ROM database 567 growing businesses were identified, 466 in urban and 101 in rural areas. In order to obtain robust data the total sample was carefully analysed and reflected the success data. Balance Consulting Ltd had calculated a success index for successful firms in the provinces of Finland. A closer look at the single observations revealed that the data should be refined in order to be able to focus on really high growth and highly successful SMEs. In several studies it was noticed that if growth is measured with relative variables the size matters (Almus, 2002). Since some micro businesses were included in the data we first removed all the businesses that had fewer than 10 employees. Moreover, we eliminated all the firms that had more than 250 employees since they included several multinationals and their subsidiaries. The final step was to take away investment banks and finance and holding companies where the amount of assets was large compared with other companies with similar numbers of personnel. Altogether we eliminated 219 companies.

Most studies define growth as growth of sales or turnover (Davidsson and Wiklund, 2000). In this study, the definition of growth follows the Smallbone et al., (1995) criterion, which states that the annual growth of sales should be greater than 10%. The success of the firm is defined by using the success index (SI) constructed from the following variables: earnings before taxes, current ratio, return on investment, equity ratio, debt ratio, repayment period of liabilities and business growth (Appendix 2).

Patents, trademarks, utility models and registered designs (IPRs) were used as proxies for innovations. The IPRs are used as proxies because they are available for many countries and the information is broken down into very detailed technological sectors. This information represents the most precise and reliable classification in diverse branches of industry and the most precise and reliable classification of commercial and technological output of innovation and R&D activities (Archibugi, 1988). The prior innovation investigations that use IPRs include mainly patents in focused branches of industries. This study uses broader definitions of IPRs. The possible problems in the comparison of innovation and R&D activities in different branches of industry may be decreased by following the practise of the OECD (2005) Oslo Manual and using broader definitions of IPRs. The exclusion of micro and large firms clearly decreases the amount of firms with IPRs. However, the inclusion of these categories would probably have increased the skewness of the distribution towards micro firms since relative figures were used in measuring the growth of turnover.

The definition of rural and urban areas follows the Nomenclature of Territorial Units for Statistics (NUTS) criteria (http://ec.europa.eu/eurostat/_ramon/nuts/introduction_regions_en.html), which are based on the population density. Eastern Finland is clearly a rural area since the population density is 7.8 inhabitants/km². In the Helsinki region the population density counts 222.6 inhabitants/km² and thus it is considered an urban area.

Because the objective was to determine the factors differentiating innovative SMEs from other firms, logistic regression analysis (LRA) was used to analyse the data. LRA-analysis instead of log linear modelling is recommended when explanatory independent variables are not only nominal or ordinal but also scale variables (Tansey et al., 1996). The dependent variable in the LRA model will have a value 0 if the firm does not have IPRs and 1 if the firm has produced some IPRs. The explanatory (independent) variables include location, age and size, success index and the amount of public R&D funding received. In the LRA model it is always possible to achieve at least 50% accuracy by simply setting the prediction for each observation to respond the most frequent outcome (Hoetker, 2007). Thus, the model is not appropriate if it does not reach the level of a priori probability. SPSS Inc.'s Predictive Analytics Software package was used in the statistical analysis.

Coad and Rao (2008) emphasized that in research sets that are related to the growth of a firm and patent data the use of basic regression analysis (RA) may be misleading. This could be explained through the assumption of regression analysis. In regression analysis normality of the distribution and equality of the variance are the basic assumptions. However, the distributions of the returns to innovation (IPRs) are highly skewed and the growth rates often heavily-tailed, too (Coad

and Rao, 2008). Because of the uneven distribution of IPRs matched pair comparisons were used. The same amount of non-IPR businesses was selected with the simple random sampling method from the overall group of 320 as counterparts for 28 IPR active companies. The remaining 292 non-selected observations were used in cross- validation process to improve the overall validity of the study. In practise this means that all the firms (n=348) were used in the analyses and have an impact on the results.

The sampling procedure alleviates the problems of the skewed data distribution since micro and large firms are not included in the data. As Almus (2002) pointed out, the use of the total corporate population may emphasize the relative growth in micro firms and the absolute growth in large firms. Especially, in SME databases this kind of definitional bias could be avoided without the need to use special indexes such as the Birch index.

4. Results

The descriptive statistics (Table 1) show that the distribution of the branch of industry is problematic because of a very small amount of observations in some industry groups. Moreover, the branch of industry and the location are dichotomic variables, which limits the interpretation of their impact in the model. The size, age and success of the firm do not cause similar problems since they all are continuous variables.

Based on the data characteristics (Table 1) about 8% of the growing SMEs in the sample (n=348) did possess at least 1 IPR during the examination period of 1988-2005. The low amount of IPRs could be explained in some cases by strategies and the ownership of IPRs. In small firms, especially, the owner of the IPRs may be the entrepreneur, not the firm. Moreover, they could be bought or rented, for example by using licenses. There may be situations in which the firm could patent its R&D outputs but chooses not to do so. This kind of action could be connected to situations in which the patenting costs are larger than the value creation. IPRs may even cause problems that could harm the competitive situation if the competitors take advantage of valuable public information in patent applications (Heimonen and Virtanen, 2009).

The meaning of one single IPR could be huge to small firms. Heimonen and Virtanen (2009) discovered that some firms could internationalize their business with the exploitation of only one trademark. It seems that innovation activities take multiple forms in firms where certain forms cannot be patented or protected by using IPR. Services and manufacturing branches have relatively more growing SMEs with IPRs than other branches of industry. Most of these firms seem to employ 10-49 people and fall within the age range of 5-19 years.

Around one-quarter of the firms in the whole sample and one-fifth of the firms with IPRs are located in rural area. Acs et al., (2008) found that about 23% of growth firms are located in rural areas but over time the number of these firms has been decreasing slightly. The distribution of firms with IPRs confirms Arundel and Kabla's (1998) idea that the diversity of the firms generating IPRs might be wide. In this study the explanation for this observation may be the definition of IPRs, which include trademarks, utility models and registered designs.

Table 1. Characteristics of the data

	Firms with IPRs		*Firms with no IPRs*		*Total*	
	N	***%***	***N***	***%***	***N***	***%***
Sample	28	8.0	320	92.0	348	100
Branch of industry						
Construction	2	0.6	34	9.8	36	10.3
Trade	6	1.7	80	23.0	86	24.7
Transport and telecommunication	1	0.3	12	3.4	13	3.7
Services	10	2.9	160	46.0	170	48.9
Manufacturing	9	2.6	34	9.8	43	12.4
Location						
Rural area	6	1.7	80	23.0	86	24.7
Urban area	22	6.3	240	69.0	262	75.3
Size (personnel)						
10-19	14	4.0	126	36.2	140	40.2
20-49	7	2.0	126	36.2	133	38.2
50-99	5	1.4	11	3.2	16	4.6
100-249	1	0.3	46	13.2	47	13.5
250-500	1	0.3	11	3.2	12	3.4
Age (years)						
< 5	4	1.1	49	14.1	53	15.2
5-9	10	2.9	85	24.4	95	27.3
10-19	9	2.6	116	33.3	125	35.9
20-29	3	0.9	52	14.9	55	15.8
30 ≥	2	0.6	18	5.2	20	5.7

A stepwise logistic regression (LRA) analysis was applied to estimate the best-performing model. In the LRA model IPR was as a dichotomic dependent variable (0=firms with no IPRs, 1=firms with IPRs). The independent variables included location, size, age, success index, public R&D funding, turnover/employee ratio, which could be interpreted as a measure of productivity. The branch of industry and its annual growth as well as the amount of personnel and its annual growth were also tested as independent variables. These variables did not have any statistical significance or they did not improve the overall classification rates of the estimated model, thus they were left out of the model.

It may be concluded that location, size and age will have no statistical significance in differentiating growing innovative SMEs from their non-innovative counterparts (Table 2, Model 1). Moreover, the overall classification rate improves when these variables are excluded from the analysis. Thus the hypotheses 1, 2 and 3 should be rejected.

In the best statistical model the explanatory variables are success index, public R&D funding and turnover/employee ratio (Table 2; Model 2). Of these variables, success index and public R&D funding were statistically significant at the level of $p \leq .1$ and $p < .01$. Thus these results support acceptance of the fourth and fifth hypotheses. The turnover/employee ratio was not statistically significant but it improved the overall classification rate.

All the explanatory variables in the best model (Table 2; Model 2) were continuous, meaning that the signs of these coefficients may be used to interpret the direction of the impact of the variable (Hoetker, 2007). It was found out that the worse the success index, the larger the probability of being classified as an innovative growth SME. This means that these firms are probably less successful than non-innovative SMEs. The direction of the impact is unexpected but this results responds to the expected preconception of high variance in short-term income and profitability (Bhide, 2000; Freel and Robson, 2004). The sign of turnover/employee ratio is positive, implying that a higher turnover/employee ratio increases the odds ratio of being classified as an innovative SME. This result is consistent with former results that fast growth businesses with higher productivity are more IPR intensive (Coad and Rao, 2008).

Public R&D funding is a statistically significant variable in both the models (Table 2). This means that a firm that receives public R&D funding will be more likely to generate IPRs. The result is natural since precondition for granting public R&D funding to firms is the requirement of overall innovativeness in R&D projects. One reason for the lower probability of successful businesses belonging to the group of innovative firms may be a lag between R&D funding and the successful commercialization and exploitation of IPRs. Thus, the benefits of R&D seem to ripen slowly. What could explain the lower success of those firms that are IPR intensive? In the basic production function an increase in capital intensity (inputs in IPR) decreases the need for employment. This may increase the productivity of labour but decrease the productivity of capital. In this study, the productivity of labour is measured by the turnover/employee ratio and the productivity of capital by the return on investment, which is included in the success index. It could be deduced that higher productivity may lead to lower success because success is a function of the productivity of capital. However, this conclusion may be biased because of the measures of success and the indirect impact of the productivity of capital.

In Model 2 the overall classification rate of the selected as well as the unselected cases is about 78%. In the group of selected cases around two-thirds of SMEs with IPRs were classified correctly. The value of Nagelkerke R Square (0.297) and Hosmer and Lemeshow's test statistics (0.192) indicate that the model is applicable for finding out which factors differentiate innovative growth

firms from other firms. The data in Model 2 include 348 observations. The variance of the error term in logistic regression is not constant for all the observations, which in the case of a small sample causes heteroscedasticity and thus loss of efficiency. However, according to Pindyck and Rubinfeld (1976), the presence of heteroscedasticity does not itself result in either biased or inconsistent parameter estimates.

Why do firms allocate resources to IPRs if the current products and services are attractive? One possible explanation may be connected with the time span between patent acceptance and commercial breakthrough. In some branches of industry the commercial breakthrough may take several years. Heimonen and Virtanen (2006) pointed out the meaning of time lags through some cases. For example, two Finnish growth companies in the stonework industry, Tulikivi Plc. (Http://www.tulikivi.com) and Nunnauuni Plc. (Http://www.nunnauuni.com), created patents as well as registered design and trade marks in the early and mid-1990s. These elements were related to their main products, soapstone fireplaces and natural stone products. However, the commercial breakthrough of these products including IPRs did not occur until at the beginning of the 2000s. The commercial breakthrough of these firms was not only the result of the long term R&D, but also the current trends in furnishing opened the window of opportunity for their products.

The common assumption for specific product success is justified by using market demand as the ultimate explanatory factor. The recent study of Heimonen and Virtanen (2009) pointed out that there may be time lags with the developed technology and its market acceptance. One case from the forestry sector innovations shows that a small Finnish family firm, Pentin Paja Ltd (Http://www.pentinpaja.fi), developed and patented a new energy wood harvesting product as already as the 1980s. However, there were no promising markets for this kind of innovation. The market situation in forestry changed radically at the beginning of the 2000s mainly because of global trends such as environmental protection, climate change and an increased need for renewable energy. These factors have influenced the procurement of new technology products and applications positively.

As a summary of the results of the best model it could be stated that the relationship between IPRs, growth and success of the firm has many layers. R&D projects in which IPRs will be developed demand large financial resources and include technology risk in addition to other business risks. As Ruhnka and Young (1988) emphasized, investors are not willing to take technology risks and thus the firms have to use more of their own funds to finance these activities. The use of own funds, e.g. retained earnings, has a direct impact on the capital structure of the firm as well as on the cash flow situation, both of which are included in the success index. Growing

SMEs with IPRs might experience even more financial challenges or pressures than other companies since simultaneous IPR activities and business activities both require plenty of resources.

Table 2. Logistic Regression analysis of the factors differentiating IPR intensity

Dependent variable (0,1):	Model 1					Model 2				
(firms with no IPRs / firms with IPRs)	***Coeff.***	***S.E.***	***Wald***	***Df***	***Exp. (b)***	***Coeff.***	***S.E.***	***Wald***	***Df***	***Exp.***
(b)										
Independent variables										
Constant	0.398	1.231	0.104	1	1.488	0.425	1.119	0.144	1	1.530
Location	0.514	0.740	0.482	1	1.672					
Size	- 0.002	0.005	0.135	1	0.998					
Age	- 0.004	0.046	0.009	1	0.998					
Success Index	- 0.027*	0.017	2.707	1	0.973	- 0.027*	0.016	2.777	1	0.973
Public R&D funding	0.175**	0.066	7.067	1	1.192	0.186**	0.065	8.305	1	1.204
Turnover / employee	0.003	0.003	1.151	1	1.003	0.003	0.002	1.257	1	1.003
Model summary										
Number of firms	348					348				
A priori probability firms with IPRs	0.500					0.500				
A priori probability firms with no IPRs	0.500					0.500				
Log likelihood	55.185					56.427				
Hosmer and Lemeshow test sig.	0.294					0.192				
Cox & Snell R^2	0.232					0.222				
Nagelkerke R^2	0.310					0.297				
Classification Rates (%)										
Overall classification	68.0					72.0				
Firm with IPRs	60.9					65.2				
Firm with no IPRs	74.1					77.8				
Cross validation	81.2					78.2				

Note: Level of significance * $p \leq .1$, ** $p < .01$

5. Conclusions

About 8% of the firms in the sample could be defined as innovative growth SMEs. Most of these firms belong to the branches of services and manufacturing. Firms with IPRs are small in size, employing 10-49 people, and belong to the age range of 5 – 19 years, similarly to the distribution of the whole sample (Table 1). One-fifth of them is located in rural areas.

In this study the impact of location, branch of industry, size and age as well as success and public R&D funding on innovativeness has been tested. Finnish growing SMEs cannot be characterized to be outstandingly radically innovative either in rural or in urban areas. The result is parallel to that of North and Smallbone (2000) who concluded that relatively little difference is found in the level of innovation between SMEs in the different areas.

The size and age of the firm did not differentiate IPR-intensive firms from their non-IPR intensive counterparts. This does not inevitably mean that such differences do not exist but the result is opposite to those of many former studies (Battacharya and Bloch, 2004; Bouwer and Kleinknecht, 1999) that support the resource advantage of large firms or the importance of age (Churchill, 2000; Davidsson and Delmar 1997; Huergo and Jaumandreu, 2004) in creating IPRs. The conclusions are parallel to those of Kohn and Scott (1982), who suggested that scale economies in producing innovative output are not necessarily decisive.

Coad and Rao (2008) discovered that IPRs may be of crucial importance, especially to highly growing firms. This study confirms that the connection between IPRs and success is a complex phenomenon. In the short term a negative relationship may even exist between innovations and success (Bhide 2000; Freel and Robson 2004). The results also propose that there is a positive correlation between innovativeness and productivity of labour. On the other hand, higher productivity of labour may result from the increase in capital intensiveness, which may decrease the productivity of capital (return on investment). Thus, higher productivity may lead to lower success because success is a function of the productivity of capital.

IPR-intensive growing firms may confront more financial pressures than those without IPRs. One explanation for this may be simultaneous heavy investment in R&D and the need for plenty of working capital at the growth stage. The results support the prior findings of Autio (2009), Bhide (2000) and Davidsson and Delmar (1997) that most successful businesses do not start or look for new opportunities by exploiting new radical innovative concepts. Instead, most entrepreneurs seem to start or grow by imitating or slightly modifying the existing products or services or by acquiring external innovations.

Public R&D funding was shown to increase the odds of being classified as an innovative firm. The results confirm the views of Santarelli and Piergiovanni (1996) that both private and public R&D expenditures proves to be positively correlated with the development of product innovations and the development of IPRs.

The implications of the study results are important for policy makers since they show that the allocation of resources to R&D will be appropriate strategy for increasing the amount of IPRs. From the perspective of regional policy, however, it should be asked whether this kind of allocation of the resources is proper policy in such areas where receptivity of the local environment does not respond to the objectives of R&D effort. For example, in Finland strategic centres for science, technology and innovation have been established in five clusters. This activity may be well justified in such areas where there are enough high-quality resources to be allocated in R&D activity. However, in rural and remote areas where for example scientific resources are scarce it could be better to concentrate on basic businesses that are succeeding well and creating jobs and prosperity for the region.

From regional policy perspective the role of R&D activity should be rethought since the amount of innovation inputs does not inevitably lead to the optimal growth and success. We should think about Acs, Parsons and Tracy's (2008) conclusion: *"Local economic development officials would benefit from recognizing the value of cultivating high growth firms versus trying to increase entrepreneurship overall or trying to attract relocating companies when utilizing their resources"*. In regional policy we should take advantage of indigenous assets in different locations. This could be achieved by analysing carefully the population of businesses and determining the high-impact and innovative firms of the region. Moreover, from the perspective of regional development the allocation of inputs in the development of basic business know-how, commercialization and entrepreneurial behaviour may be equally as important as the development projects in high-tech.

For venture capitalists and business angels the implications suggest consideration of the time frame of their investment. If they want to take advantage of the introduction of IPRs they should be patient and wait for the benefits of commercial exploitation. On the other hand, opportunities for lower risk could be found in such businesses that search for market innovations and modernize and diversify their activities effectively. Education and training institutions may benefit from the results when planning their courses and activities.

Limitations including the small sample size, skewness of the data and the definitions of IPR measures and growth could be pointed out. The approach does not take into account the application or purchase of IPRs developed outside the firm. External ideas and the so-called open-source

innovations are currently becoming increasingly important. One limitation of the study is connected with model specification and the selection of variables. The model does not include any internal decision or relationship variables like strategy, product, policy or development of capabilities and networking (Littunen and Virtanen, 2009). These behavioural variables may interact with the tested variables and thus they could have an impact on both innovativeness and growth, too. Because of the skewness of the distribution the predictive power and reliability may be poor. The reliability of the test was improved by using cross-validation. LRA was estimated ignoring the a priori probability and thereafter matched comparisons (cross-validation) were introduced. Discriminant analysis or different forms of least square analyses could have been used as the method of analysis. However, the assumptions of these methods include several restrictions for the distribution and variance of variables and the error term. LRA was selected since it includes fewer restrictions and will be more effective.

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Appendix 1.

Corporate population characteristics of Finland, Eastern Finland and the Helsinki region in 2002-2005

Region	**Finland**	**Eastern Finland** (Classified as a rural area; Eurostat NUTS criteria)	**Helsinki Region** (Classified as an urban area; Eurostat NUTS criteria)
Total amount of firms	*236 435*	*35 056*	*73 573*
Change in the amount of firms 2002-2005	*4.3 %*	*2.7 %*	*5.4 %*
Density of population	*17.3 inhabitants/ km²*	*7.8 inhabitants/ km²*	*222.6 inhabitants/ km²*
Location of firm	*Around 60% of firms located in towns and 40% in countryside*	*Around 70 % of firms located in towns and 30 % in sparsely populated areas*	*93 % of firms located in towns and 7 % of firms located in municipalities*
Total costs of private and public R&D investments	*5648 Million USD*	*715 Million USD*	*2372 Million USD*
The amount of SMEs (size 10-249 employees)	*15 672*	*2 348*	*4929*

(Sources: OECD 2008; Rural Policy Reviews: Finland; Statistics Finland, Business register, (Http://www.stat.fi), Statistical Yearbooks of Finland 2004; 2005; 2006; 2007; Suomen Asiakastieto Oy Voitto+ CD-ROM 2006).

Appendix 2.

Scoring table of SI

Classification points	1	2	3	4	5	6	7	8	9	10
ROI %	-1.9	0	1.8	2.7	5.8	8.9	13	16.4	21.9	27.4
EBIT %	-6.3	-4.7	-3.1	-1.8	-0.5	0.5	2	3.6	5.2	6.7
Current ratio	0.7	0.9	1	1.1	1.3	1.5	1.7	2	2.2	2.5
Equity ratio	0	7	11	15	22	30	38	45	51	57
Debt ratio	785	536	411	287	191	94	58	21	0	-12
Repayment period	100	60	40	20	12	5	3	1	0.5	0

Success index

This study exploits the success index developed by Balanced Consulting Ltd. The success index (SI) measures the financial success of the firm. The reason to use this index is the fit of the index with the database that Balanced Consulting Ltd has also provided. In order to determine the holistic financial success ,not only profitability, but also other aspects such as capital structure and liquidity of the firm should be taken into account.

The content and construction of the SI

In the SI definition the firms are classified into 10 different classification point categories according to their financial data. Before using different financial parameters, the financial statements of the firm were adjusted by following the instructions of international accounting standards of financial statements (IASs) and the instructions of the Finnish Advisory Board of Corporate analysis (YTN). IAS were used:

a to prevent the effect of random capital gains on annual growth and success classification
b to increase the reliability of comparisons in different branches of industry
c to create more holistic view of the financial success at the firm level

The following variables are used in constructing the SI: return on investment, earnings before taxes, current ratio, equity ratio, net gearing, repayment period of liabilities and business growth. The selected financial key figures are not dependent on the branch of industry. The financial parameters produce classification points that fluctuate from 0 to 10 points.
The overall success classification of the firm is obtained by summarizing the classification points of the firm (max. 60 points). The SI is the relative figure where the minimum is 0 and the maximum 100.

The key parameters were calculated by using the following formulas:

$$\text{Current ratio (CR)} = \frac{\text{Inventories + short-term receivables + liquid assets}}{\text{short-term debts}}$$

$$\text{Debt ratio (DR)} = \frac{\text{100 x (debt – liquid assets)}}{\text{equity + voluntary provision + minority share}}$$

$$\text{Earnings before taxes (EBIT)} = \frac{\text{100 x earnings before taxes and interest rate}}{\text{turnover}}$$

$$\text{Equity ratio (ER)} = \frac{\text{100 x (equity + provision + minority share)}}{\text{balance sheet + advance payment}}$$

$$\text{Repayment period (years)} = \frac{\text{debt – liquid assets}}{\text{earnings after interest – taxes + depreciation}}$$

$$\text{Return on investment (ROI \%)} = \frac{\text{100 x (earnings + cost of finance)}}{\text{return on investment}}$$

Appendix 3.

Distribution of personnel (%) by branch of industry in Eastern Finland and the Helsinki Region during 2002-2005

	Eastern Finland			Helsinki Region		
Branch of Industry SIC Code (TOL2002)	2002	2005	Change during 2002-2005	2002	2005	Change during 2002-2005
A Agriculture, hunting and forestry	3,81	3,85	-0,04	0,31	0,28	-0,03
B Fishing	0,08	0,08	0	0,01	0,01	0
C Mining and quarrying	0,74	0,67	-0,07	0,14	0,13	-0,01
D Manufacturing	34,42	32,18	-2,24	19,12	17,94	-1,18
E Electricity, gas and water supply	0,96	0,83	-0,13	0,51	0,5	-0,01
F Construction	10,11	10,78	0,67	7,95	8,47	0,52
G Wholesale and retail trade	16,56	16,66	0,11	21,62	22,31	0,69
H Hotels and restaurants	4,65	4,48	-0,17	4,42	4,3	-0,12
I Transport, storage and communication	11,43	11,07	-0,36	12,02	11,63	-0,39
J Financial intermediation	2,63	2,39	-0,24	5,16	5,14	-0,02
K Real estate, renting and business activities	8,78	10,36	1,58	21,1	21,34	0,24
L Public administration and defence; compulsory social security	0	0	0	0,58	0,59	0,01
M Education	0,26	0,27	-0,01	0,79	0,77	-0,02
N Health and social work	2,7	3,45	0,75	2,14	2,59	0,45
O Other community, social and personal service activities	2,89	2,92	0,03	4,13	3,99	-0,14
X Industry unknown	0	0	0	0	0	0
Total (%)	100	100		100	100	
Total (N; amount of total personnel in the region)	148853	153416		455 470	455 461	

(Sources: Statistics Finland, Business Register, (Http://www.stat.fi), Statistical Yearbooks of Finland 2004; 2005; 2006; 2007)

PART 2: ARTICLES

II

Heimonen, T. and Virtanen, M. (2012). Characteristics of successful gazelles – problems in approaches and methods of analysing the data. International Journal of Business and Globalisation, Vol. 9, No. 1, pp. 12-41.

Characteristics of successful gazelles – problems in approaches and methods of analysing the data

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Abstract: This paper focuses on the problems of analysing growth and success of a firm. The data consists of 348 growing SMEs. 75 of them were growing rapidly and highly successful (HGS). The methods include discriminant, regression and logistic regression analysis. In regression models, growth and success seem to be inversely related. Regression analysis is not an appropriate way to analyse HGS firms. Logistic regression and discriminant analysis should consider a priori probabilities to produce reliable results. The use of different methods depends on the design of the study, the characteristics of the data and the validity of the research questions. A robust analysis presupposes refinement of the data, accurate model specification, and competent interpretation of the results. Future research should focus on periods longer than 3–5 years and take into account uncertainty and discontinuity of variables. A qualitative approach where behavioural and management issues will be included is needed.

Keywords: high-growth ventures; high success ventures; venture profitability and growth; methodology.

Reference to this paper should be made as follows: Heimonen, T. and Virtanen, M. (2012) 'Characteristics of successful gazelles – problems in approaches and methods of analysing the data', *Int. J. Business and Globalisation*, Vol. 9, No. 1, pp.12–41.

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1 Introduction

The fostering of high growth (HG) and highly successful (HS) businesses is considered an important element of economic development. Different approaches have been used to identify these so-called 'gazelles' since they are thought to generate the majority of new jobs in society. Many expectations are loaded onto entrepreneurs and their businesses when society changes. However, these expectations followed by the allocation of resources for business development may be overestimated because of the wide diversity of entrepreneurs and businesses. Thus the identification of HG and HS businesses could decrease the gap between expectation and actual outcome.

From the policy perspective it is essential to be able to identify HG businesses, since these businesses will be the most prominent portfolio companies of venture capitalists and improving access to venture capital is one very important policy target. Several studies have been conducted aimed at identifying growing firms as well as high or even hyper-growth businesses (Acs et al., 2008; Almus, 2002; Ardichvili et al., 1998; Davidsson and Wiklund, 2000, 2001; Littunen and Virtanen 2006, 2009; Markman and Gartner, 2002; Sexton et al., 2000; Smallbone et al., 1995; Virtanen and Heimonen, 2007). However, is the identification of high-growth businesses sufficient if we are also interested in high success? Statistics from venture capitalists suggest that only one tenth of their portfolio of companies will be exceptionally successful and the success of only one quarter will be considered satisfactory.

In most previous studies growth performance has been connected with the success of the firm and in some studies growth has even been used as a surrogate measure of success (Birley and Westhead, 1990). This kind of approach could be defended in studies such as that of Smallbone et al. (1995). They used samples where high-growth firms were associated with good performance, so that only those businesses which showed some profit at the end of the period were classified as high-growth businesses. On the other hand, in their study, success was defined as being adequate if the firm showed more than zero profit, which cannot really be considered to demonstrate good profitability at the lowest levels of success of the definition.

Virtanen and Heimonen (2007) concluded that a HG rate does not inevitably equate to high success. The reason for this is obvious if you think about the factors associated with growth. In order to grow, a lot of funds will be needed, which may cause cash flow problems. However, Markman and Gartner (2002) suggest that both sales and employment growth are unrelated to profitability in the case of extraordinarily high-growth businesses. The growth and success of small and medium sized enterprises (SMEs) can be considered from different perspectives depending on definitions of the relevant concepts, their operationalisation and methods used in the analysis (Davidsson and Wiklund, 2000; Delmar, 1997; Kirby, 2005; Markman and Gartner, 2002; Pasanen, 2003). This paper focuses on different approaches to studying HG and HS businesses and the use of different quantitative methods in analysing the data. Simultaneously, the paper describes the learning process associated with refining the data and selecting appropriate methods for the analysis.

The paper is organised so that first we briefly introduce the research outline and research questions. Then we turn to the existing literature relevant to the subject, especially those empirical studies addressing the problems of growth and performance as well as the methodology used in these studies. Thereafter we introduce the methods that

we used and the results of our estimations. Finally the conclusions, implications and limitations of the study are presented.

2 Research outline and research questions

In our previous papers we have used both regression analysis (RA) (Virtanen and Heimonen, 2007) and logistic regression (Heimonen and Virtanen, 2007) when analysing almost the same data as that discussed herein. Moreover, in Virtanen and Heimonen (2007) we used correlation analysis to study the connection between growth and success. The inspiration for the current paper was the fact that, when using this kind of data, one is faced with problems associated with the research design and objectives, the meaning of outliers, and the applicability of the research methods. Thus in the process of learning about appropriate techniques the data should be refined to eliminate biases and to create a proper platform for a robust analysis of firms exhibiting high performance. For example, when studying growth and success simultaneously, the distribution will be highly skewed. Thus one should take into account a priori probabilities when conducting logistic regression or discriminant analysis (DA). In this paper, we focus on simultaneous growth and success. A lot of the discussion relating to performance studies has been devoted to definitions and measurement of different concepts, i.e., growth and success. Growth, even if it includes several dimensions (Davidsson and Wiklund, 2000; Delmar, 1997; Delmar et al., 2003), is easier to define than success since it is difficult to find an objective measure of success. In this study success means financial success, which includes profitability, solvency and liquidity.

The purpose of this paper is to answer the following questions:

1 What are the factors that explain simultaneous growth and success in different statistical models?

2 What are the problems connected with different methods of analysing HG and HS SMEs?

3 How does the selection of different analytical techniques affect the results?

4 How could we improve the robustness of the data and the methods used in the analysis?

The subsidiary question that underlies the different methodological problems is: What kind of impact does the ignorance of a priori probabilities have on the results of the analysis?

In order to understand the research questions we would like to point out the dilemmas associated with using different methods for the data analysis. When RA is used properly we must assume that the data and error terms are normally distributed and that variances are equal. We can manipulate these features of the data by scaling of the variables, using logarithmic (or other) transformations and by the use of dichotomic variables. But when, for example, we change a continuous variable to a dichotomic variable we lose information and the interpretation of the coefficient is made more difficult.

The problem of explaining simultaneous fast growth and high success demands the use of a dichotomic variable as a dependent variable. This calls for the use of either DA or maximum likelihood methods when analysing the data. When we use logistic

regression, interpreting the coefficients requires continuity of variables. Moreover both in logistic regression and in DA uneven skewed distributions of different classes should be considered since they affect a priori probabilities.

The main motivation for this study was to understand more profoundly the use of the data and different methods for analysing the high performance of SMEs. In this analysis high performance means simultaneous fast growth and high success. We analyse the same data using RA, logistic RA and DA. When reflecting on previous empirical studies, we pay special attention to the data, the assumptions associated with the different methods, specification of the models, and selection criteria of variables and reporting of the statistical characteristics of the analysis.

3 Former empirical studies

Wiklund (1998) emphasised that prior research on entrepreneurship and performance studies of growing SMEs exhibited several problems. Lack of conceptualisation and development of theory, integration of previous knowledge into research models and a failure to apply rigorous research methods are the major complications of such studies. In addition to these problems we should highlight the importance of the quality of data. Growth is time dependent and should be analysed using longitudinal data. As Delmar et al. (2003) concluded, the 'highgrowth firm' in itself is a heterogeneous phenomenon. When studies focus mainly on HG issues they may totally ignore success as one of the important aspects of performance.

Parker et al. (2010) introduced five main issues related to the variety of definitions of fast growth firms. These definitions include:

1 an appropriate metric for growth

2 a definition of 'fast' growth

3 the time period

4 continuity

5 the mode of growth (organic/acquisition).

Fast growth could be quite easily defined if sales are used as the metric for growth. Parker et al. (2010) pointed out that, in growth studies, 20%–30% is a minimum for fast growth. In this paper we use 30% sales growth as the lower limit for fast growth, i.e., gazelles. This definition deviates from the original gazelle definition of Birch (1979; 1987), who suggested that a gazelle has to grow by at least 20% a year for four years. This means that it at least doubles its size over the four-year period. Since we use growth data for only three years, doubling of sales requires 30% growth rate.

However, as Sexton et al. (2000) stated, the method of measuring growth is inconsequential if changes in both sales and profits are not considered. The study by Smallbone et al. (1995) is one where growth was connected with success. They used a sample of 306 firms in eight specified manufacturing sectors in the UK. High-growth firms were associated with good performance so that only those businesses which showed some profit at the end of the period were classified as high-growth businesses. However, when we wish to allocate a score to indicate the level of the success, breaking even is not

sufficient to differentiate between high or low success. In this study we use simultaneous financial success (success index) as the measure of performance (Appendix 2).

3.1 Time span and the data

One of the most essential factors in analysing growth and success is the time period over which they are measured. Growth usually implicitly means a change in the state of the measure and it will be time dependent. Thus the analysis presupposes longitudinal data. However, quite a large number of studies have been conducted using cross-sectional data. Even though longitudinal data has been used in several studies, these have mainly examined data from a three to five-year period (Delmar, 1997). There are a few exceptions where the time span is longer. Acs et al. (2008) and Smallbone et al. (1995) used data from a 12-year period. However, both studies relied on descriptive statistics as the method of analysis. Delmar et al. (2003) used data from ten years when identifying the typology of HG firms by means of cluster analysis. Littunen and Tohmo (2003) and Littunen and Virtanen (2006, 2009) followed the same firms over an eight-year period and used logistic regression when analysing the data.

Davidsson and Wiklund (2000) demanded more longitudinal research, a feature that has been lacking in entrepreneurship research. Since growth is a dynamic phenomenon this demand is justified. However, several studies that use longitudinal data – including our own – finally analyse cross-sections, since the study periods are often too short to allow time series analysis.

The majority of growth studies use annual data. The analysis of Weinzimmer et al. (1998) was exceptional in the sense that they solved the problem of time periods that were too short by using quarterly data. They studied the measurement of organisational growth by using quarterly data from the years 1987–1991, using time series analysis to estimate beta, so that size was regressed on time. However, some caveats should be noted, especially because of the nature of the quarterly data. Even if it is possible to control seasonality and carefully justify the use of deflators, these selections could be criticised. It is difficult to find a single indicator to correct seasonality since many firms, especially larger ones, will be multi-branch businesses. There are also huge differences within the same industry depending on the markets and products and/or services offered. Since the data points are the same for every business, deflating the growth measures by the same deflator does not really improve the power of the analysis if different points of time are not compared with each other. Moreover, the use of a GDP price deflator does not reveal the branch-specific effects of cost changes. In a stable economy the price changes between different quarters are probably small and so the robustness of the analysis does not inevitably require the use of a deflator, which could even be biased.

Refinement of the data has mostly included using of logarithmic transformations in order to control the huge variance associated with absolute figures. In some cases exceptionally high values of the variables have been excluded (e.g., Siegel et al., 1993) but in some other studies these ‘super-high’ values are the focus of the whole paper (Markman and Gartner, 2002).

3.2 Methodology and methods of analysis

Chandler and Lyon (2001) reviewed 416 articles from the entrepreneurship literature, asking whether the methodologies and measurements employed in entrepreneurship

research are sufficiently robust to foster paradigmatic growth and maturation. They evaluated the research design and methodologies used and categorised papers. About 70% of the papers described empirical studies and RA was the most frequently used analytical technique.

Delmar (1997) studied methodological considerations in measuring growth and the pros and cons of different growth measures by analysing the contents of various studies. He reviewed and analysed the content of 55 studies and concluded that a large array of different measures was used and thus comparison between studies is difficult. Delmar (1997) found that little attention was given to the choice of growth indicator, the chosen time period and the consequences of transformations of dependent variables. Delmar et al. (2003) considered, for example, heterogeneity of growth measures and indicators, regularity of growth over time, and the simultaneous use of multiple growth indicators. According to the titles of the articles analysed, the concept of growth is fuzzy since 40% of the titles referred to performance. Growth orientation and motivation were also the focus of some of the studies (Delmar, 1997). Delmar (1997) noted that 47.3% of the reviewed articles used regression techniques in the analysis and stepwise RA was the most popular method (23% of the sample).

The use of different methods of analysis in growth and performance studies is highly dependent on the available data and their characteristics. In quite a few studies attention is focused on the characteristics of the relationship and different assumptions associated with the methods used. In most cases the methods used, such as ordinary or generalised least square (OLS, GLS) and their variants, assume continuity of variables and linear relationships between dependent and explanatory variables and linear independence between different explanatory variables (Appendix 1). Moreover, error terms are assumed to have a mean of zero and constant variance. There are several different techniques and approaches that allow these assumptions to be relaxed, but these should be taken into account in the interpretation of results and the bias, consistency and efficiency of the estimates.

3.2.1 Regression analysis

Markman and Gartner (2002) used stepwise regression when analysing the connection between extraordinary growth and profitability of *Inc. 500* companies. They tested a hypothesis that extraordinarily high-growth rates – as measured by sales and employment – are negatively related to profitability. They did not find any statistically significant connection between growth and profitability. The caveats they proposed included the exceptionality of the data and the so-called problem of single-method bias. Markman and Gartner referred several times to those studies that point out the importance of measuring growth but do not pay much attention to the operationalisation of profitability that is used. Would the results have been different if profitability had been a continuous variable, similar to growth, allowing a wider variance of profitability indicator? In their analysis the standard deviation of profit growth was 11 and the standard deviation of the growth of employment almost 4,000 and sales more than 2,300. Thus the explanatory power of their model was very low. We do not argue that the relationship between growth and profitability in this case would have corresponded to that described in the null hypothesis but would like to highlight the sensitivity of the analysis for operationalisation of variables and their measurement (see Davidsson and Wiklund, 2000; Delmar, 1997).

Glancey (1998) used OLS and 2SLS when investigating the determination of growth and profitability in small manufacturing firms in Scotland. The complete dataset consisted of 38 small firms (<100 employees) from three different branches of manufacturing. He concluded that the larger of the small firms grew faster; this was considered to follow on from expected monetary rewards. Moreover, older firms grew less rapidly than younger firms. The justification of the model and the refinement of the data, as well as the estimation procedures, are thoroughly explained and reported. However, the small number of observations may have led to biased estimates even if the explanatory power of the model was high; this was caused by the singularity of the matrix of explanatory variables.

Wiklund et al. (2009) built an integrative model in order to discover how entrepreneurial orientation, environment and characteristics of an entrepreneur and a firm affect small businesses' growth. The data, which consisted of 413 small businesses, was analysed by partial least square (PLS) analysis. They estimated the model in two stages and found that adding direct effects (e.g., attitudes, dynamism and hostility) increased the explanatory power of the model substantially. Their conclusion was that entrepreneurial orientation affects small business growth together with firm age and direct environmental effects. The major problem with this approach is the interpretation of the results. Since PLS uses latent variables, reverse causality is possible. Thus interpretation of signs as well as testing of the bias of estimates is not valid.

Audretsch (1995) used cross-sectional data from 631 firms and multiple RA to study the effect of growth and profitability on innovation activity. His conclusion was that profitability positively affects innovative activity for firms in industries with high-technological opportunities, whereas growth generates more innovations in low-technological industries. However, in the combined model, neither growth nor profitability was found to be a statistically significant explanatory variable. Some caveats apply especially to the partitioned versions of the models and their characteristics. In the combined model the sample size was 631 whereas the number of summed observations of the two separate samples was 592. The number of the firms in different industry sectors was quite low, ranging from 12 to 41. This may cause exceptionally high rates of R2 and, therefore, adjusted R2 would be more appropriate to describe the goodness of fit of the model. Tabachnik and Fidell (2007) recommend that, for every explanatory variable, you should have at least 40 observations or even more if the model is used in cross-validation.

Birley and Westhead (1990) completed cross-sectional analysis using data from 249 small firms. Since their purpose was to test the stage theories, they used RA mainly in order to combine the factors that contribute to size and performance. They stated that in the previous literature there is no evidence that size and performance correlate with each other. As a conclusion based on their RA, they stated that more mature firms that have no external finance other than bank overdrafts recorded the highest levels of profitability. Even though it can be argued that testing stage theories would need longitudinal data, Birley and Westhead (1990) succeed in distinguishing eight different clusters which had different profiles characterised by internal variables (ownership, management, and product structure) and by external variables (product and market positioning). However, they did not discover any evidence to support the theory that small firms pass sequentially through predefined stages of growth.

Taking into account the conclusions of Birley and Westhead (1990), it is interesting to examine Cowling's (2004) analysis in which lagged sales growth rates were used as

explanatory variables for profit. He used OLS and 2SLS estimation when analysing the data (N= 204–256). Cowling's (2004) analysis supports the growth-profit-growth nexus which means that firms use profits for internal investment purposes but there is no growth-profit trade-off. An inverse relationship between profits and the age of the firm can be challenged since, for example, Audretsch (1995) suggested that growth generates more innovations in low-technological industries and these firms are more mature than high-technological industries. If we assume that innovations generate profits the result is the opposite of Cowling's conclusion. The major problem with Cowling's (2004) paper is the reporting of statistical results. The majority of the evaluation criteria are presented in tables but no interpretation of the goodness of fit or other evaluation criteria are explained in the text.

3.2.2 Discriminant analysis

Siegel et al. (1993) analysed the characteristics which differentiate high-growth ventures from low-growth companies by using the so-called Reynolds data (smaller, younger firms) and Price Waterhouse data (mature, medium-sized firms). They defined high-growth as more than 25% annual growth for at least three consecutive years. Siegel et al. (1993) also refined the data by excluding exceptionally high-growth businesses as outliers. Their analyses distinguish industry experience as a differentiating factor in both samples. The Reynolds data showed that the highgrowth companies were more focused and more revenue was generated by a single product than in their low-growth counterparts. Moreover, smaller companies used scarcer resources, were more productive and reported a greater use of advanced technology. Larger companies (PW data) had a higher propensity for market and product diversification, balanced management teams, more rapid market growth and the ability to develop close customer contacts. In Siegel et al. (1993) the correct classification rates were high (around 80%) and thus the predictive power was good. They did not have serious problems with the skewness of the distribution even though a priori probabilities of the other Reynolds database were not equal for both small, high-growth and large, low-growth groups.

Ettlinger and Tufford (1996) used DA when studying the performance of small firms in a local context. Their sample consisted of 63 manufacturing firms which employed fewer than 100 employees in Columbus, Ohio. The study by Ettlinger and Tufford (1996) analysed static and dynamic value added and sales per employee (labour productivity). They concluded that high performing firms invest more in labour than in capital, but most firms invest more in capital than labour. Discriminant functions and statistical parameters were well justified and reported, but the full potential for evaluating the models was not exploited. For example, a priori probabilities, cross-validation and classification rates were not reported.

Moreno and Casillas (2007) used DA and a dichotomic dependent variable in differentiating high-growth firms from non-high-growth firms. They defined a firm as HG if its percentage of growth in the period 1998–2001 was more than 100% higher than the median of its branch of industry. Moreno and Casillas (2007) found that, according to their definition, more than 10% of the firms studied were high-growth businesses. They solved the problem of uneven distribution by dividing the non-high-growth businesses into nine groups of equal size. Even if this separation of data solves the problem of uneven distribution it is possible that randomly selecting the same number of non-high-growth and high-growth firms could have influenced the results.

3.2.3 Maximum likelihood models

Littunen and Tohmo (2003) and Littunen and Virtanen (2006, 2009) used logistic RA when investigating longitudinal data from 200 start-ups from the manufacturing and business services sectors in 1990. These firms were followed up to 1997 and after seven year development 86 respondents were found and responded in 1998. In Littunen and Virtanen (2006, 2009), a similar definition as that given by Smallbone et al. (1995) was applied, stating that growing firms should double their turnover during the period of the study (>10% annual growth). The distribution of the data was even, since it included 43 observations in both growth and non-growth classes, which meant that cross-validation was unnecessary. The majority of those factors that differentiated growing ventures from non-growth companies were dependent on the strategic and operative choices of the entrepreneur. Littunen and Virtanen's (2009) model did not include any statistically significant entrepreneur-specific variables. They concluded that fit of the entrepreneur is necessary but not a sufficient condition for successful growth performance. The classification rate of growth businesses was 92.1% and 86.1% for non-growth firms, indicating that nine of the ten growing firms were correctly classified. Littunen and Virtanen (2006, 2009) focused on growth issues and no direct link to success was shown in their study.

In those studies which investigate growth and success simultaneously, the usual measure of growth is related to financial performance. However, some success studies use survival or growth of the firm as an indicator of successful performance. Veronique et al. (2000) used growth in the number of employees as their success indicator. They conducted stepwise logistic RA in order to identify the factors that had an impact on their growth indicator. Veronique et al. (2000) drew conclusions about the size of the impact of independent variables on the likelihood of hiring new employees. However, they did not give any statistical data about classification, i.e., how well the predictor variables classified the dependent variable in different categories. Moreover, the success indicator used by Veronique et al. (2000) may have been biased. For example, Lussier and Corman (1995) found that failed businesses had higher workforce education and did not have problems in acquiring staff. This could be interpreted to mean that owners of failed ventures take greater risks and are not cautious enough in recruiting personnel.

The resource-based view was used as a theoretical framework by Davidsson et al. (2009); they examined the connection between profitability and growth using parametric testing and logistic RA. Swedish data collected from the years 1997–2000 consisted of 1,470–1,482 SMEs and Australian data from the periods 1994–1995, 1995–1996 and 1997–1998 consisted of 3,488–3,717 observations. Davidsson et al. (2009) used sales growth and return on assets (ROA) as measures of variables. Following the RBV, they calculated both growth and profitability relative to other firms in the industry.

Steffens et al. (2009) studied performance configurations over time, seeking the growth – profit relationship. Their longitudinal survey data included 2662 firms. Industry medians were subtracted from growth and profit figures in order to adjust them for industry variations. Steffens et al. (2009) used probit and ordered probit analysis to examine the differences between growth and profit orientation of young and old firms. Unlike many other empirical studies, including our own research, Steffens et al. (2009) succeeded in using the potential of longitudinal data in probit analysis. The usual practice is that even if the data has been gathered from a longer period, the time series properties cannot be used in the analysis. In their dynamic analysis, Steffens et al. (2009) compared

the kind of growth-profit development that different age categories exhibited during the research period. Their conclusion was that both young and old firms were more likely to be classified into a 'star' category as a result, first, of above-average profitability and then because of growth, rather than by achieving growth first and expecting profitability later (c.f. Davidsson et. al., 2009). One deficiency of the paper is that the evaluation of the model and its statistical characteristics could be more comprehensive in order to provide the reader more information about the reliability aspects.

Even though Parker et al. (2010) examined high-growth firms, i.e., gazelles, their study also addressed aspects of success, since in their multinomial logit model they compared the status of the firm in 2001 with the situation in 1996 when the interviews about management strategies took place. They found that, in order to become or remain large, the firms needed to follow two key strategies. Gazelles should invest in marketing (via a marketing department) and have focused product strategies. This means that a main product is a major contributor to sales. This confirms results showing that strategy can act as a differentiator of growth firms (Littunen and Virtanen, 2009) and that focused strategy is important in order to achieve fast growth (Virtanen and Heimonen, 2011). Moreover, continuously growing gazelles are less likely to sell their shares to other stakeholders (workforce, directors, venture capitalists). The analysis and construction of Parker et al.'s (2010) model is thoroughly justified, including an evaluation of its statistical performance. However, the small number of failed businesses and the number of observations in different categories compared to the number of independent variables were fairly low and thus the interpretation of coefficients is not straightforward.

Fabling and Grimes (2007) investigated which business practices set successful firms apart from others. Their cross sectional data consisted of a survey of 3,000 firms from New Zealand. Most questions in the survey were qualitative and thus they used mainly binary data in their probit estimation. A self-reported measure of performance (business results higher/lower than competitors) was used as a dependent variable and different practices and characteristics connected with profitability, productivity and market share as explanatory variables. They discovered that both internal and external features of the firms were associated with business success. Statistically significant explanatory variables were:

1 investment in up-to-date capital equipment

2 labour augmenting practices (incentives and HR practices)

3 R&D activities

4 market research.

Fabling and Grimes (2007) suggested factors that differentiate high performers from the other groups. Their analysis was thoroughly justified including a careful explanation of categorisation and estimation of results and a Kernel density function comparison of the potential outcomes. However, they ignored the growth perspective; this constitutes the other dimension of our study.

In this paper we follow quite closely the definitions of Parker et al. (2010). For fast growth businesses we expect consistent HG throughout the whole study period. The difference between our data and that of Parker et al. (2010) is that we are unable to

differentiate between organic and inorganic (acquisition) growth. We also cannot identify strategy changes, although these have been found to be important in differentiating growing businesses (Littunen and Virtanen, 2009; Parker et al., 2010).

4 Data and methodology

The data were collected using a purposeful sampling strategy and came from several sources. Incomplete information and problems of missing data necessitated restructuring and refinement of the data.

Data were collected from four different sources:

1 Accounting data including the years 2002–2005 from the Voitto+ CD-ROM (http://www.asiakastieto.fi/voitto). Voitto+ is an extensive database that includes financial statement data for around 150,000 Finnish companies (Suomen Asiakastieto Oy, 2006–2008).

2 IPR data were collected from the National Board of Patents and Registration of Finland and from the international registry of patent data esp@cenet (http://www.prh.fi/en.html).

3 Public R&D funding data were provided by the Finnish Funding Agency for Technology and Innovation (http://www.tekes.fi).

4 Success index data for firms in the provinces of Finland were acquired from Balanced Consulting Ltd. (http://www.balanceconsulting.fi) (Appendix 2).

From the Voitto+ CD-ROM database, 567 growing businesses were identified – 466 in urban and 101 in rural areas. In order to obtain robust results, the sample was carefully analysed to ensure that it reflected the success data. A closer look at individual observations revealed that we needed to refine the data used in Heimonen and Virtanen (2007) and Virtanen and Heimonen (2007) in order to be able to focus on really HG and HS SMEs. Several authors have noted that, in cases where growth is measured using relative variables, the size of the firm involved becomes important (Almus, 2002). Because the full dataset included some figures for micro businesses, we initially removed all the businesses that had fewer than ten employees. We also eliminated all firms that had more than 250 employees, since these included several multinationals and their subsidiaries. The final step was to take out investment banks and finance and holding companies, which have disproportionately large amounts of assets compared to other companies with similar numbers of personnel. Altogether, 219 companies were eliminated prior to the analyses.

In Heimonen and Virtanen (2007), the focus was on differences between two regions. Data on growing firms in the years 2002–2005 were collected from the databases already mentioned. Firms that grew more than 10% annually were classified as growth businesses. The use of 10% as the annual nominal growth of turnover corresponds to Smallbone et al.'s (1995) definition of doubling turnover within ten years. Doubling of turnover means slightly more than 10% annual growth each year. We have not deflated the figures since, during the period 2002–2005, the annual change in the consumer price index was less than 1% Moreover, the closing month of the accounting period may change from firm to firm which would skew the impact of the annual inflation rate as a

deflator. Using this classification criterion we identified 500 growing firms – 412 from urban (Helsinki region) and 88 from rural (Eastern Finland) areas.

In Heimonen and Virtanen (2007) the criterion for fast growth was more than 30% growth in average annual sales for the period 2002–2005. This means that firms more than doubled their turnover. Firms classified as successful businesses should be allocated at least 80 points out of the maximum 100 points in the index used. We used the same growth and success classification but combined the "Successful businesses in provinces in Finland" data published in 2007 with the original data. Altogether we identified 466 and 101 growing businesses in urban and rural areas, respectively; thus the total size of the sample was 567 businesses.

The data used in this study consist of 348 growing SMEs. The data were collected for the period 2002–2005. As in our previous paper we selected growth businesses by using 10% annual growth in turnover to define growing firms and at least 30% annual growth for a company to be considered a gazelle. The construction of the success index is explained in Appendix 2. Balance Consulting Oy (2007) considers that those businesses which exceed 70 points belong to the A-category. These firms were considered to be high success businesses. Using this classification criterion we identified 273 non-high growth (NHG) and/or non-highly successful (NHS) and 75 HG and HS businesses.

The definition of urban and rural areas follows the NUTS[1] criteria. We use the density of population in relation to the density of population within the country as a criterion to classify areas as urban or rural. We selected Eastern Finland as a rural area and the Helsinki region as an urban area.

The basic assumptions, evaluation criteria and challenges in interpretation of different methods used in the analysis are presented in Appendix 1. RA, logistic regression analysis (LRA) and DA were used to examine the data. Growth and success of the firm were used as dependent variables in the RA models. In the discriminant and logistic regression analyses the classification of simultaneous growth and success of firms was used as a dependent variable (1 = HG and HS; 0 = other combinations). First, both discriminant and LRA are estimated ignoring the a priori probability (Model 1) and then matched comparisons (cross validation) are introduced (Model 2). Explanatory (independent) variables include age and size of the firm, branch of industry, innovativeness (IPRs), and public R&D funding (Appendix 3). Moreover we use region as an independent dummy variable in the growth and success estimations.

5 Models and results

5.1 Regression analysis

Even though regression analysis is frequently used in growth and success studies, its use is problematic because of the nature of the growth and success as a dynamic change phenomenon and its basic assumptions (Appendix 1). The basic assumptions of multiple linear regression analysis, the approach most often used in such studies, are linearity, normality of the distribution of the error term, unbiased estimates, equality of variances of the error term (homoscedasticity) and an absence of correlation between predictor variables (no multicollinearity).

Since the operationalisation of the combined continuous variable measuring both growth and success would be difficult in a RA model, we decided to test the variables

separately and analyse the similarities and differences. The *hypothesis* was that if growth and success are surrogates the same variables should be statistically significant in the model.

We introduced the derivation of the alternative hypotheses from theories and previous research in Virtanen and Heimonen (2007). On this basis we derived and tested six groups of hypotheses affecting both growth and success:

1 the branch of industry (Cooper et al., 1994; Littunen and Virtanen, 2006, 2009; Almus, 2002)

2 the size (Gibrat's Law; Glansey, 1998; Moreno and Casillas, 2007; Parker et. al., 2010)

3 the number of innovations (IPRs) (Audretsch, 1995; North and Smallbone, 2000; Heimonen, 2012)

4 location (Acs et al., 2008; North and Smallbone, 2000)

5 age (Cooper, 1993; Littunen and Virtanen, 2006)

6 growth and success (Birley and Westhead, 1990; Davidsson et al., 2009, Markman and Gartner, 2002).

In addition to these variables we included some structural and exploratory variables, including the number of auxiliary business names (size of organisation), public R&D funding and the growth of the branch of industry. Appendix 3 includes a complete list of variables used in the analysis. Only the best models are reported in this study.

Based on the hypotheses, the following regression models were constructed:

$$G = \alpha + \beta \left[SI, HR, dHR, GB, RI, PF, A, DR, DBI_i\right] + \varepsilon \quad (1)$$
$$\qquad\quad + \; + \quad + \quad + \; + \; + \; + \; + \quad ?$$

$$SI = \gamma + \lambda \left[G, HR, dHR, GB, RI, PF, A, DR, DBI_i\right] + \theta \quad (2)$$
$$\qquad\quad + \; + \quad + \quad + \; + \; + \; + \; + \quad ?$$

where[2]

G growth of sales turnover (%)

SI success index

A age of company

BN the number of auxiliary business names

DBI_i branch of industry dummy, i = 1, …, 5

dHR annual growth of the number of staff

DR dummy for the region (urban 1, rural 0)

GB growth of the branch of industry

HR the number of staff employed by the firm

PF profitability factor

RI the number of intellectual property rights (radical innovations).

The signs of the first derivatives of the explanatory factors are shown under the equations. It was expected that the number and annual growth of staff (Veronique et al., 2000), the growth of the branch of industry (Audretsch, 1995; Markman and Gartner, 2002), the number of IPRs (Heimonen, 2012), the success of the firm (Davidsson et al., 2009; Steffens et al., 2009) and being located in an urban area (theories of resource-munificence and regional competitiveness) would have a positive effect on growth of the firm. The expected impact of predictor variables would otherwise be the same, but with success index treated as a dependent variable and growth of sales turnover as an independent variable. The age of a firm was expected to have a positive impact on growth (Cooper, 1993; Heimonen and Virtanen, 2007; Littunen and Virtanen, 2006) and a negative impact on success (Birley and Westhead, 1990).

Factor analysis was completed in order to identify the main dimensions of the financial data. Four factors profitability, liquidity, solvency and business volume with eigenvalues of more than one were found to explain about 70% of the variation in the financial data.

Stepwise regression was applied separately in the growth and success models (Tables 1 and 2). The best model for growth included the variables logarithmic transformation of the number of staff, company age and IPRs. Moreover, the profitability factor and branch of industry (trade) and region were found to be statistically significant explanatory variables. In the success model, age and IPRs were not statistically significant but the number of auxiliary business names was included in the model. Two dichotomic variables, manufacturing and transportation + telecommunication, were statistically significant but they were different from the growth model dummy (trade). The results of the growth model are consistent with, for example, Delmar (1997) so that the younger the firm the higher the growth, but contradict Littunen and Virtanen (2006) and Heimonen and Virtanen (2007) who, like Cooper (1993), concluded that the age of a firm has a positive impact on its growth. However, it should be noted that we have used age of the firm, not age of the entrepreneur, as the explanatory variable.

We would expect that the number of innovation inputs (IPRs) would have a positive impact on the growth of a firm. It seems that the higher the total number of innovation inputs the higher the growth of the business. Contrary to our previous paper (Heimonen and Virtanen, 2007), region seems to have some effect on growth rate but not on success. Growth seemed to be slightly higher in the urban area. One interesting detail is that the growth in the number of staff seems to have a negative effect on success but a positive impact on growth. Thus those businesses employing more people during their development will have a lower level of success. We could argue that, in the short run, an increase in employment would decrease the profitability of growing businesses.

Table 1 Stepwise regression model for growth

Dependent variable: log of sales growth	*Unstandardised coefficients*		*Standardised coefficients*			*Exp. (b)*		*Collinearity statistics*	
	Coeff.	*S.E.*	*Coeff.*	*t*	*Sig.*	*Lower limit*	*Upper limit*	*Tolerance*	*VIF*
Independent variables									
Constant	0.579	0.140		4.124	***	0.307	0.859		
Log growth of the number of staff	0.704	0.062	0.500	11.309	***	0.581	0.826	0.911	1.098
Log company age	–0.259	0.053	–0.216	–4.845	***	–0.367	–0.156	0.893	1.120
Log Innovativeness (IPRs)	0.266	0.083	0.138	3.197	***	0.103	0.431	0.950	1.052
Profitability factor	–0.035	0.014	–0.105	–2.453	**	–0.064	–0.007	0.966	1.035
Branch of industry: (other industries vs. trade)	–0.099	0.034	–0.126	–2.918	***	–0.164	–0.031	0.959	1.043
Region: (rural area vs. urban area)	0.074	0.036	0.090	2.053	*	0.001	0.143	0.923	1.083
Model summary									
Number of firms	n = 321 (27 missing cases)								
Stepwise regression	6 Step								
R^2	0.442								
Adjusted R^2	0.431								
Std. error of the estimate	0.25670								
Change statistics									
R^2 change	0.007								
F change	4.214								
df1	1								
df2	314								
Sig. F change	0.041								
Durbin-Watson	1.775								

Note: Level of significance *p ≤ .05, **p ≤ .01, ***p ≤ .001

Table 2 Stepwise regression model for success

Dependent variable: log of sales growth success	*Unstandardised coefficients*		*Standardised coefficients*			*Exp. (b)*		*Collinearity statistics*	
	Coeff.	*S.E.*	*Coeff.*	*t*	*Sig.*	*Lower limit*	*Upper limit*	*Tolerance*	*VIF*
Independent variables									
Constant	72.607	1.356		53.156	***	69.939	75.275		
Profitability factor	12.969	0.978	0.567	13.267	***	11.046	14.893	0.989	1.011
Branch of industry: (other industries vs. trade)	–13.231	2.655	–0.216	–4.984	***	–18.454	–8.008	0.965	1.036
Number of auxiliary business names	–1.098	0.292	–0.163	–3.764	***	–1.673	–0.524	0.968	1.033
Branch of industry: (other industries vs. transportation and telecommunication)	–9.953	3.058	–0.142	–3.255	***	–15.970	–3.936	0.953	1.049
Growth of the number of staff	–0.044	0.018	–0.109	–2.514	*	–0.079	–0.010	0.960	1.042
Model summary									
Number of firms	n = 320 (28 missing cases)								
Stepwise regression	5 Step								
R^2	0.432								
Adjusted R^2	0.423								
Std. error of the estimate	17.474								
Change statistics									
R^2 change	0.011								
F change	6.320								
df1	1								
df2	314								
Sig. F change	0.012								
Durbin-Watson	2.019								

Note: Level of significance *p ≤ .05, **p ≤ .01, ***p ≤ .001

All the variables appeared to be statistically significant at least at the $p < 0.05$ level in both models. In the regression analysis, both in the success and the growth models, the profitability factor is statistically significant. The sign suggests that growth is inversely related to profitability. This means that higher growth will be connected with lower profitability. This result does not support the results of Markman and Gartner (2002) who found no connection between growth and profitability, which could be considered successful behaviour.

The explanatory power of both models was quite good, taking into account the cross-section characteristics of the data and compared with other growth and performance studies (adjusted R^2 for growth = 0.432, and for success R^2 = 0.423). Based on the regression analysis we could answer the first question about which factors explain simultaneous fast growth and high success. Growth of the number of staff and profitability are the only variables that are statistically significant in both models. However, the sign of the profitability factor is negative in the growth model, implying that the higher the profitability the lower the growth.

The positive impact of profitability on success may be the result of the structure of the success index. Since the success index includes some of the same variables as the profitability factor, it is obvious that these must be quite highly correlated. Ignoring profitability decreased the power of the model substantially and the adjusted R^2 value decreased to 10%. Based on the above analysis we can reject the hypothesis that growth and success are surrogates, i.e., the explanatory factors of the models deviate from each other. Regression analysis is probably not an appropriate way to explain growth and success simultaneously. The characteristics of the entrepreneurial market and assumptions of linearity, normality, continuity, and equality of variances among other things are in conflict. Moreover, operationalisation of simultaneous growth and success requires some artificial measures, as a result of which information is lost. In the following discriminant and logistic regression analyses, simultaneous growth and success are combined.

When we use regression analysis to study entrepreneurship and especially growth and success we have to be aware that the assumptions behind regression analysis do not fit very well with the characteristics and environment of growth entrepreneurship. As Bygrave (2006) stated, an entrepreneurial venture starts with a unique event and growth often includes quantum jumps. He concluded that regression analysis is not an appropriate method to help us understand the triggering factors associated with quantum jumps or the processes that occur during quantum jumps. However, careful data refinement and the use of methods that allow deviations from strict continuity and assumptions of normality justify such quantitative analysis, which may enhance our understanding of the factors affecting growth and success. In the following analysis we introduce discriminant and LRA as alternatives in order to find factors which affect both growth and success simultaneously.

Table 3 DA of combined growth and success

Dependent variable (0,1): (0 = non-high growth and high success firms 1 = high growth and high success firms)	*Model 1 (no matched pair comparison)*			*Model 2 (matched pair comparison and cross-validation)*		
	Coeff.	*Tolerance*	*F to remove*	*Coeff.*	*Tolerance*	*F to remove*
Discriminant function variables						
Constant	0.293			–0.495		
The number of auxiliary business names	–0.118	0.956	5.643	–0.143	0.957	6.261
Age of company	–0.047	0.963	9.139			
Branch of industry:						
Services including Kibs	1.298	0.921	13.448	1.345	0.960	7.394
Solvency factor	0.537	0.988	10.634	0.651	0.993	7.361
Model summary						
Number of firms	330 (18 missing cases)			330 (18 missing cases)		
Wilks' Lambda	0.886			0.890		
Chi-square	39.527			17.721		
Df	4			3		
Prior probabilities for groups:						
Other combinations	0.772 (n = 255)			0.500 (n = 75)		
High growth and highly successful firms	0.228 n = 75)			0.500 (n = 75)		
Functions at group centroids:						
Other combinations	–0.199			–0.349		
High growth and highly successful firms	0.643			0.349		
Classification rates (%)						
Overall classification	78.2			64.1		
Other combinations	97.6			64.1		
High growth and highly successful firms	15.4			64.1		
Cross validation				67.2		

5.2 Discriminant analysis

If we wish to predict membership of a particular group we can use DA. In this type of analysis we choose independent variables that we think might predict the membership of a certain group. The assumptions underlying DA are that the population is multinormal and the variances of groups are equal (Appendix 1). Linear combinations are compared to a cross-matrix of the data so that total variance of cross-products (S_{total}) is partitioned into variances associated with differences between groups (S^{bg}) and within groups (S_{wg}) expressed in equation form as follows:

$$S_{total} = S_{bg} + S_{wg} \tag{3}$$

After determining the overall relationship between groups and independent variables (predictors), the next step is the analysis of discriminant functions that make up the relationship (Tabachnik and Fidell, 2007). The best discriminant functions are those for which the gap between centroids of different groups is the largest.

$$Z_i = \alpha_{i1}X_1 + \alpha_{i2}X_{i2} + \ldots\ldots + \alpha_{in}X_n \tag{4}$$

where X_{in} denotes explanatory variables.

In the DA we used the same explanatory variables as in the regression analysis, but only those variables that were statistically significant in the best model are reported. Age, the number of auxiliary business names, the branch of industry dummy, and the solvency factor were discriminating variables in the standardised canonical discriminant function in Model 1 (Table 3). Model 1 classifies correctly 78.2% of the total sample and 97.6 percent of NHG and NHS firms. However, the correct classification without cross-validation was only 15.4%. In a matched pair comparison with Model 2, the classification rate was 64.1% for the overall sample as well as for the other groups (Table 3, Model 2). The cross validation rate for unselected cases was 67.2%.

In summary we can conclude that ignorance of a priori probabilities results in poorer performance of the discriminant model. The obvious reason for this is that DA is used for classification purposes, as is LRA. In DA the discriminant functions are defined and the results should be interpreted as expressing the straightforward likelihood of belonging to a specific group. In our analysis, classification of cases was quite good compared, for example, to Moreno and Casillas (2007). Cross validation of the data improves the robustness of the model. Compared to LRA the results are similar, but in DA we cannot tell anything about the direction of impact of a single independent variable.

5.3 Logistic regression analysis

In the logistic regression model, the dependent variable is dichotomic and can have one of two alternative values. If we wish to test whether a firm belongs to the group of HG businesses, the dependent variable receives a value of 0 if it is a NHG company and 1 if it is a HG. Similarly successful firms could be classified into two separate groups [non-highly successful firm (NHS) = 0; HS firm = 1]. When we wish to test both HG and high success we combine these two variables by multiplying them. Then HG and

HS are each allocated a value 1, whilst 0 denotes the absence of HG, high success or both.

$$y_i = \alpha + \beta (X) + \varepsilon, \tag{5}$$

where

y 0 for low growth or success

1, for HG and high success

X matrix of the predictor variables.

The probability that $y_i = 1$ will be

$$P\left(y_i=1\middle|x_i\right)= \exp\left(x_i'\beta\right) \Big/ \left[1 + \left(x_i'\beta\right)\right] \tag{6}$$

The list of predictor variables is presented in Appendix 3. In the logistic regression the impact of changes to the coefficients on the probability of an event occurring depends on the initial probability of the event.

In Table 4, LRA is presented first without taking into account a priori probabilities (Model 1) and thereafter with matched selection of NHS and NHG businesses (Table 4, Model 2). In addition to the number of auxiliary business names, age, business volume factor and services as a branch of industry, which were found to be significant in the DA, trade and manufacturing as well as the liquidity factor were also found to be statistically significant in the LRA. In model 2, which included a matched pair comparison and cross validation, age and services as a branch of industry were no longer statistically significant. The number of auxiliary business names was the only variable that decreased the odds ratio with respect to classification as a HG and HS firm. These results are partly in the line with the conclusion of Ettlinger and Tufford (1996) that high performing firms seem to invest in labour; however, in the current study it is not possible to tell whether labour investments exceeded capital investments made by the firms.

In Model 1 the overall classification rate of the model was almost 80%, but this was due to the correct classification of NHS and NHG firms; in contrast, the correct classification of HS and HG firms was very poor (26.7%). It should be noted that in the logistic regression model it is always possible to achieve at least 50% accuracy by simply setting the prediction for each observation to correspond to the most frequent outcome (Hoetker 2007). Thus the model is not appropriate since it does not reach the level of a priori probability (0.5) for the HS and HG group.

When a priori probabilities are taken into account and similar numbers of cases are selected for the analysis, the results change so that age is no longer a statistically significant variable (Table 3, Model 2). Moreover different dummies for branch of industry are statistically significant in the forced model. The overall classification rate of the model was 63.8%. The correct classification rate of selected cases was 62.3% for NHG and NHS firms and 65.3% for HG and HS firms. Unselected cases all belonged to NHS and NHG and their classification rate was 66.3%.

Table 4 LRA of combined growth and success

Dependent variable (0,1): *(0 = non-high growth and high success firms 1 = high growth and high success firms)*	*Model 1 (no matched pair comparison)*					*Model 2 (matched pair comparison and cross validation)*				
	Coeff.	*S.E.*	*Wald*	*Df*	*Exp. (b)*	*Coeff.*	*S.E.*	*Wald*	*Df*	*Exp. (b)*
Independent variables										
Constant	–0.243	0.340	0.513	1	0.784	–1.953	0.689	8.047	1	0.142
Number of auxiliary business names	–0.191*	0.109	3.046	1	0.826	–0.265**	0.127	4.367	1	0.767
Age of company	–0.057***	0.022	6.990	1	0.944					
Growth of the number of staff	0.006**	0.003	6.206	1	1.006	0.010**	0.004	6.245	1	1.010
Branch of industry:										
Services including Kibs firms	–0.889**	0.304	8.545	1	0.411					
Trade						0.857*	0.454	3.565	1	2.357
Manufacturing						1.146**	0.553	4.293	1	3.147
Liquidity factor	0.606***	0.176	11.877	1	1.833	0.660**	0.238	7.721	1	1.936
Business volume factor	–1.117*	0.598	3.483	1	0.327					
Model summary										
Number of firms	321 (27 missing cases)					321 (27 missing cases)				
A priori probability firms with other combinations	0.766 (n = 246)					0.500 (n = 75)				
A priori probability firms with high growth and success	0.234 (n = 75)					0.500 (n = 75)				
Log likelihood	293.996					178.523				
Hosmer and Lemeshow test sig.	0.568					0.934				
Cox and Snell R^2	0.158					0.191				
Nagelkerke R^2	0.238					0.254				
Classification rates (%)										
Overall classification	79.8					63.8				
Firms with other combinations	95.9					62.3				
Firms with high growth and high success	26.7					65.3				
Cross validation						66.3				

Note: Level of significance *p ≤ .1, **p ≤ .05, ***p ≤ .01

As a summary of LRA and in answer to the question about the impact of ignorance of a priori probabilities on the results of the analysis, we can state that ignorance of a priori probabilities has a significant impact on classification statistics. This means that the model does not predict the correct classification better than random selection. Even if the overall classification rate is almost 80%, the correct classification of the 'winners' is only 27%. When a priori probabilities are taken into account the classification rate of HG and HS businesses is 65%. We conclude that, in order to be a robust method for analysing skewed data, cross validation should be used to take into account a priori probabilities of dichotomic groups. The results of LRA models should be interpreted differently from linear regression. LRA results should be interpreted as the function of the estimated model. In other words, the value of the likelihood function expresses the probability or odds of belonging to some predefined group but the interpretation presupposes continuous explanatory variables.

In LRA it is recommended that the number of observations exceeds 500 in order to avoid systematic overestimation of coefficients. The variance of the error term in the logistic regression was not constant for all the observations. When small samples are used this is associated with heteroscedasticity, which reduces the effectiveness of the model. However, according to Pindyck and Rubinfeld (1976), the presence of heteroscedasticity does not in and of itself result in either biased or inconsistent parameter estimates.

6 Conclusions and comparison of different analyses

The growth of the number of staff and the profitability factor were the only variables that were statistically significant in regression models of both growth and success. Thus, we can conclude that growth and success are not the same phenomenon and, indeed, may be inversely related. Regression analysis is not an appropriate way to analyse HG and HS businesses when time series analysis is not possible. The reason is that in the entrepreneurial market, growth and success are dynamic and presuppose in most cases discontinuity, vague environment and a holistic approach. Moreover, the explanatory power of success models will probably be quite modest if the model specification is based on all the statistical requirements.

In DA, the number of auxiliary business names, the branch of industry (service sector) and the solvency factor were statistically significant variables in the discriminant function and allowed the correct classification of almost two thirds of the observations (64%). Without cross validation the model also included age as a statistically significant variable in the function. The total classification rate of this model was more than three quarters (78%), demonstrating that skewness of the distribution distorts the results quite substantially. Compared to LRA, in addition to the number of auxiliary business names, the growth of the number of staff, both trade and manufacturing industries, as well as the liquidity factor were discovered to be statistically significant in the LRA.

Both logistic regression and DA produce unsatisfactory results if a priori probabilities are not taken into account. If we ignore a priori probabilities and skewness of the data we may obtain invalid results even if the statistical indicators of the fit of the model and its characteristics are satisfactory. There is no sense in using sophisticated statistical methods to analyse the data if it does not produce better results than the toss of a coin.

The second question was "what are the problems connected with different methods of analysing factors that distinguish high growth and HS SMEs and how does the selection of different analytical techniques affect the results?" In Appendix 3, we present characteristics of the statistical methods used. These characteristics include modelling criteria and assumptions, evaluation criteria for models and challenges in interpretation. In all the models – as in all the statistical model analysis – the specification of the model is the basic problem. Model specification affects the validity of the results and in that sense it is of the utmost importance for the robustness of the analysis. Operationalisation and measurement have an impact on reliability of the analysis. Selection of variables (Appendix 3) has an important role from the perspective of both validity and reliability. Skewed distributions may cause the most severe problems when using discriminant or LRA if cross validation is not used. In DA the overall classification without cross validation was 78% but correct classification of HGS was only 15%, whereas with cross validation the rates for both were 64%. In LRA without cross validation the overall classification rate was 80% but the correct classification was only 27% compared to 65% with cross-validation. Thus we can conclude that ignorance of a priori probabilities will reduce the performance of discriminant and logistic regression models and the results will be adversely affected.

How could the robustness of the data, and methods used in the analysis be improved? In this paper we have explained the refinement of data and compared the results of different analyses. It can be concluded that, before using certain methods for analysing data, one should carefully investigate the characteristics of the data and be aware of the assumptions and aims of the selected methods of analysis. Moreover, it is appropriate to exploit statistical procedures that take account of the skewed data characteristics.

This paper is inspired by our experiences of analysing growth, success and the development of growing and successful businesses in a regional context. In the course of the research process we have learned that there are more myths than realities in the world of HG and HS businesses. These myths are driven by the unconscious application of widely respected statistical methods to problems and contexts where their use is not necessarily appropriate. The same or even better results could be achieved by simple analysis of distributions and the application of univariate statistics. However, careful analysis of data and its refinement may improve our understanding of the parallel growth and success of businesses.

Low and McMillan's (1988) advice to select a proper framework and define the purpose of any analysis should be remembered. The purpose and framework of the study affects the methodological opportunities and selection of analysis. We have to acknowledge that the chosen framework in this study has not enhanced our aim to exploit a variety of methods, but we have learned through experience – through trial and error. This has been very valuable and we wish to share the experience to save our peers' and students' time and expenses.

The limitation of this study was the use of cross-sectional analysis. Even if we have longitudinal data the selection of methods and the time span of the data do not support the use of longitudinal data. Siegel et al. (1993) stated that: "A longitudinal study that follows companies through defined stages of growth and focuses on the characteristics that set companies apart at different stages in their life cycle would greatly contribute to our ability to predict winners and losers at their inception". Bygrave (2006) demands more field research, including descriptive and in-depth longitudinal case studies.

This paper describes the development and learning process associated with a series of quantitative papers analysing the same basic dataset. In Virtanen and Heimonen (2011), we followed Bygrave's (2006) advice and picked five HG and HS cases from Eastern Finland and analysed their development from inception to a HG period in 2002–2005. We also followed their development before and after the HG period. The main difference compared to quantitative analysis is the fact that strategic behaviour is really important for the high performance of a firm. Moreover, it seems that HG and high success firms pay a lot of attention to their profitability before their HGS period (Davidsson et al., 2009; Steffens et al., 2009). Since continuation of the HGS period is not guaranteed (Parker et al., 2010; Steffens et al. 2009), future research should focus on a period longer than three to five years and take into account of uncertainty and the discontinuity of variables. This probably necessitates a qualitative approach, in which behavioural and management issues could also be included.

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Notes

1 NUTS – The Nomenclature of Territorial Units for Statistics, available at http://ec.europa.eu/eurostat/ramon/nuts/introduction_regions_en.html.

2 We have used the average figures from the period 2003–2005.

Appendix 1

Table A1 Characteristics of different methods

Statistical method	*Assumptions and modelling criteria*	*Evaluation criteria*	*Challenges in interpretation*
Regression analysis (RA)			
Dependent variable	Linearity	The fit of the model	Model specification
	Normality of distribution of error term	Explanatory power	Characteristics of entrepreneurial market:
Log growth	Homoskedasticy	Confidence interval	Discontinuity and unstability
Success	Equality of variances	Multicollinearity	Change and dynamism
	Least square modelling	Singularity	Operationalisation of variables
	Degrees of freedom		Measurement
Logistical regression (LRA)			
Dependent variable combined growth and success	Log linearity	A priori probability distribution	Model specification
		The fit of the model	Classification and estimation
	Normality of distribution of error term		Power based on probabilities and odd ratios
	Equality of variances	Classification statistics	Operationalisation of variables
HG +HS = 1	Maximum likelihood modelling	Cross validation	Measurement
NHG + NHS = 0	Degrees of freedom		Interpretation of coefficients
Discriminant analysis (DA)			
Dependent variable combined growth and success	Multinormal population	A priori probability distribution	Model specification
	Equality of variances of groups	Canonical discriminant function	Classification and estimation
	Linear combinations are compared to crossmatrix of the data	Classification statistics	Power based on discriminant function
HG + HS = 1	The amount of discriminant function (the amount of groups – 1)	The gap between centroids	Operationalisation of variables
NHG + NHS = 0	Degrees of freedom	Cross validation	Measurement

Appendix 2

Table A2 Scoring table of SI

Classification points	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
ROI (%)	–1.9	0	1.8	2.7	5.8	8.9	13	16.4	21.9	27.4
EBIT (%)	–6.3	–4.7	–3.1	–1.8	–0.5	0.5	2	3.6	5.2	6.7
Current ratio	0.7	0.9	1	1.1	1.3	1.5	1.7	2	2.2	2.5
Equity ratio	0	7	11	15	22	30	38	45	51	57
Debt ratio	785	536	411	287	191	94	58	21	0	–12
Repayment period	100	60	40	20	12	5	3	1	0.5	0

Success index

This study exploits SI developed by Balanced Consulting Ltd. SI measures financial success of firm. The reason to use this index is the fit of the index with the database that Balanced Consulting Ltd. has also provided, too. In order to find out the holistic financial success not only profitability, but also other aspects such as capital structure and liquidity of the firm should be taken into account.

The content and construction of the success index

In SI definition the firms are classified in ten different classification point categories according to their financial data. Before using different financial parameters, the financial statements of the firm have been adjusted by using the instructions of international accounting standards of financial statements (IAS) and the instructions of Finnish Advisory Board of Corporate analysis (YTN).

IAS have been used:

a to prevent the effect of random capital gains on annual growth and success classification

b to increase the reliability of comparisons in different branches of industry

c to create more holistic view of the financial success at the firm level.

The following variables are used in constructing SI: return on investment, earnings before taxes, current ratio, equity ratio, net gearing, repayment period of liabilities and business growth. The selected financial key figures are not dependent on the branch of industry. Financial parameters produce classification points which fluctuate from 0 to 10 points.

The overall success classification of the firm is received by summarising classification points of the firm (max. 60 points). SI is the relative figure where the minimum is 0 and maximum 100.

The key parameters have been calculated by using the following formulas:

$$\text{Current ratio (CR)} = \frac{\text{Inventories + Short term receivables + Liquid assets}}{\text{Short term debts}}$$

$$\text{Debt ratio (DR)} = \frac{100 \times (\text{Debt} - \text{Liquid assets})}{\text{Short term debts}}$$

$$\text{Earnings before taxes (EBIT)} = \frac{100 \times \text{Earnings before taxes and interest rate}}{\text{Turnover}}$$

$$\text{Equity ratio (ER)} = \frac{100 \times (\text{Equity} + \text{Provision} + \text{Minority share})}{\text{Balance sheet} + \text{Advance payment}}$$

$$\text{Repayment period (years)} = \frac{\text{Debt} - \text{Liquid assets}}{\text{Earnings after interest} - \text{Taxes} + \text{Depreciation}}$$

$$\text{Return on investment (ROI \%)} = \frac{100 \times (\text{Earnings} + \text{Cost of finance})}{\text{Return on investment}}$$

Appendix 3

Table A3 Variables used in regression equations

Variables
Age of the firm
Amount of auxiliary business names
Amount of personnel
Development expenses
Goodwill value
Growth of the amount of personnel
Growth of the industry
Growth of the sales turnover
Intangible assets
Other long term expenses
Public R&D funding
Radical innovativeness
Research expenses
Sales turnover
Size of the firm
Success index
Turnover/employee

Table A3 Variables used in regression equations (continued)

Dichotomic variables
Branch of industry
Other industries = 0, manufacturing = 1
Other industries = 0, construction = 1
Other industries = 0, services including Kibs = 1
Other industries = 0, trade = 1
Other industries = 0, transportation and telecommunication = 1
Region
Rural area (Eastern Finland) = 0, urban area (Helsinki Region) = 1
Factors
Profitability
Liquidity
Solvency
Business volume

PART 2: ARTICLES

III

Virtanen, M. and Heimonen, T. (2011). The development of high growth and highly successful SMEs: cases from Eastern Finland. International Journal of Technology Transfer and Commercialisation, Vol. 10, Nos. 3/4, pp. 411-432.

The development of high growth and highly successful SMEs: cases from Eastern Finland

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Abstract: The study analyses the development of high growth and highly successful (HGS) Finnish firms before and after their HGS period. What factors affect growth and success of the firms? How do these firms contribute to job creation? After some critical events, the firms followed focused strategy and concentrated on core activities. In HGS, firm growth and profitability fluctuates parallel directions. Firms had quadrupled their employees in ten years. Family business and venture capital backed university spin-off categories were identified to have slightly different approaches in their development. Strategic changes and focused strategies were found to be drivers for success.

Keywords: high growth ventures; high success ventures; venture profitability and growth; venture strategy; job creation; Finland.

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Tomi Heimonen is a PhD student at the Aalto University, School of Economics in the field of entrepreneurship. His PhD project is focused on the characteristics of high growth SMEs. At present, he works as a Project Expert at the Aalto University, School of Economics, Small Business Centre.

> "Money is not a measure of success because we have not had it in really vast amounts yet. I do not know how much you should have. When you have enough for a normal life, and a little for entertaining and for business operations so that there is no need to hold out a begging bowl when you approach a banker that will be great." (CEO Mikko Häikiö, Pentin Paja Oy)

1 Introduction

Small firm growth and especially new venture growth has been the subject of much empirical research recently (e.g., Davidsson et al., 2005; Wiklund et al., 2009). In the field of entrepreneurship the main journals reporting empirical growth studies include *Entrepreneurship Theory and Practice*, *International Journal of Entrepreneurship and Innovation Management*, *Journal of Business Venturing*, *Journal of Small Business Management*, *Regional Studies* and *Small Business Economics*. Roughly 100 articles have been published during the last 50 years. About 75% of these articles have been published in the 2000s. Theoretical background and frameworks of these studies represent a wide spectrum of entrepreneurship and management theories including, for example, Gazelles literature, industrial organisations, life cycle theories, resource-based view, and strategic management. In addition, data and methodological choices include both cross-sectional and longitudinal data as well as quantitative and qualitative approaches.

Connection between sales and employment growth has been investigated, especially in the so-called Gazelles literature (e.g., Acs et al., 2008; Birch, 1979; Julien, 2001). Acs et al. (2008) revisited and expanded Birch's findings on gazelles and labelled those firms which grow fast and create a significant growth in employment as high impact firms (HIFs). In spite of the large amount of SME growth studies concentrating especially on high growth businesses the simultaneous analysis of profitability, which could be used as the measure of success, has been quite scarce (Davidsson et al., 2005). The purpose of this paper is to study the development path of those firms which experienced simultaneous high growth and success period compared to their industry in 2002 to 2005. The approach of this paper starts from the growth perspective, but even if we differentiate between growth and success factors, both will be studied simultaneously.

Previously we have analysed simultaneous growth and success of businesses in the period 2002–2005 and concluded that high growth and high success are not concentrated only in high technology industries but are also found in the service sector (Heimonen and Virtanen, 2007, 2008). Inspired by the outcome that the average high impact firm is 25 years old (Acs et al., 2008) we decided to focus more carefully on the overall development path of high growth and highly successful (HGS) firms.

The aim of this paper is to answer the question, what kinds of overall development have these HGS firms encountered? Especially, we are interested in their performance before and after HGS period. Can we identify and suggest what factors could affect growth and success of the case firms? How do the entrepreneurs evaluate their high growth and high success? How do these firms contribute to job creation and employment growth?

2 Theoretical framework and former studies

Many of the former growth studies (e.g., Davidsson and Wiklund, 2001; Delmar, 1997) are mainly concerned only with growth as such, without any wider emphasis on other dimensions of performance. As Birley and Westhead (1990) point out, success is seen as a parallel phenomenon with growth. However, they argue that the use of external finance which could be thought to be a prerequisite for growth correlates negatively with profitability. Davidsson et al. (2005) notice that even if numerous empirical studies on small firm growth can be compiled only a few have investigated the crucial relationship between growth and profitability.

One notable inquiry into the determinants of high growth versus marginal survival (Cooper et al., 1994) found that the chances of both survival and high growth were positively associated with a higher level of education, greater industry-specific know-how and larger initial financial resources. Zhao and Aram (1995) compared low growth with high growth firms. They found that the range and intensity of business networks was markedly higher in the firms that grew rapidly.

Sandberg and Hofer (1987) who used return on equity as their performance variable found no confirmation for the effects of the entrepreneur's characteristics on venture performance. But they found support for the interactive effects of venture strategy and industry structure. Chrisman et al. (1999) extended the theoretical model of new venture performance proposed by Sandberg and Hofer (1987). The original model combined several potential explanatory factors that influence the performance of a firm. Their extended model specified that the performance of a new venture was a consequence of a confluence of factors that encompass attributes of entrepreneurs, industry structure, business strategy, resources, and organisational structure, processes, and systems.

Acs et al. (2008) examined firms with significant revenue growth and expanding employment which they call HIFs. They found about 375,000 US HIFs in 2002 to 2006. HIFs were discovered in all industries, in almost all regions. Similarly, Chan et al. (2006) concluded that high growth small firms experience similar management challenges regardless of the industry, size and revenue level. Acs et al. (2008) found out that HIFs represent 2% to 3% of all firms, and they account for almost all of the private sector employment and revenue growth in the economy. Clearly, being a HIF in the previous four years has a significant impact on firm performance in the subsequent four years, and the effect is more evident as firm size categories increase (Acs et al., 2008). The study suggests that there is a connection between the age of the firm and its performance. But even if they state that HIFs are younger than low impact firms, their average age is around 25 years.

Wiklund et al. (2009) use relative sales growth and sales growth compared to competitors, relative growth of employment and value growth (market value) compared to competitors as measures of growth. They conclude that resources have only an indirect effect on growth but environmental dynamism appears to have a complex relationship with changes over time, i.e., growth. Wiklund et al. (2009) argue that entrepreneurial orientation and growth attitude have a strong direct impact on growth. Littunen and Virtanen (2009) discovered that the growing ventures were more probably opportunity driven (pull motivation), used more often external financing (loans and public funding) at the start-up stage, applied group management style, had increased their production capacity, were adopting a specialised product policy but focusing on current customers, and were more open to external discussion. Littunen and Virtanen (2009) concluded that

growth generation is governed by motivation, strategic choices and decision factors. Their results imply that growing firms are not concentrating on subcontracting or specialisation but could be diversifying their activities with respect to new markets and customers and taking advantage of the economies of scale in their production. Growing businesses were likely to be extrovert in their communication but mainly used their internal strengths as their competitive edge in the market place.

Smallbone et al. (1995) argued that high growth can be achieved by firms with a variety of size, sector and age characteristics and one of the most important factors in achieving growth is the commitment of the leader of the firm. Few high growth firms were pulled along market trends but in most cases active strategies were necessary to achieve growth over an extended period. The best performing firms were the most active in managing their products and markets.

Markman and Gartner (2002) tested whether extraordinary high growth is correlated with firm profitability. They discovered that growth rate of sales and employment do not correlate with profitability. Only firm age and industry sector were significantly correlated to profit growth. They concluded that younger hyper-growth firms tended to be more profitable than older companies. Orser et al. (2000) studied the link between managerial capacity and firm growth comparing growing firms with declining firms. Parallel with the results of Acs et al. (2008) and Markman and Gartner (2002) they found that growing firms tended to be younger than the firms in the declining category.

Barringer et al. (2005) classified prior literature into four major areas: founder characteristics, firm attributes, business practices and human resource management. In order to test the framework, they used cumulative sales growth during a three-year consecutive period as the measure of growth. From the content analysis, Barringer et al. (2005) discovered new variables in three categories. The suggested new variables were entrepreneurial story (narrative) in founder characteristics, customer knowledge in business practices, and training and employee development in HRM practices.

Chetty and Campbell-Hunt (2003) examined what the relationships are between rapid international growth and business networks and how networks contribute to success. From the outcome of the case studies they concluded that business networks offer the only vehicle for internationalisation when the process is sudden and involves big increases in capability and specialisation. This implies that the use of external resources through networking is of the utmost importance for the rapidly internationalising firms. This outcome is supported by Littunen and Virtanen (2009) who state that a lively interplay between entrepreneur and external personal networks increases the odds of becoming a growth business.

The early studies on prediction of initial success and the impact of entrepreneurial and management experience were performed by Stuart and Abetti (1987, 1990). They concluded that entrepreneurial experience was one predictor of better performance. Parallel to their results, Cooper et al. (1994) found greater industry-specific know-how that could be interpreted as work experience to be typical of successful and growing firms. Thus, entrepreneurial skills could be measured by using the entrepreneur's past work and entrepreneurial experience, the type of vocational training and the age of indirect variables for skills. Baum et al. (2001) test a comprehensive multilevel model of venture growth including average annual sales, employment and profit as measures of growth. Similarly as Littunen and Virtanen (2009) they found that motivation and competitive strategies were direct predictors of venture growth.

Davidsson et al. (2009) and Steffens et al. (2009) used the resource-based view (RBV) as a theoretical framework and return on assets (ROA) as a measure of profitability. They hypothesise that firms which grow without securing high level of profitability tend to be less successful in subsequent periods compared to firms that take care of high profitability first. The study confirms that profitable growth firms are more likely to reach the desirable state of high growth and high profitability. They have a decreased risk of ending up performing poorly on both performance dimensions compared to firms starting from a high growth, low profitability configuration.

Cowling (2004) analysed the relative importance of firm and market effects on the profitability of firms. In the short-run, there does not exist any growth-profit trade-off. However, Cowling (2004) concluded that in the long-run, growth and profit are positively correlated so that growth generates profits and these profits enable future growth. SMEs focus on profitable growth but have much greater variation in their profits than large firms whereas large firms prefer maintaining their status quo rather than increasing profits through growth.

Roper (1999) investigated what determines firms' choice of business strategy and how strategy choice changes subsequent business performance. Roper (1999) used ROA, turnover growth and the efficiency of asset utilisation as measures of performance. In the short-term the growth of turnover and ROA are weakly correlated with high profitability. Small firm performance is shown to depend strongly on strategy choice and the growth of turnover is especially dependent on strategy choices. This result is supported by Littunen and Virtanen (2009). One strategy choice that had positive effects both on profitability and on growth was the development of new export markets.

Abetti (2005) studied in one case study the long-run development of Steria and the factors that have contributed to the success of the company using Greiner's stage model. He concludes that entrepreneurial characteristics, evolution of market opportunity and acquisition of the resources and luck have been the major contributing factors in Steria's success. Greiner (1972, 1998) suggests that the major driving forces to cope with tough times in the beginning of the 2000s were entrepreneurial family-like culture and creative leadership. Since we use a success index (SI) as the measure of the success of the firm these factors cannot be directly applied in our analysis. But we may reflect upon these results when analysing the overall development of our case companies.

Based on the previous literature and models in growth and performance studies we have built a framework for the interview in our case companies. The major components of the model include:

1 entrepreneur and experience including educational background and motives at start-up and growth (Baum et al., 2001; Cooper et al., 1994; Littunen and Virtanen, 2009; Veronique et al., 2000)

2 product and production policy (Smallbone et al., 1995; Littunen and Virtanen, 2009)

3 management and ownership – management team and board compositions (Barringer et al., 2005; Chan et al., 2006; Littunen and Virtanen, 2009)

4 finance – start-up funding, public funding and external sources (Birley and Westhead, 1990; Littunen and Virtanen, 2009)

5 market and customers – changes over the course of time, diversification and market innovations (Abetti, 2005; Cowling, 2004; Roper, 1999; Smallbone et al., 1995)

6 firms' strategic choices – growth and internationalisation, subcontracting, specialisation and protection of competitive advantage (Smallbone et al., 1995; Littunen and Virtanen, 2009)

7 social capital – networks, environment and trust in relationships (Chetty and Campbell-Hunt, 2003; Littunen and Virtanen, 2009).

This design was applied in themed interviews and in the organisation of the analysis.

In addition to the above framework, we asked for the entrepreneurs' own perceptions of what success and performance really mean for themselves. Questions asking what had been the main challenges in the development path and what kind of challenges could be expected to lie ahead in the future were also included in the interviews.

3 Methodology and data

In order to find out the real nature of the development of HGS firms we have followed in this paper more carefully some case firms. As Bygrave and Hofer (1991) state it is difficult to fit mathematical models in entrepreneurship studies. They argue that regression analysis usually generates smoothly changing analytic functions, while entrepreneurship deals with sudden changes and discontinuities.

In this analysis, our purpose is to identify and understand potential prerequisites and consequences of the HGS stage of SMEs. Since it came out that the amount of HGS firms is very small and no proper statistical analysis could have been performed, we selected multiple case approach as the method of analysis. The empirical path will be followed to define the entrepreneur's judgment and perception of the processes. Thus the unit of analysis in this study is an owner manager entrepreneur rather than a firm even if financial development and job creation will be analysed as the firm level phenomena. The study concentrates only on those existing firms that have experienced HGS period in 2002 to 2005. This could possibly cause some self-selection bias, but a totally objective analysis is quite impossible to attain in this kind of approach. Together values, judgments, beliefs and attitudes are generally a matter of subjective rather than objective characteristics, and as Arrow (1965, p.12) states, only the values and beliefs of an agent are relevant to explain his choice.

The criterion for selection of the cases required that average sales grow more than 20% in the period 2002–2005 and the growth is at least 15% every year. Thus the high growth firms have more than doubled their turnover in the four-year period. Success of the firm is defined by using the index constructed from the variables: earnings before taxes, current ratio, return on investment, equity ratio, debt ratio, repayment period of liabilities and business growth (Appendix 2). A firm should get annually at least 70 points out of a maximum of 100 to be classified as a highly successful business.

We selected HGS firms from the longitudinal data including 348 SMEs. Altogether these data included 49 HGS firms of which nine were located in Eastern Finland. From these data, we selected from Eastern Finland five HGS firms where both the growth and success had been above the industry average in 2002 to 2005 (see Appendix 1). We excluded four cases based on their branch of industry. The excluded firms represented such branches where they had monopoly power because of legislation (motor-vehicle inspection) or they could cause some bias in employment and job creation (labour leasing).

Our main interest in this paper was to understand how the firms have performed before and after their high growth and high success period. Moreover, we investigated the job creation process and employment growth. The annual figures of financial statements and key ratios of the selected SMEs were obtained from the Voitto+ database and completed the data with the latest financial statement figures from the Patent and Registration Office of Finland and annual reports (ePortti databases). Because of the availability of the data in Voitto + database financial figures of the case firms were mainly restricted to the years 2000 to 2009.

The primary data for the study were collected through interviews. The above framework for the theme interview was applied and used to analyse the results of the study. The interviews were carried out from 21 August to 15 September 2009, mainly in the offices of the case firms. All the interviewees were the main owners and CEOs of the firms. The interviews were recorded and transcribed accurately. The text was classified accordingly and the content was analysed.

4 Results and implications

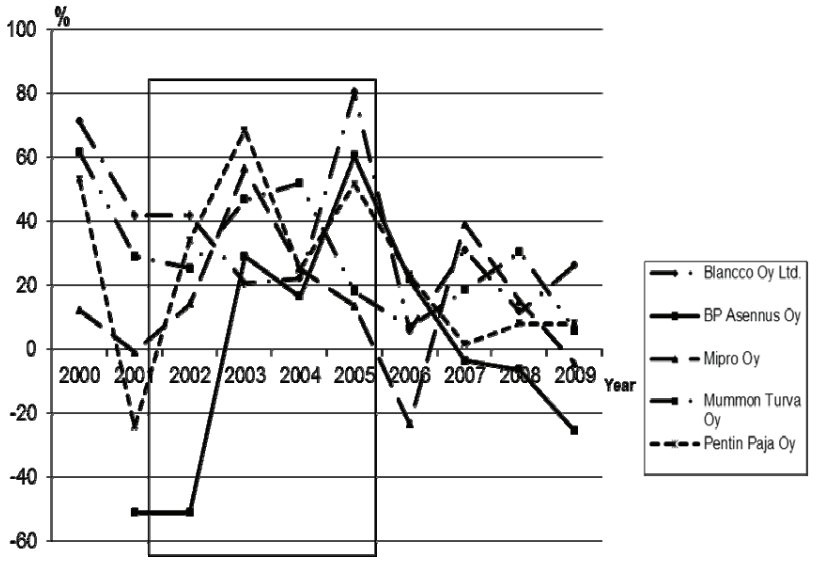
4.1 The development of the case firms

The characteristics and the development of the firms in the period 2000–2009 are described in Figures 1 to 3 and in Appendix 1. As can be seen all the firms have grown and succeeded well during the period 2002–2005. But before this period the trend of changes of turnover was declining in all the firms. After the HGS period both the turnover and ROA were mainly decreasing. The only exception is Mummon Turva Oy where ROA increased. ROA in Mummon Turva Oy was below 20% in 2004 and 2005 but because the SI takes into account the overall situation of the branch of industry, companies which score higher than the mean of the branch getting high SI figures. These findings are consistent with the results of Orser et al. (2000) which show that small firm growth is neither linear nor described well by biological paradigms (life-cycle theories). On the other hand, in HGS firms the changes of turnover and ROA seem to be parallel (cf., Davidsson et al., 2009; Steffens et al., 2009).

The overall trend of the development of employment in the case firms seems to be upwardly sloping for the whole period of our study. The only exception in this development is BP Asennus Oy where the changes in the number of personnel are mainly due to the high number of project workers. The firm uses a lot of part-time and temporary workers, too. The overall employment effect of the case firms is substantial. Altogether the firms employed 51 people in the year 2000. At the end of 2009, the total number of personnel was 218. Thus these firms create regionally a significant growth in employment and consistent with the findings of Acs et al. (2008) they can be considered regionally as HIFs.

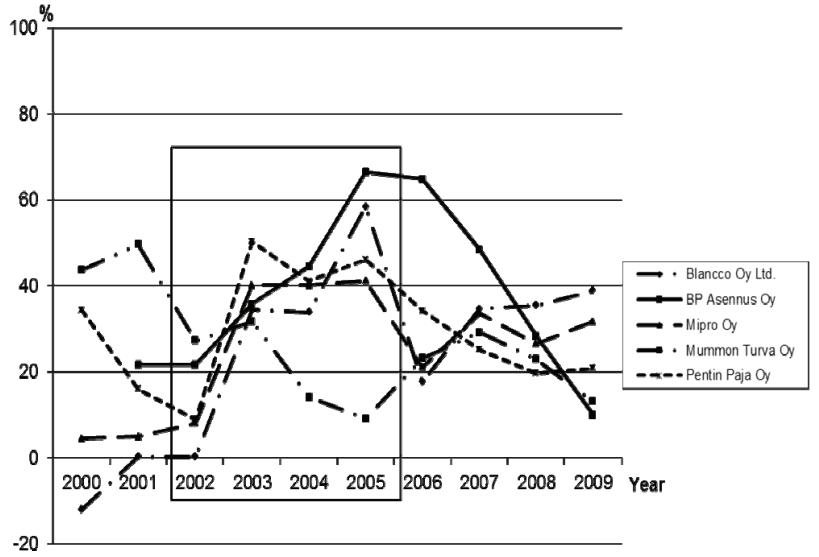
Based on the financial statement and annual report figures it seems that growth and success measured by profitability are parallel phenomena. Both the growth and profitability curves of the case firms fluctuate but the direction changes simultaneously. This result is consistent with Cowling's (2004) outcome that the movement of growth and profits is parallel but runs contrary to the conclusions of Davidsson et al. (2009) and Steffens et al. (2009) where firms first take care of profitability and then strive for high growth.

Figure 1 Change of turnover in case firms in 2000 to 2009



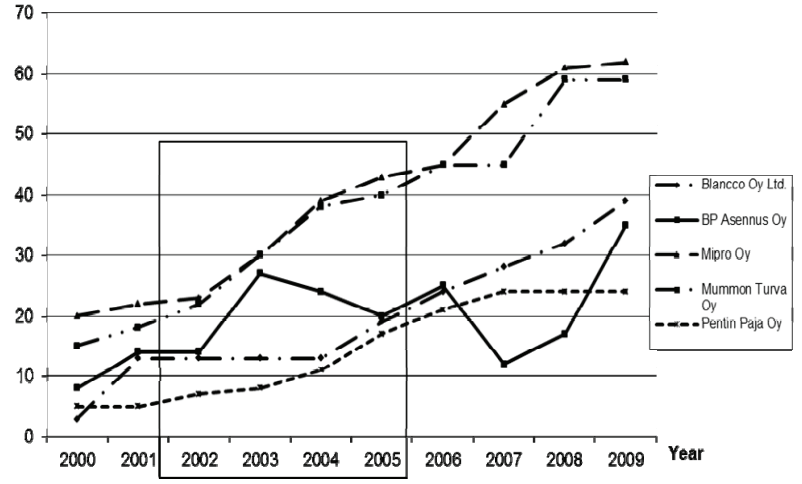
Note: Observations of HGS period within rectangle

Figure 2 ROA (%) in case firms in 2000 to 2009



Note: Observations of HGS period within rectangle

Figure 3 Number of personnel in case firms in 2000 to 2009



Note: Observations of HGS period within rectangle

4.2 Entrepreneur, management and ownership

Baum et al. (2001) suggested that CEOs' competencies and motivations are direct predictors of success whereas CEOs' traits and general competencies had significant indirect effects on venture growth. The case firms show two patterns of establishment (Appendix 3). Three of the businesses have been established by former classmates or colleagues and the other two are the result of the efforts of individual entrepreneurs. Currently, three firms are family businesses including two independently established ventures Mummon Turva Oy and Pentin Paja Oy. Mipro Oy is the third firm where the other founder was bought out in the middle of the 1990s.

Motivations at the start-up vary and are not self-evident and clear since the oldest firm, Pentin Paja Oy, was already established in 1964 and is currently taken care of by the second generation. Origins of some of the firms are clearly opportunity driven. Mipro Oy made a thorough market study before deciding on where to start activities: "the forest industry was the major customer of industrial automation. We made a market study and discovered that the large share of forest industry in Finland was located within a 150 kilometre radius from Mikkeli".

Push factor is evident in Mummon Turva Oy. CEO Jorma Hartikainen discovered after the recession that public services would be cut down and there would be a need for private efforts in that branch of industry in the future. "I was acting as a head nurse in a large service centre. We had to think about how to cope with the recession. Then we discovered that one field of outsourcing could be night work".

All the lead entrepreneurs had some entrepreneurial experience at the beginning but the only firm where the entrepreneurs had start-up experience before taking the lead in their current venture was BP Asennus Oy. All the entrepreneurs at the head of family businesses had vocational training and some experience in the same branch of industry.

The entrepreneurs in venture capital backed firms (Blancco Oy Ltd. and BP Asennus Oy) had university backgrounds. Moreover, the entrepreneurs of BP Asennus Oy had had experience of failure in the IT business before taking over the running of BP Asennus Oy. These results support the view of Veronique et al. (2000) that there exists no typical successful starter (Appendix 3).

Compared to the previous studies (e.g., Littunen and Virtanen, 2009) the case firms do not seem to have an unambiguous management mode. A management team exists in one family firm and one venture capital backed firm. As Abetti (2005) suggested, the family firms in our study could also be seen as representatives of entrepreneurial family-like culture. Creative leadership is shown in Mummon Turva where the shop steward belongs to the management team and thus ensures the satisfaction of employees.

4.3 Finance and public funding

The three family firms were committed to stabilising their own financial situation and using mainly retained earnings for the development of the business after the critical event that changed the direction of the firm. Both Blancco Oy Ltd. and BP Asennus Oy which have been established by university classmates have attracted venture capital. All the firms but Mummon Turva Oy had public support for their investments or R&D activities in the early years of the development. "We use all the available public funding as effectively as possible" states the CEO Kim Väisänen of Blancco Oy Ltd.

Mipro Oy was planning to expand its operations remarkably when the money market was liberalised in Finland at the end of the 1980s.

> "We ran towards the wall and were forced to reorganise the activities. The main challenge was to survive and avoid debt restructuring. If you have a lot of accounts payable the deliveries will end if your debts will be restructured. Currently, our customer Ratahallintokeskus trusts us to take care of the contracts. For us it will be a matter of honour to deliver on time."

Outokummun Metalli Oy partly financed the product development of Pentin Paja Oy in the 1990s. After the interview the firms deepened their cooperation so that Outokummun Metalli Oy bought half of the shares of Pentin Paja Oy. "We invested all the available funds back in the company in order to generate new profit. We have followed that kind of practice otherwise but got some funding from Finnvera for the real estate investment with a very low interest rate".

Our cases demonstrate that start-up entrepreneurs with university background attract venture capital investments. On the other hand, family businesses rely on internal sources and retained earnings first and are not very eager to accept external owners. The line of thought of family business owners is consistent with Birley and Westhead (1990) who argue that the use of external finance correlates negatively with profitability. The interviews of the lead entrepreneurs of family firms confirm that the growth should be managed so that first you should take care of profitability (cf., Davidsson et. al. 2009; Steffens et. al. 2009).

4.4 Market and customers

Three of the businesses, BP Asennus Oy, Mipro Oy and Mummon Turva Oy, sell their products totally to domestic customers. Blancco Oy Ltd. exports 92% and Pentin Paja Oy

about 50% of their products. All the case firms have different customer orientation and focus as well as different competitive advantage which depends on the major markets of the firm. Globally operating Blancco Oy Ltd. emphasises the importance of sales and distribution as well as close connection to the customers.

> "It took ten years to learn that in the software business nothing else matters but sales organisation and business model. In order to maintain competitive advantage you have to have big ears to listen and find out the needs of customers, to satisfy them and in addition to surprise the customer positively."

BP Asennus Oy is highly dependent on the subcontracting of six large domestic customers and the services are produced as the customer demands. In order to keep the existing large businesses you have to offer better service and quality than your local competitors. "Price is not a decisive factor but the current customers are willing to pay more for the existing qualified resources. In practice it would be impossible to get a new customer at the price we receive from the old customer base".

The market of Mipro Oy consists of automation of the infrastructure in waterworks and safety systems for the railways. Both of the business areas include mainly public customers and thus the projects are long-term investments which usually are financed through budgetary funds. The firm has long-term partnerships and framework contracts where the project will be split into parts. The market is small, including four to five players operating in Finland where Mipro Oy is the largest private player. Competitors and challenges come from the international market. According to CEO Raimo Laine the solution as to how to differentiate the business from competitors is:

> "Quality, and compared to the international competitors, the methods and approach are different. The difference in the approach will concretely mean that we listen to what the customer wants to have, whereas the large international competitors sell what they have produced without taking into account the desire of customers. If the customer then really expresses some need of novelty the price is so exorbitant that the customer does not want it anymore."

Mummon Turva Oy considers that the need for taking care of elderly and sick people is growing. This growing demand has also increased competition. Competitors are both large and small firms. The competitive advantage of Mummon Turva Oy is based on certified quality services and flexible assignment of employees.

Because of climate change and the increasing demand for renewable energy the market for harvesting and energy wood processing machines is growing, too. Pentin Paja Oy's products respond exactly to the need for harvesting energy wood. The competitive advantage of Pentin Paja Oy is product innovation and flexible assignment of employees.

> "Part of the product ideas comes from customers and part comes through our own thinking. Good inventions are always simple. Because the market for energy wood has soared and we started in the middle of the 1990s to produce harvesting machinery for energy wood we are currently ten years ahead compared with our competitors. It requires time before people are ready to buy completely new machinery. It should be known and safe. If the machine has been operating for ten years it is much easier to buy."

In the interviews we dealt also with business environment and social capital issues. All the case firms were satisfied with the current environment and business conditions. Social capital issues appeared indirectly in customer relations. This was mainly referred to when

the entrepreneurs described their relationships with their main customers and their reputation regarding professionalism and timely deliveries.

Even if the case firms have different customer orientation and focus, they emphasised the importance of the recognition of customer needs and listening to customers. This finding is in line with Barringer et al. (2005) who proposed customer knowledge as one new variable for business practices. Sales organisation and distribution channels in international markets were suggested to be of major importance, similarly as in Chetty and Campbell-Hunt (2003). Resource-based view and direct impact of resources was evident in BP Asennus Oy where subcontracting is the main business.

4.5 Firm's strategic choices and growth strategies

When we analysed the development of the case firms, we identified certain critical events which had a large impact on the firms' performance. In Blancco Oy Ltd. the critical event was the disagreement over the focus of the firm. The other owner wanted to have a wide selection of software products whereas the current CEO Kim Väisänen required the firm to focus on data erasure only. "My ex-partner would have liked to continue with several product lines. I wanted to concentrate on data erasure. We had several consultants who supported my view on concentration". This development follows with Greiner's (1972, 1998) arguments: "in the first entrepreneurial phase, the professional service firm pursues and tests the variety of market paths. The phase ends with the partners arguing about whether or not to stay together to concentrate on one partner's vision for the future".

From the perspective of the current owners of BP Asennus Oy bankruptcy of the IT-business was a critical event which led to the acquisition of BP Asennus Oy. In Mipro Oy, the change of ownership at the end of the 1990s could be seen as a critical event. The strategy was changed from sales and agency efforts to focusing on the projects in the two niche markets, infrastructure of waterworks and safety systems in railways. "The other owner who was mainly responsible for sales of appliances was bought out and we started to focus strictly on the projects where we took the holistic responsibility".

The change of location from Nurmes to Joensuu was a critical event in the activity of Mummon Turva Oy. This change caused a hiccup in sales in 2005.

> "It had started already in 2004 when I ceased to work the night shift. That caused displeasure among employees who said that he does not really sing for his supper. As long as I acted as a friend-manager the company was fair but after I began to behave as a professional leader things became more complicated. They said that you do not know anything about this work even though I had more than ten years' experience of ordinary work."

The death of the lead entrepreneur Pentti Häikiö was a critical event in Pentin Paja Oy. The successors had to consider the continuation of the business. After the recession the financial situation was difficult but the firm had good innovative products and more than one million Finnish marks ($200,000) in orders.

> "When father died in February 1996, we had to decide what to do. I had been educated as an anaesthesia nurse during the recession but decided to continue father's work because we had a full order book. In the small village we had to retain our reputation and thus we settled the debts of the firm."

The driver for growth of Blancco Oy Ltd. will be the obvious growth of the need for data erasure. The amount of data will increase 150% in two years. New editions of different devices, terminals and servers will create a rising market for the applications. In the future there will be more need for mobile solutions and new methods. For BP Asennus Oy growth strategy is dependent on their ability to get more employees. Currently it would mean that the firm could give work to those professionals who are laid off in the region. Thereafter recruiting more personnel will cause problems since there are always some candidates who are inappropriate for the tasks offered.

The decision about internationalisation is a real challenge for Mipro Oy. If the firm wants to grow it has to internationalise or diversify its activities to other branches of the industry. Eastern markets include too high risks. The firm participates in the export group which has China as a target market. According to the CEO Russia is not an actual market yet, but former Eastern-Bloc countries have large potential. "If the decision to go abroad will be made we will do it seriously, not just in order to test the market".

In Mummon Turva Oy, the growth motivation is evident: "the aspiration to grow is strong but we must control the growth as well as possible by using retained earnings and picking the raisins from the cake". CEO Hartikainen states that all business areas will be growing. The new firm Joen Onni Oy was established to take care of home services in Joensuu. The use of electronic communication systems makes geographical expansion easier but very distant areas cause some problems with meetings and foremen would probably be needed to manage these distant locations.

Profitable growth is also the dominant strategy in Pentin Paja Oy. "We do not seek such growth which is not explicit from the very beginning or at least possible to foresee. We do not invest like crazy when the family business is in your own hands, you do not have to take crazy risks". The CEO highlights how surprisingly well they have managed high growth compared to the resources of the firm. When it comes to the need for funds in investments they have been very lucky, too.

> "In our first location the growth of activities would have been impossible since there was not enough space for production. Then we got from the Ilomantsi municipality the donation of production space which normally would have required millions in investment. In the 2000s we already had construction plans for production expansion when my wife noticed the suitable space which was for rent. Later on we had an opportunity to buy the facilities and got funding from Finnvera. We were very lucky to get a suitable space and did not have to move away."

Roper (1999) states that small firm performance will depend on strategy choices and growth of turnover will be particularly strategy dependent. Especially the family firms in our study challenge this proposition and lead us to suggest that the firms focus on strategy where profitability will be taken care of first before managed growth. The development path of the case firms as well as the interviews demonstrate that the firms have focused strategies which have been changed because of some critical event (cf., Littunen and Virtanen, 2009; Smallbone et al., 1995). Even if the strategies focus on very narrow niche markets they could be very successful in the international market (Blancco Oy Ltd. and Pentin Paja Oy).

4.6 Success

All the lead entrepreneurs had different perceptions of the success of the firm. Financial success which is mainly used as a measure of success in empirical studies appears to be more an indirect measure of the experience of success (Stuart and Abetti, 1987). The closest perception compared with the classical perspective of entrepreneurship literature was stated by the CEO of Blancco Oy Ltd. First he defined success as: "reaching the realistic objectives you have set". The objectives may include such variables as growth, profitability and the number of personnel. But he also proposed that the increase of employment is not so necessary if you can grow and be profitable without additional staff. He emphasises that you have to achieve a decent return on your investment. "I have never understood entrepreneurship, as such, to be an intrinsic value. That does not make sense. Entrepreneurship includes risk and you have to get a better pay-off from your efforts compared, for example, with being a civil servant".

The chairman of the board of BP Asennus Oy does not see his experience as that of a successful entrepreneur. "Success will involve some kind of independence and that is the highest reward of success". The lead entrepreneur points out that when the firm fares badly no other people but the entrepreneur can be accused. On the other hand, when the firm succeeds the entrepreneur may take a small part of the credit but several others should take credit for the success, too.

In Mipro Oy, success was seen as survival of the business and trust and perception of professionalism by their customers. Financial success which follows from the professional effort will be used as an incentive. When the firm succeeds financially the outcome will be shared out to personnel. "Over several years they have received one month's salary as a bonus".

"For me success means that it has been quite easy to plan the future and to secure my old age with a pension plan" says the CEO of Mummon Turva Oy. He is planning to make a transfer of the firm to his descendants. He notes that: "the best characteristic of entrepreneurship is that you are yourself responsible for the outcome of your effort. If your firm fares badly you cannot accuse anyone else but yourself that you have made an inferior offer".

In Pentin Paja Oy the success is seen to be involved in the development of the firm. "That is something we are seeking all the time. I do not know if it is some special state of affairs, even if you succeed we continue to work as normal". Pentin Paja Oy has received several prizes, for example, an internationalisation prize and regional innovation prize. External appreciation creates gratitude and good feelings and act as incentives for improving activities. "But even the larger incentive is the actual growth since all the time you are afraid of having no success and no profit at all. Such a stable state of affairs does not exist but is continuously up or down".

The majority of performance studies use some kind of financial ratio such as profitability or job creation as measures to describe success (Acs et al., 2008; Davidsson et al., 2009). The entrepreneurs themselves, even if some of them highlight the importance of profitability and return on investment, consider such subjective measures as independence, professional pride, family values and external recognition as their major motives and incentives for their entrepreneurial career. Moreover, the lead entrepreneurs are quite modest and did not claim themselves to be really successful entrepreneurs.

4.7 Challenges

The most demanding challenge for Blancco Oy Ltd. is the size of the firm since they are in a difficult size category. "We are not a large firm but not a really small one either. The largest challenge in my opinion is how do we handle this intercultural diversified organisation? Research on software firms shows that in the size category 35 to 50 persons – where we are currently in Finland – the development goes up or down. If it goes up the CEO is not able to decide all the issues". Following Greiner's (1972, 1998) idea of the development of the organisation, Blancco Oy Ltd. could be considered to be in the third phase of development where organisational structure will be geographically decentralised and more delegation is needed.

For BP Asennus Oy the most challenging issue is ownership and the markets in the subcontracting industry. The lead entrepreneur's experience is that the other owner does not contribute to the development of the firm but takes advantage of the outcome. This decreases the motivation and incentives of the lead entrepreneur. On the other hand, the lead entrepreneur believes that when the economic boom takes place – his own estimate is within one to three years – the demand for installation subcontracting will soar. Then the firm will have to be ready to respond to the increasing demand.

Survival and building of trust was the major challenge of Mipro Oy in the middle of the 1990s. After survival and creation of the solid financial status the challenge has been to be evaluated as a real professional by the customers and stakeholders. Currently the toughest challenge is internationalisation. In the current market they do not have any room for expansion. Thus further growth demands new markets which could be found abroad. The challenge of large competitors is the major concern of Mummon Turva Oy. "We have to get along with the small competitors anyway but how do we manage with the large competitors?"

The CEO of Pentin Paja Oy states that the future seems to be really excellent. "We have been negotiating about collaboration with one firm and we have really enormous opportunities connected with our products, markets and new innovations". All in all, the challenges the case firms are facing in the future are connected with the competitive environment and management of growth in domestic and international markets.

5 Conclusions

In this study, we have analysed the development of five case firms which have grown fast and been highly successful in the period 2002–2005. Our analysis focuses on the period before and after the high growth and high success stage, too. The analysis gives us suggestions for the different development paths of high growth and highly successful SMEs.

Based on the financial statement and annual report figures in 2000 to 2009 it seems that growth and success measured by profitability seem to fluctuate a lot. During the HGS period their development seems to be parallel. Both the growth and profitability curves of the case firms fluctuate but the direction changes simultaneously. This result is consistent with Cowling's (2004) outcome that the movement of growth and profits is parallel. From the perspective of job creation the outcome of Acs et al. (2008) would be supported. From the beginning of the period of the study the trend of employment shows clear upward development in all but one of the case firms. BP Asennus Oy is an

exception because it uses a lot of temporary workers in different projects and this is the main reason for lower employment growth. The firms have more than quadrupled their overall employment in the 2000s.

The results of our study support the view of Veronique et al. (2000) that there exists no typical successful starter but we identified two different start-up categories, namely family businesses and firms established with former classmates. Our cases demonstrate that start-up entrepreneurs with university backgrounds attract venture capital investments but family businesses rely on internal sources and retained earnings. The family firms in the study focus on the strategy where profitability will be taken care of before managed growth (cf., Abetti, 2005). All the case firms have focused strategies which have been changed because of some critical event (cf., Littunen and Virtanen, 2009; Smallbone et al., 1995). Since our focus has been on simultaneous growth and success measured by the SI, we have not used evolutionary approach in our analysis. Following Abetti (2001), it could be argued that these critical events have been crises connected with leadership and organisational structures. Even if the strategies focus on very narrow niche markets they may be very successful in the international market (Blancco Oy Ltd. and Pentin Paja Oy).

Entrepreneurs emphasise subjective measures of success including independence, professional pride, family values and external recognition as their major motives and incentives for their entrepreneurial career. These findings support (Achtenhagen et al., 2010) who suggest that entrepreneurs give several meanings for growth and success including also traditional performance indicators.

The emphasis of the case firms is on customer needs and listening to customers. This finding is in line with Barringer et al. (2005) who proposed customer knowledge as one new variable for business practices. Similarly as in Chetty and Campbell-Hunt (2003) sales organisation and distribution channels in international markets were seen to be most important especially in export market. Resource-based view and direct impact of resources was evident in some cases (Blancco Oy Ltd. and BP Asennus Oy), which contests the findings of Wiklund et al. (2009) that resources have only an indirect impact on growth.

Major challenges of case firms are connected with the management of growth and internationalisation. Especially in such companies like Blancco Oy Ltd. where the major part of the turnover is generated in the international market the management should be adaptable to agile strategy and prepared to delegation and sharing of responsibilities.

The contribution and main implications for SME owners and especially family businesses are that firms should first have the patience to take care of profitability and thereafter strive for growth. Focused strategy may ensure more effective concentration on core activities and thus generate a more profitable outcome. The policy makers should identify different categories of businesses when allocating resources. Family business and venture capital backed university spin-offs need different support and advice during their development. For the educators and researchers the implication is that the heterogeneity of branches of industry and types of businesses should be taken into account when formulating programmes and planning studies about SME performance.

The results of our study cannot be directly generalised since we have selected the case firms from the population of firms which were growing more than 10% annually in 2002–2005. Thus comparison with the studies where the data include also declining and non-successful firms is not straightforward. In this study, we have not paid attention to the methodological problems of measuring growth. The variables used to describe the

performance are mainly discontinuous. Thus they do not inevitably capture such dimensions as dynamic capabilities, knowledge systems and absorptive capacity (Macpherson and Holt, 2007) which may be relevant for growth and success of SMEs.

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Appendix 1

The characteristics of case firms

	Founded	*Products*	*Personnel '09*	*Turnover M€, '09*	*EBIT '09, M€*
Blancco Oy Ltd.	1994	Data erasure	39	3.4	0.7
BP Asennus Oy	1996	Services (installations, welding and monitoring) in metal industry	35	2.0	0.1
Mipro Oy	1980	Infrastructure for water treatment Security systems especially for railways	61	10.2	2.2
Mummon Turva Oy	1994	Healthcare in night time	59	2.9	0.1
Pentin Paja Oy	1964	Manufacturing and sales company, specialising in solutions for forest- and construction machines and equipment	24	2.5	0.4

Appendix 2

Scoring table of SI

Classification points	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
ROI %	–1.9	0	1.8	2.7	5.8	8.9	13	16.4	21.9	27.4
EBIT %	–6.3	–4.7	–3.1	–1.8	–0.5	0.5	2	3.6	5.2	6.7
Current ratio	0.7	0.9	1	1.1	1.3	1.5	1.7	2	2.2	2.5
Equity ratio	0	7	11	15	22	30	38	45	51	57
Debt ratio	785	536	411	287	191	94	58	21	0	–12
Repayment period	100	60	40	20	12	5	3	1	0.5	0

Success index

This study exploits SI developed by Balanced Consulting Ltd. SI measures financial success of the firm. The reason to use this index is the fit of the index with the database that Balanced Consulting Ltd. has also provided, too. In order to find out the holistic financial success not only profitability, but also other aspects such as capital structure and liquidity of the firm should be taken into account.

The content and construction of the SI

In SI definition the firms are classified in ten different classification point categories according to their financial data. Before using different financial parameters, the financial statements of the firm have been adjusted by using the instructions of international accounting standards of financial statements (IAS) and the instructions of Finnish Advisory Board of Corporate analysis (YTN). IAS have been used:

a to prevent the effect of random capital gains on annual growth and success classification

b to increase the reliability of comparisons in different branches of industry

c to create more holistic view of the financial success at the firm level.

The following variables are used in constructing SI: return on investment, earnings before taxes, current ratio, equity ratio, net gearing, repayment period of liabilities and business growth. The selected financial key figures are not dependent on the branch of industry. Financial parameters produce classification points which fluctuate from zero to ten points.

The overall success classification of the firm is received by summarising classification points of the firm (max. 60 points). SI is the relative figure where the minimum is 0 and maximum 100.

The key parameters have been calculated by using the following formulas:

$$\text{Current ratio (CR)} = \frac{\text{Inventories} + \text{Short-term receivables} + \text{Liquid assets}}{\text{Short-term debts}}$$

$$\text{Debt ratio (DR)} = \frac{100 \times (\text{Debt} - \text{Liquid assets})}{\text{Equity} + \text{Voluntary provision} + \text{Minority share}}$$

$$\text{Earnings before taxes (EBIT)} = \frac{100 \times \text{Earnings before taxes and Interest rate}}{\text{Turnover}}$$

$$\text{Equity ratio (ER)} = \frac{100 \times (\text{Equity} + \text{Provision} + \text{Minority share})}{\text{Balance sheet} + \text{Advance payment}}$$

$$\text{Repayment period (years)} = \frac{\text{Debt} - \text{Liquid assests}}{\text{Earnings after interest} - \text{Taxes} + \text{Depriciation}}$$

$$\text{Return on investment (ROI\%)} = \frac{100 \times (\text{Earnings} + \text{Cost of finance})}{\text{Return on investment}}$$

Appendix 3

Characteristics of variables of case firms

	Blancco Oy Ltd.	*BP-Asennus Oy*	*Mipro Oy*
Entrepreneur and experience	• Established with former classmate • Entrepreneurship not a major objective of the lead entrepreneur • Father, grand-father and great-grand father were entrepreneurs.	• Established with former classmate • Experience of failure IT-firm went bankrupt • Bought the company from firm broker without own funds	• Established with former colleague as a limited partnership • Change in ownership in the middle of 1990s • More than ten years family business
Management and ownership	• Management Team 4 members, regular meetings • Board 5 members, 4 external • Lead entrepreneur owns 41.5% , venture capitalist 23%	• Board 3 members, 1 external, regular meetings • Lead entrepreneur owns 60% and former classmate 40%	• Family business MGT discontinued and external reference group activated
Finance	• 0.5 M€ seed funding for data erasure 2000 • 2001 seed financing spent ↔ threat of bankruptcy VC involvement	• Support funding for acquisition, venture capitalist and public financier	• Public funding at the beginning • Retained earnings after change of ownership
Market	• The need for data erasure is growing. • International competition mainly from US • Competitive advantage: listen to customers	• Highly dependent on subcontracting of 6 large domestic customers • Competitive advantage: own service better than local competitors' service	• Small market 4–5 players operating in Finland • Competitive advantage: long-term partnerships and framework contracts
Firm's strategic choices	• Focusing on data erasure (2002) • Development of different editions	• Adaptation to the changing situation • Focus on customer relationships	• No debt • Focus on projects

Characteristics of variables of case firms (continued)

	Mummon Turva Oy	*Pentin Paja Oy*
Entrepreneur and experience	• Established by the lead entrepreneur • Solution for a customer problem (night shift) • Problems with tax authorities and the public sector employee resistance characterised start-up	• Established by the father of lead entrepreneur • Death of the entrepreneur forced the family to consider how to continue. • Full book of orders and social pressure for continuation
Management and ownership	• Family business MGT 4 family members 1 external (shop steward) • Board, no external family members	• Family business no regular MGT meetings • Board 3 family members
Finance	• No external support funding at the beginning • Public R&D funding for one R&D project (quality system)	• Public funding for investment, several R&D and internationalisation projects
Market	• The need for taking care of elderly and sick people is growing • Increased competition of both large and small firms • Competitive advantage: certified quality services and flexible assignment of employees	• The need for machinery for harvesting energy wood is growing • 50% export (28 countries) • Competitive advantage: product innovations and flexible assignment of employees
Firm's strategic choices	• Focus on elderly people's healthcare at night time • Profitable growth	• Focus on R&D projects and product innovations • International profitable growth

PART 2: ARTICLES

IV

Siikonen, J., Heimonen, T. and Pellikka, J. (2011). Developing innovation support services for small high-growth technology firms in Eastern Finland. International Journal of Entrepreneurial Venturing, Vol. 3, No. 4, pp. 392-419.

Developing innovation support services for small high-growth technology firms in Eastern Finland

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Abstract: This study examines innovation support service requirements of small, high-growth firms in Eastern Finland. The results show that most rapidly growing firms in the region can be defined as small, knowledge-intensive business service (KIBS) providers. In order to create and commercialise innovation these firms use various innovation support services (most frequently technology-related and internationalisation-related services). The results also show that there is a concrete need for intermediary organisations that help small technology firms to choose appropriate innovation support services and generally act as external strategic partners during the commercialisation of innovation process. Providing convenient access to suitable 'brokers' may thus enhance the contributions innovation support services can make to the development of small, high-growth technology firms.

Keywords: innovation support services; regional development; high-growth firms; growth entrepreneurship; knowledge-intensive business services; KIBS; Finland.

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1 Introduction

Endogenous growth theories (Bresnahan et al., 2001; Cooke, 2002; Marshall, 1920; Porter, 1998; Storper, 1992) lack both the ability to explain why certain firms operating within a given region grow rapidly, and the ability to predict which firms will grow most rapidly. In attempts to enhance traditional growth theories, entrepreneurship researchers (in particular) have been interested in explaining characteristics of single firms' performance and hence have analysed symptoms of growth from various firm-based perspectives (see, for examples, Chrisman et al., 1999; Davidsson and Wiklund, 2000; Delmar et al., 2003; Evans, 1987; Gibb and Davies, 1990; Littunen and Virtanen, 2005; 2006; Moreno and Casillas, 2007; Pasanen, 2003; Sandberg and Hofer, 1987; Storey, 1994).

Previous studies focused at firm-level have underlined that innovation is one of the most important sources of growth. Therefore, innovation policies in Europe have been strongly targeted to enhance the creation and exploitation of innovation, particularly in the small firms that are perceived as being important sources of innovation (e.g., Blakely, 1994; Bridge et al., 1998; Malecki, 1997). At the same time, many small, growth-oriented firms have become increasingly dependent on external knowledge sources due to their incapability to generate all the knowledge required for the creation and commercialisation of innovation (Cormican and O'Sullivan, 2004; Pellikka and Lauronen, 2007). However, previous studies have reported that regional innovation support services have failed to meet these requirements (see e.g., Kaufmann and Tödtling 2002; Pellikka and Virtanen, 2009; Pellikka, 2008). Therefore, it is essential to develop innovation support services that are specifically targeted to support small technology

firms' growth in the regional context, but there has been little research regarding the kind of support that is needed and how it should be provided (Blakely, 1994; Klofsten and Jones-Evans, 1996). This paper assesses the support required by fast-growth firms in Eastern Finland. Such firms are here defined using essentially the definition of 'gazelles' presented by Birch (1979): "A gazelle firm has to grow at least 20% a year for four years, from a base of at least $100.000 in revenues, thus at least doubling in size over that four-year period". However, in this paper the timeframe applied in the definition for doubling revenues is different (three years). In addition, West and Farr's (1990) broad definition of the term 'innovation' is adopted: "*the intentional introduction and application within a role, group or organisation of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group, organisation or wider society*."

This paper examines in detail the business requirements of small, high-growth technology firms that are not fully met by regional innovation support services, to ascertain ways in which the services should be adjusted to enhance the overall growth of small firms, especially small knowledge-intensive technology firms in Eastern Finland. In order to do so, the following question was addressed: *What enhancements to regional innovation support services can regional policy-makers and economic developers make to foster the overall growth of small firms?*

However, in order to answer this question, the following subsidiary questions first had to be addressed: *What are the fast growing industrial branches in Eastern Finland? What characteristics distinguish firms in fast-growing industrial branches from those in other branches? What do these small firms require from regional innovation support services?*

In order to address these questions, the study is organised as follows. The second section discusses previous literature related to the role of high-growth firms and entrepreneurship in the Finnish economy, describes distinguishing characteristics of the identified fast growth sectors, presents background information regarding innovation support services (ISS) targeted for small technology-intensive KIBS firms and reviews the potential benefits they can provide. Section 3 describes the methodology and data acquired, the results are presented in Section 4 and finally, in Section 5, conclusions and implications of the results are discussed.

2 Supporting high-growth small firms

Ideally, policy-makers and investors should distinguish between SMEs (which are key components of Europe's economy) that will stay small and those that will grow, because although entrepreneurship is a major focus of industrial policy it is rare. For example, in Finland, the median size of new firms surveyed by Hyvärinen and Rautiainen (2006) three years after their start-up was one, i.e., the average firm employed only the focal entrepreneur. Further, most new firms will never employ anyone other than the founder, and the owners of only 7% of Finnish firms surveyed by the former Finnish Ministry of Trade and Industry wanted their firms to grow (KTM, 2004). Various studies have also shown that most firms do not innovate in the sense of developing new products and technologies or conquering new markets. Most businesses operate in their local market and often focus on small-scale provision of services or trading in well-established or even

'old-fashioned' products (Hyvärinen and Rautiainen, 2006). In Finland, only about 5–10% of new firms can be considered innovative (Rouvinen and Ylä-Anttila, 2004).

However, many studies have shown that growing firms are essential to regional development because of their high overall contribution to job and value creation (Davidsson and Wiklund 2000; Keeble, 1997; North and Smallbone 2000; Storey, 1994). The economic importance of small, growing firms and their founding entrepreneurs cannot be understated. Therefore, governmental and local development organisations need to target innovation support services towards ventures with high growth potential in order to increase the efficacy of job creation; there is a real need to support these high-growth firms that actually generate employment to promote local and national growth.

2.1 Growth entrepreneurship in Finland

According to data from the Finnish Trade and Industry Ministry and Statistics of Finland (2007), around 237,000 firms are currently operating in Finland, of which only ca. 7% (16,600) are growing (in terms of salaries and/or sales). Further, rapidly growing firms ('gazelles') account for just ca. 0.2% (n = 473) of the total national firm population in Finland. This frequency of gazelle firms is similar to the proportion reported in a previous study (Autio et al., 2000) of the economic impact of gazelle firms in Finland during 1994 to 1997.

In previous growth studies the exclusion of some branches of industry, notably services and trade, has been one of the most severe shortcomings, since services currently seem to be the most important components of the economy in most developed countries. Further, venture capitalists typically include such businesses in their portfolios since they are thought to have high growth and success potential. However, the proportion of such companies which successfully obtain venture capital is very low (2–5%) and their regional distribution is often biased in favour of the most developed regions. Thus, more high growth businesses are likely to be based in urban than in rural areas (Virtanen and Heimonen, 2007).

One of the sub-objectives in this study is to obtain detailed understanding of a specific, fast-growth sector (services, here and hereafter including KIBS), by using publicly available data and case studies to compare characteristics of firms operating in it to those of firms operating in other branches of industry in Eastern Finland. The study appraises the role of existing service businesses in contemporary contextual economic development. Further, the study increases empirical knowledge regarding existing fast-growth KIBS firms, which have been largely neglected in growth-focused entrepreneurship research in Finland and elsewhere. A large proportion of previous performance studies have concentrated on the development of new ventures from start-up during early stages of their growth. However, even if the establishment of new start-ups is important, it could be argued that the development of any region is highly dependent on the growth and success of existing businesses within it (Virtanen and Heimonen, 2007).

2.2 Growth in the KIBS sector

Small firms are widely regarded as promoters of economic growth, regionally, nationally and internationally (Westhead and Storey, 1994). The positive impact of these firms is

generally related to their capability to create, transfer and exploit innovations (Autio, 1998; Fontes, 1997; Kuratko and Hodgetts, 2001). In addition, growth-oriented small firms have a strongly positive effect on employment in their respective regions (Storey, 1994). However, innovation literature has previously focused mainly on innovation by and in large firms (e.g., Woodcock et al., 2000), and relatively few empirical studies have focused on innovation in small firms (Gudmundson et al., 2003).

Innovation and renewal of organisations are regarded as providing a basis of competitive advantage; the means by which organisations anticipate and meet customer needs, and the method by which organisations utilise technology (Schumann et al., 1994). Further, innovation is expected to play an increasingly crucial role in determining organisational success (Tushman, 1997). For instance, Kanter (1997), Kao (1997) and Tushman (1997) have argued that the ability of organisations or companies to innovate is one of the key competitive capabilities that organisations must acquire to be competitive in the 21st century, and Lengnick-Hall (1992) has demonstrated a connection between innovation and sustainable competitive advantage. Indeed, it is argued, firms need to develop new products and services through active renewal and innovativeness to gain (or maintain) competitive advantage due to the continuous change of the environment (Abell, 1999; Lengnick-Hall, 1992). However, innovation and the maintenance of competitive advantage are not solely driven by firms' internal resources. According to Oerlemans et al. (2001) "*innovation output depends on the presence and volume of innovation resources and the utilisation of the internal and external resources in the innovation process*". KIBS can play important roles in this, since they are private companies or organisations that provide intermediate products and services to other companies and organisations, based on high-level knowledge and expertise related to specific (technical) disciplines or functional domains (den Hertog, 2000; Hermelin, 1997; Miles et al., 1995).

One of the important characteristics of KIBS firms from a regional development perspective is that they employ unusually high proportions of graduates, trained in various disciplines (Miles, 2005), which is not surprising since KIBS have been defined as services that involve "*economic activities which are intended to result in the creation, accumulation or dissemination of knowledge*" (Miles et al., 1995) and they "*can be described as firms performing, mainly for other firms, services encompassing a high intellectual value-added*" (Muller, 2001). At a general level, KIBS can be divided into two groups: traditional professional services/non-technological KIBS (KIBS class I, P-KIBS; e.g., accountancy and bookkeeping, legal services, marketing and advertising, management consultancy and labour recruitment services) and new technology-based KIBS, KIBS II or T-KIBS (e.g., computer and information-technology-related services, technical engineering services, privately funded research and development services) (see Miles et al., 1995; Werner, 2001). This study focuses largely on the latter.

KIBS can play multiple roles in the national innovation system (see, for example, den Hertog, 2000; Miles, 2003; Muller and Zenker, 2001) to which they may contribute by:

1 creating and exploiting their own innovations (Muller and Zenker, 2001; Wong and He, 2002)

2 enhancing their clients' innovation processes through inputs of external knowledge (see Hipp, 2000; Machlup, 1962)

3 acting as intermediaries by integrating complementary knowledge and resources from several firms or organisations in order to create innovations (Toivonen, 2004).

From this perspective, KIBS may have remarkable potential to enhance firms' competitive advantages (Schumann et al., 1994) or organisational success (e.g., Kanter, 1997; Kao, 1997; Lengnick-Hall, 1992; Tushman, 1997). In addition, KIBS may be able to foster cooperation between potential partners in a region (Smedlund and Toivonen, 2006).

2.3 Innovation support services for small, high-growth technology-intensive firms

It has been argued that the local service infrastructure should provide a nurturing environment for small technology-intensive firms in order to support and accelerate the innovation activities and growth of these firms and, thus, enhance regional economic growth (e.g., Abetti and Rancourt, 2006; Höyssä et al., 2004; Phillips, 2002; Tidd et al., 2001). In addition, it has been recommended that priority should be given to policies designed to promote technology development and technology-based business by (for instance) establishing science parks and business incubators (Abetti and Rancourt, 2006). Accordingly, major objectives of economic policies have included the provision of suitable infrastructure and enhancement of the availability of appropriate innovation support services (defined here as services that are provided by public or private organisations and are aimed to help small firms to overcome challenges related to innovation; Heydebreck et al., 2000) for small technology firms. However, it has been argued that studies should be more focused on identifying effective instruments and their integration within a wider support system and the optimal deployment of public policy to promote entrepreneurship and innovation (Audretsch, 2004). Thus, there is a need to examine the requirements of growth-oriented small technology firms associated with the commercialisation process and to identify potential alternatives to help these firms to overcome the challenges associated with the process.

However, in the absence of unlimited resources, it is necessary to make local choices between industries in order to support the creation and development of small technology firms efficiently (Cohendet and Meyer-Krahmer, 2001). Further, before decisions regarding the allocation of regional resources can be taken, policy-makers need to know how they can efficiently support small technology firms' commercialisation activities. Previous studies have shown that realising the potential benefits of innovation requires an effective commercialisation process (Andrew and Sirkin, 2003), whereby potential products are generated from ideas and transformed into market-competent products. Developing effective commercialisation processes is a complex, challenging task for small technology firms in the modern business environment, in which customer requirements are rapidly changing and the life-cycles of new products are shortening. This is especially significant in high technology branches since technologies are changing so rapidly that small technology firms specialising in the production of high-technology products must match or exceed the pace of change in order to maintain competitiveness (Kozmetzky et al., 2004). Partly for these reasons, small technology firms are increasingly using external competencies and knowledge, accessed via innovation-related networking, in order to accelerate commercialisation, and to reduce associated risks and costs (Chesbrough, 2003; Slowinski et al., 2009). Further, as shown by empirical data presented by Feldman (1994), regional contributions to product innovation are related to the underlying inter-organisational relationships, technological infrastructure and availability of relevant knowledge inputs, all of which are mutually reinforcing

determinants of a region's competitive advantage. These factors are especially important for small firms, which may be more deeply embedded in regional innovation systems than large corporations, and thus more dependent on regional innovation infrastructure and social networks (Galbraith et al., 2008).

In addition, small knowledge-intensive firms are especially dependent on external partners' resources to create and exploit innovations (Axelsson and Easton, 1992), and use multiple channels to seek external resources, many of which are gathered through innovation support services (Freeman, 1991). Thus, facilitating access to external resources may provide several advantages for the creation and exploitation of innovation, such as accelerating the processes and reduction of costs and uncertainty (Dodgson, 2000).

In order to support innovation-related activities, diverse innovation support services and programmes have been developed, some of which (as mentioned) are provided by science parks, technology centres and business incubators. In addition, there are large numbers of public and private organisations and other KIBS firms that aim to support small firms' creation and commercialisation of innovation in various ways (see, for instance, Abetti et al., 1988; Blakely, 1994; Malecki, 1997). Previous studies have clearly indicated that small knowledge-intensive firms, in particular, face several challenges during the commercialisation of innovations (e.g., Pellikka and Virtanen, 2009). Most of the challenges are associated with the inability to acquire and exploit external resources that are often crucial for small firms (Blakely, 1994). Consequently, small firms whose competitiveness is based on knowledge such as KIBS have become increasingly dependent on external knowledge sources due to their incapability to generate all the required knowledge on their own. In addition, substantial positive externalities may be realised by providing innovation support services to help small firms to overcome these challenges in order to accelerate firm-related growth (e.g., Blakely, 1994; Pellikka and Lauronen, 2007). In conclusion, small knowledge-intensive firms are most likely to rely heavily on regional innovation support services, and they are key drivers of regional growth, so it is important to examine ISS in a regional context (Malecki, 1997; Tödtling and Kaufmann, 1999). Hence, a key objective of regional innovation support services must be to improve the innovative performance of firms that can be achieved only by providing certain inputs to the creation and commercialisation of innovation (Kaufmann and Tödtling, 2002). The study presented below assesses in more detail the requirements of small high-technology firms in these respects, and ways in which support services could be adjusted to meet their requirements more effectively.

3 Data and methods

In this study we use a triangulation method to increase holistic understanding of the requirements of the growth firms. Triangulation in this context refers to attempts to describe the phenomena under consideration and increase understanding of the phenomena using multiple data sources (data triangulation), gathered by various methods (data gathering triangulation) and analysis by various methods (data analysis triangulation) (Eisenhardt, 1989; Scandura and Williams, 2000; Yin, 1994). The data considered here include:

1 *national data* (related to 567 firms)

2 *branch of industry data* (213 KIBS sector firms)

3 *organisational data* (case studies of 12 high-growth T-KIBS firms; to increase our understanding of the specific requirements of the high growth KIBS firms and their need for innovation support services in Eastern Finland).

The content of the data, the research methodology applied in each step and the main purposes of each stage of the analysis are summarised in Table 1.

Table 1 The three levels of research data considered in the study

Level of analysis	*No. of firms*	*Type of data*	*Research methodology*	*Objective*
Firm: (Population of firms from two regions: Eastern Finland and Capital area of Finland and diverse branches of industry)	567	Quantitative	Logistic regression analysis	To identify the most rapidly growing industry sector from the data and the distinguishing characteristics of that sector, relative to other sectors, during the years 2002 to 2005
Firm: (Population of firms from one branch of industry and region: Eastern Finland, especially the North-Savo region)	213	Quantitative	Logistic regression analysis	To identify the innovation-related activities of the chosen sector (KIBS firms) and their relationship to growth
Firm: (Population of firms from one region: Eastern Finland, especially the North-Savo region)	12 case firms	Qualitative	Case study methodology	To identify the small KIBS firms' requirements for regional innovation support services (ISS)

Table 2 National-level data; branch of industry distribution of growth firms (n = 567)

	Included in LR-analyses (n = 433)			*Cross-validation cases (n = 133)*			*Total (N = 567)*		
	N	*Branch %*	*Total %*	*N*	*Branch %*	*Total %*	*N*	*Branch %*	*Total %*
Services inc. KIBS-sector	216		49.5	0		0	216		38.1
Other branches of industry:	217		50	133		100	350		61.7
Trade	97	44.7		61	45.9		157	44.9	
Manufacturing	56	25.8		29	21.8		85	24.3	
Construction	34	15.7		20	15.0		54	15.4	
Transportation and telecommunication	30	13.8		23	17.3		53	15.1	
Missing cases	1		0.5	0		0	1	0.3	0.2
Total	434	100	100	133	100	100	567	100	100

3.1 National-level data

The national data analysed in this study were collected by compiling data on growing, profitable and successful firms in the '*Successful Firms in Finnish Provinces*' database published by Balance Consulting Ltd (2007) and data on the growth of firms published by Suomen Asiakastieto Ltd, for the years 2003 to 2005 (based on accounting data from the years 2002 to 2005). Businesses that grew during this period were defined as those that consistently showed more than 10% growth of turnover in consecutive years during the period. Consecutive turnover change was applied partly because it is a highly market-led and widely used indicator for identifying growing firms in international studies, and partly because it has a clear temporal perspective and direction. We examined at least three years consecutive change in order to assure that the growth of the identified firms was not coincidental or simply consistent with average performance in the economy during the study period. Using this classification criterion 567 firms-based in the two regions considered (101 in Eastern Finland and 466 in the Capital area of Finland) were identified as growing firms (see Table 2).

In addition, our criterion for a fast-growth firm was that its turnover grew by more than 30% in consecutive years in the period 2002 to 2005. This change indicator was chosen because the turnover of such firms doubled during the study period. A *firm success variable* was also defined, based on a success index constructed from variables including the return on investment ratio, earnings before taxes ratio, current ratio, equity ratio, net gearing ratio and repayment period of liabilities. We applied the success index because it describes more holistically financial success perspectives such as profitability, solvency and financial structure of single firms and reduces potentially complicating factors related to financial success-related comparisons of different branches of industry. In order to be classified as a highly successful business a firm needed at least 80 points out of the maximum possible 100 success index points, and to be classified as a highly successful business a firm needed a consecutive success index of at least 80 points during the study years 2003 to 2005.

The definition of rural and urban areas follows the NUTS criteria (EC, 2003). We used the population density of specific areas in relation to the population density in the country as a criterion to classify areas as rural or urban. Our national data are based on one rural area (Eastern Finland) and one urban area (the capital area of Finland), for which we collected data from official databases.

Our data indicate that the service sector was the only fast growing branch of industry during the years 2002 to 2005 in Eastern Finland, based on branch of industry total sales growth during this period. In order to address the second research sub-question presented above, we used exploratory logistic regression analysis (LR-analysis), especially binary logistic analysis. The dependent variable in the model is the branch of industry, which is divided into two distinct classes as follows: services firms = 0 and other branches of industry (including trade, manufacturing, construction and transportation/telecommunication) = 1. The explanatory (independent) variables include firm-related variables that are believed to be capable of differentiating the services sector from other branches of industry, such as the age and size of the firm, its location (rural or urban), growth of the branch of industry, innovativeness (e.g., numbers of patents and trademarks produced by the firm during 1988 to 2005), and public R&D funding obtained during 2000 to 2005. The model also included two dummy indicators of firms' financial performance: their success indices and growth classification (0 = high success/high

growth and 1 = non-high success/non-high growth; hence a positive sign for the success indices and growth classes in the resulting LR-model indicates that KIBS firms were more likely to be successful, high-growth firms than those in other sectors).

3.2 Industry-level data

The industry-level data used in this study were data related to small KIBS firms located in Northern Savo, Finland. These data are secondary and provide complementary information to address the core research question of this study. The statistical categories employed in this study follow NACE classifications (see Commission of the European Communities, 2006) in which KIBS are defined as classes 72–74. The data were acquired from the register of regional KIBS firms presented by Statistics Finland in 2006. Single-industry studies offer greater control and accuracy of characteristics and problems that are specific to that industry (Mohr and Spekman, 1994). There were 1,143 small KIBS firms (with 1–49 employees) in Northern Savo, 20 of which were excluded from further analysis because of their size or inaccuracies in the database. Most of the surveyed firms offer customer services related to technical know-how (e.g., computer-related services and other technical services). Another major industry in the KIBS sector was accounting, book-keeping and auditing activities (see Table 3).

Table 3 Sample characteristics of KIBS firms in Eastern Finland

KIBS sector in Northern Savo region	*Total number of KIBS firms (N = 1123)*	*Proportion of KIBS sector (%)*	*Response rate in each sub-sector (N = 213)*	*Proportion of responses (%)*
Computer and computer-related services, software	179	16.0	32	15.0
Research and development	24	2.1	8	3.8
Law and legal services	54	4.8	12	5.6
Accounting, book-keeping and auditing activities	202	18.0	48	22.5
Advertising and marketing	105	9.4	21	9.9
Technical services	373	33.0	60	28.2
Consultancy and personnel services	186	16.7	32	15.0

A questionnaire was sent to 1,123 entrepreneurs of small KIBS firms in Eastern Finland. All respondents were informed of the purpose of the questionnaire by an introductory letter in which types of KIBS sector services were defined. The questionnaire was divided into three main sections as follows:

1 the entrepreneur's and firm's background and general characteristics including: year founded, turnover, number of employees etc.

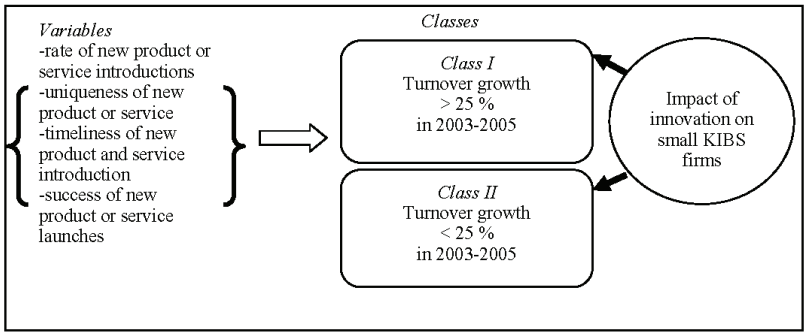
2 the firm's innovation activity (number of innovations created during the years 2003 to 2005) the type(s) of innovation created and the degree of newness of the innovation(s)

3 innovations' effects on the firm's turnover.

Before the survey, the questionnaire was tested with three entrepreneurs of KIBS firms, and the feedback was used to adjust it. All firms invited to participate were contacted by letter or telephone. Nearly 30% of the respondent announced that their businesses were so small or part-time in nature that they did not want to respond to the questionnaire. Of the returned questionnaires 213 could be used for the analysis, providing a satisfactory response rate of 19%.

The first problem to be addressed in our empirical analysis of innovation activities of KIBS firms was to ensure that innovation and its effects on turnover growth of KIBS firms were adequately measured. In empirical studies of firms' innovation, a common strategy is to measure innovation either by input or output indicators, even though there may be problems in measuring them (see Becker and Dietz 2004; Rogers, 2004; Tether, 2003). However, according to Rogers (2004), proxy variables can be used to measure whether a firm produced some type of innovation in preceding years. In this study we use this method, by dividing the dependent variable (turnover growth) of firm's innovation activity into two classes: I and II (see Figure 1), according to whether firms' chief executive officers (CEOs) claimed that innovations increased their turnover in 2005 through renewal and development activity between 2003 to 2005 by more than 25% or less than 25%, respectively. We then applied a stepwise logistic regression model to analyse the effects of the independent variables. The variables and operationalisation are provided in Appendix 1.

Figure 1 Measurement of variables



Based on the KIBS classification, we then analysed if there was any linkage between the impact of innovation and the firms' class (I or II) by using logistic regression analysis (e.g., Cameron and Trivedi, 1998). We then attempted to identify, by means of logistic regression, dependent variables that influenced the probability of a firm having more than 25% turnover growth in the years 2003 to 2005.

3.3 Firm-level data

The use of innovation support services by small, high-growth T-KIBS firms is an uncharted research area. In the firm-level analysis, small KIBS firms are understood as those knowledge-intensive business services that derive their intermediate function primarily from the production and transfer of technology-related knowledge e.g., knowledge related to computer and associated IT services, R&D services or architectural and technical engineering services (NACE codes 72, 73, and 742/3). The research data were gathered from interviews with the firms' CEOs, annual reports and interviews. The research data were collected from 12 small KIBS firms located in Eastern Finland. These case firms were selected via purposive sampling (Miles and Huberman, 1984) and the key informants approach was used to collect data from those case firms that used at least three different kinds of innovation support services during the preceding two years.

The CEOs of the selected firms were interviewed because they were assumed to have the best overall knowledge and insight into their respective firms' use of ISS. In the firms, the CEOs were also expected to see the implications of specific findings obtained during the research. Theme-based open questions were asked to explore the innovation support services used from different, flexible perspectives. In this respect, previous studies of the innovation support services used by small KIBS firms offered background information for the questions posed during the interviews. All the questions were first reviewed by three other academics and were pre-tested by conducting in-depth pilot-interviews with two managers. Participants were asked to comment on questions that needed development, and the final list of questions was adjusted accordingly. Initial contacts with the case firms were made over the telephone. Participants were interviewed during May and June of 2004 by means of a personally administered semi-structured theme interview, with a checklist of two groups of questions regarding:

1 background information and the history of the interviewee and the firm

2 information on the utilisation of innovation support services during the commercialisation process of innovation, including the type of services used, and the phase in which they were used.

Interviews lasted, on average, 1½–2 hours. At the start of each interview, the respondents were asked to base their answers on innovations that they had recently commercialised. After that, the respondents were requested to give a detailed description of the innovation support services that they had used. The interviews were digitally recorded and organised into a usable form. Finally, the data were coded for analysis, by categorising the innovation support services used into a time-ordered matrix based on the structure of the commercialisation process in small T-KIBS firms. In addition, annual reports and other materials (e.g., process-charts) were used to obtain supplementary information. Descriptions of the interviewees and the firm-related case information are presented in Appendix 2.

4 Results

4.1 Distinguishing characteristics of the high-growth sectors compared to other industrial branches

In order to address the main research question, we first discuss the results regarding the previously presented sub-questions (i.e., acquired information on the branches of industry that grew rapidly in Eastern Finland in the study period, and their distinguishing characteristics relative to other branches of industries with growing firms). We found that the services sector was the only fast-growth branch of industry during the period 2002 to 2005 in Eastern Finland. In addition, we identified several factors that may differentiate the service sector, including KIBS growth firms, from the growth firms in other sectors, such as trade, manufacturing, construction, transportation and telecommunication.

The results presented in Table 2 show the overall distribution of growth firms according to their branch of industry among the firms considered. Not all firms were included in the Logistic regression analyses (LR-analyses) because there were fewer services firms (216) than firms representing other branches (350). This imbalance, in the absence of appropriate adjustment, would have led to bias regarding the role and influence of the larger group in LR-analysis. Therefore, we included only part of the data regarding other industry branches in the LR-analysis, and used the remainder of the other industry data for cross-validation of the results, i.e., to assess the validity and reliability of the results. Hence, 433 firms were included in the analysis, 133 firms defined as other branch of industry firms were used in the cross-validation (and one firm for which data for some variables were missing was excluded). Both an Omnibus test of model coefficients and a Hosmer and Lemeshow test of correct classification ($p > 0.05$) indicated that the model can reliably differentiate services growth firms from growth firms representing other branches of industry (e.g., trade, manufacturing, construction and transportation/telecommunication).

We also used binary logistic analysis in an attempt to identify common characteristics of the fast-growth KIBS firms in a specific rural area (Eastern Finland). For this purpose we first studied variables and factors capable of differentiating services firms from firms representing other branches of industry (using the binary classification system described above). The independent variables and factors that were found to be statistically significant differentiators in the model were:

1 the number of auxiliary business names

2 age of the firm

3 growth of the branch of industry

4 success class

5 growth class

6 log-transformed public R&D funding received.

We logarithmically transformed public R&D funding values to reduce the wide ranges of this variable. The location of the firm did not appear to be a statistically significant factor for differentiating between these branches of industry. In other words, this model seems to fit firms in both a rural area (Eastern Finland) and an urban area (the capital area of Finland).

Table 4 Summary statistics of the model of characteristics distinguishing between services (including KIBS) firms and firms of other industries

	B	*S.E.*	*Wald*	*df*	*Sig.*	*Exp(B)*	*95,0% C.I.for EXP(B)*	
							Lower	*Upper*
Number of auxiliary business names	–0.201	0.055	13.557	1	0.000	0.818	0.735	0.910
Age of the firm	0.030	0.013	5.690	1	0.017	1.030	1.005	1.056
Growth of the branch of industry	–0.037	0.013	8.638	1	0.003	0.963	0.940	0.988
Success index (1)	0.496	0.221	5.031	1	0.025	1.642	1.065	2.533
Growth class (1)	0.777	0.223	12.092	1	0.001	2.174	1.403	3.368
Ln public R&D funding	–0.056	0.025	4.943	1	0.026	0.945	0.900	0.993
Constant	–0.323	0.287	1.268	1	0.260	0.724		

Notes: –2 log Likelihood 522.1
Cox and Snell R^2 16.5%
Nagelkerke R^2 22.1%
Classification capability 68%
Classification capability (cross-validation based on other industry cases) 66%

Our model results (Table 4) suggest that firms were more likely to be classified as successful or high-growth firms if they operated in the service sector than if they operated in other branches of industry. In addition, a specific firm was more likely to be a growth firm if:

1 it had several auxiliary business names

2 was young or quite young

3 operated in a growing branch of industry

4 had received public R&D funding.

The role of innovativeness is measured in this study conventionally by using numbers of registered patents and trademarks. These proxies of innovativeness were not statistically variables for distinguishing between the services sector and other industries. However, according to our data, manufacturing industry seems to be the most innovative branch of industry, as measured by numbers of registered patents and trademarks. Nevertheless, it should be emphasised that innovativeness could be related to other factors than solely products or components of products. For example, it could be argued that innovation activity is intense in the services sector because it has been heavily supported by public R&D funding. It should be noted that in Finland public R&D funding requires evidence of product, process, organisation and/or marketing innovations. Thus, by measuring the

innovation activity of firms conventionally we risk missing much of the holistic innovation and innovation activities in diverse branches of industry.

The results of the industry-level study show that the KIBS sector is relatively heterogeneous in terms of innovation activity targeted to growth. The main finding in this respect is that KIBS firms' orientation towards new commercial and conceptual services increased their probability of being classified as growth-oriented. There were several differences between classes I and II related to numbers and types of innovation. Firms in group I saw innovation activities as a central part of their business. Interestingly, the firms in class I estimated that innovation also had a substantial impact on their business, while their counterparts in class II reported that innovation only had minor positive influences. When the respondents were asked to estimate the relationship between innovations created during the years 2003 to 2005 and their effects on their business, 40% of the respondents claimed that innovation had a less than 10% impact on their turnover. Interestingly, however, almost 25% of the respondents estimated that innovation had a remarkable influence (25% or more) on their firm's turnover. Logistic regression analysis revealed that the following characteristics significantly increased the firm's likelihood of recording turnover growth over 25% (and hence being classified in class I): complete new process innovation, current product or service renewals, complete new product or service innovation and complete new market and marketing innovation. The other variables were not significant in this respect (see Appendix 1).

Table 5 presents summary statistics of a stepwise logistic regression model indicating that the following variables increased the probability of a firm having turnover growth exceeding 25% (and thus being classified as class I):

1 enhancement of products or services

2 implementation of new products or services

3 new market or marketing-related innovation.

Table 5 Variables increasing the probability of KIBS-firms being classified in class I, i.e., increasing turnover by more than 25% in the preceding three years (2003–2005)

	B.	*S.E.*	*Wald*	*Sig.*	*Exp(B)*
Enhancement or renewal of current products or services	0.613	0.199	9.90	*	1.85
Implementation of new products or services	0.592	0.186	10.13	*	1.81
New market or marketing-related innovations	0.585	0.192	9.27	*	1.79
Constant	–4.538	0.797	4.50	***	

Notes: –2 log Likelihood 190.6
Cox and Snell R^2 29.8%
Nagelkerke R^2 40.3%
Level of significance *** = $p \leq 0.001$, ** = $p \leq 0.01$ and * = $p \leq 0.05$
Clasiification capability 76%

The goodness of the model (Cox and Snell – R^2) is 30%, showing that it is statistically very significant, and it has a satisfactory classification capability of 76%. The logistic regression analysis confirmed that several factors significantly influenced the probability of having turnover growth exceeding 25%. However, innovation related to partnerships

and networking seems to have had only a minor effect on their business. This might be explained by the finding that small firms are engaged in innovation networks less often than larger firms, and if they have innovation partnerships they are primarily with business partners. Since relationships involving science and technology transfer are rare, SMEs make only limited use of the full potential of their respective regional innovation systems.

It should be noted that this perspective of innovation is rather limited in the context of small businesses. Small firms consistently refer to the general pervasiveness of poor management and marketing or skills development as constraints on innovation (Adams, 1982; Moore, 1995). In addition, behavioural school theorists regard innovation as essentially involving 'controlled chaos' (Quinn, 1985) and innovation processes as non-linear cycles of divergent and convergent activities that may be reiterated over time, and at different organisational levels, if resources are obtained to renew the cycle (Van de Ven et al., 1999).

This section presents results of the case study that are potentially useful for government and university officials, economic development centres and other providers of innovation support services. The case firms were found to use the following categories of innovation support services:

1 market-related services

2 finance-related services

3 technology-related services

4 internationalisation-related services.

Each of these categories is discussed in detail below. Market-related services are quite often used by the case firms. Building distribution and retail networks seems to be a critical process during commercialisation. The distributors play a vital role, because they are often responsible for selling products and services to end-users. This requires, *inter alia*, inter-organisational collaboration based on the formation of trust-based relationships among the firms. Market-related services used by the case firms are provided and financed by the market research institution, Finpro, Tekes (the Finnish funding agency for technology and innovation) and the local technology centre (Technopolis Ventures Kuopio Ltd). The most frequently used services are global market research, services facilitating searches new customers, distributors and resellers. In addition, case firms have used assistance in negotiations to reach commercial agreements (e.g., contractual arrangements) and assistance with initiating marketing efforts with other T-KIBS firms, organised for instance by the local technology centre. Previous studies (e.g., Heydebreck et al., 2000), have highlighted the importance of internationalisation-related services in commercialisation processes.

Finance-related services were used primarily to obtain assistance with the financing of innovation projects organised by public and private organisations. Among the case firms, external financing was mostly obtained from public sponsors. In addition, direct financial support instruments, such as subordinated loans and export credit guarantees were used. The results show that internal financing was mentioned as a primary source of financing of the case firms. Venture capitalists have had a positive impact on the commercialisation process in some cases, and financial support and experience provided by venture capitalists and business angels have also been used by some firms. However,

the respondents of the case firms would like the venture capitalists to play a more active role in supporting activities for daily business, especially development of internationalisation. The respondents would also like the venture capitalists to have more experience of their industry.

The technology-related services used were related to the requirements of external support, mostly for scientific and professional knowledge of technology. This pattern is often ascribed to the availability of external resources, and access to innovation support services helps to reduce the uncertainty posed by disruptive technology faced by these companies. Particularly, during the commercialisation process in small high-technology firms, external knowledge-based resources seemed to have a major importance. The kind of technological consultancy described above was mostly provided by consultants, universities and other research institutions. These organisations have also provided help for the case firms in searches for R&D cooperation partners and assistance with immaterial property rights (IPR) and other technology-based agreements, e.g., patenting, licensing and original equipment manufacturer (OEM) contracts. In addition, former colleagues in universities, advisory board members and other scientific partners can play a crucial role in sharing first-hand knowledge and experience that can be exploited in commercialisation processes.

Internationalisation-related services seemed to have played a crucial role from the initial foundation of the case firms. Many high technology ventures (like the case firms) produce highly differentiated products and services, and thus concentrate their activities in narrow market segments. This means that firms frequently have to find international customers to secure their continued existence (O'Gorman, 1997). Many of the case firms can be called 'born globals, since they show very rapid and intensive international growth-orientation. However, internationalisation requires many kinds of resources. In this respect, many challenges that the case firms have faced are mainly caused by their limited knowledge-based resources. It is also important to note that in some cases factors such as low levels of manufacturing competence, product differentiation and information regarding international markets has been key deficiencies that firms have tried to address using internationalisation-related services. The most frequently used internationalisation-related services are assistance with global technology transfer and assistance with international standards and agreements in the healthcare sector. In addition, export consultancy was used by several case firms.

5 Conclusions and discussion

At the beginning of the 21st century we are witnessing increases in the importance of services and knowledge as engines of economic development. At the aggregate level, growth firms are required for aggregate job creation and for raising the innovation capability in local or regional areas. Further, at the firm level, growth firms are essential for providing high-quality jobs for professionals. These policy objectives will be better met when entrepreneurship support policies are focused specifically on promoting the growth of entrepreneurial firms. In this study we examine fast-growth entrepreneur-led, KIBS firms' growth and the innovation support services they use and require, in an attempt to understand their anatomy, and present theory and recommendations for the design of more effective fast-growth and innovation entrepreneurship policies. The results of our study emphasise the importance of innovative, fast-growing KIBS firms in

providing new opportunities for wealth creation, opportunities to foster rapidly growing businesses and the creation of new jobs in the contemporary and future Finnish economy. In addition, the results show that the shift to service-provided business opportunities has not been solely service sector-based, but other branches of industry have also utilised new service-based opportunities. However, our study confirms that the prospects of rapid growth and success were better for service (including KIBS) sector firms than for other firms in other branches of industry during the period 2002 to 2005 in both rural and urban (Capital) Finnish areas. Further, the LR-analysis proved capable of correctly classifying ca. 2/3 of individual case firms, both firms included in the model development and the cross-validation set. However, it should be noted that in logistic regression modelling it is always possible to achieve at least 50% accuracy by simply setting the prediction for each observation to respond to the most frequent outcome (Hoetker, 2007). Nevertheless, our model provided sufficient classification power to evaluate possible growth of firms, and discriminate successful firms from diverse branches of industry in a systematic manner.

During the study period, the Finnish government also strongly fostered growth of the service sector, especially KIBS, by granting large amounts of R&D funding. In practise, this kind of action has increased the innovativeness of this branch of industry, the frequency of new ventures, new jobs and new tax flow sources in rural and urban areas. However, it is important for the policy-makers to be able to recognise high growth firms or potential high growth firms located in the region, to recognise the special needs of high growth firms and be aware of measures that could deliver support for them, if needed. In addition, staff and managers of high growth firms should consider strategies and actions required to manage business growth in order to be profitable and competitive during growth periods and maintain business sustainability in intervening periods. Overall, business change seems to be highly incremental according to the innovation activities of the firms, especially since imitation seems to be the main competitive strategy of KIBS firms. Small high growth firms located in rural areas should continuously look for new business opportunities from their contextual perspective and new ways to commercialise their products and services, irrespective of their distance from markets, by using (for example) ecommerce opportunities. Further, even though small high growth firms have resource constraints they should not rely too heavily on expectations of continuous governmental support. They have to use broader business strategies and actions, for example by exploiting open innovation systems.

5.1 Policy and managerial implications

From a managerial perspective the study identifies several factors that can be used to support and develop the commercialisation process in high growth small technology firms. The results indicate that entrepreneurs recognise that commercialisation is a vital, integral part of their business. Thus, an appropriate business model needs to become part of the new dominant logic for managing commercialisation (Chesbrough and Rosenbloom, 2002) and more attention should be paid to market-orientation during commercialisation to help firms to estimate the market potential of their products and to acquire information regarding their customers' requirements. In addition, greater awareness of the key role distributors and resellers play in bringing new products to the market is required. In the small technology firm context these issues should be understood as key disciplines in the commercialisation process. The study also shows that maintaining an appropriate balance between market-related and technology-related

activities is important in commercialisation. Imbalances in this respect may lead to adverse consequences, e.g., low product-based turnover, due to limited marketing activities and resources. Thus, it is important for small technology firms to develop the ability to shift their activities and resources assigned to specific activities during the commercialisation process to meet changing priorities. Lack of the ability to react to such changing needs seems to be a major cause of the problems faced during commercialisation. Therefore, growth-oriented entrepreneurs should develop their ability to foresee changes in these needs and the adjustments that need to be made.

To help achieve these growth aims entrepreneurs can use resources such as external innovation support services as channels to bring complementary assets into the firm to support critical phases of the commercialisation process or to expand the knowledge base related to critical activities (see also Heydebreck et al., 2000; Kaufmann and Tödtling, 2002). The study also indicates that entrepreneurs should reinforce their capabilities to respond to internationalisation requirements during the commercialisation process, such as their access to and exploitation of innovation support services, planned strategies and distributors (see also Spence, 2003). Global demand, potential customers and distribution channels all need to be investigated from the beginning of the commercialisation process in order to estimate the potential market and customer requirements for any new product. Acquiring information about customer preferences is also important during new product development in order, for example, to improve prototypes (see also von Hippel and von Krogh, 2006). In addition, the ability to reallocate resources during the commercialisation process seems to be an important contributor to the effectiveness of the process, and hence is another important aspect for the entrepreneurs to take into account when planning and managing the commercialisation process. Reallocation requirements should be estimated in advance and included in the commercialisation process plan (an appropriate process model may also provide valuable tools for this task).

This study also shows that the characteristics of the small technology firm and the background of the entrepreneur should be considered when planning to exploit innovation support services and foster growth. It is particularly important to identify the limitations (e.g., resource limitations) of the firm. For example, lack of business competence was found to be a major deficiency in the case firms, but this could be alleviated by networking and active interaction with appropriate partners (e.g., suppliers, customers, universities, and public agencies) during the commercialisation process. In addition, an open innovation approach (see e.g., Chesbrough, 2003) and more intensive collaboration with customers during commercialisation can provide real-time feedback that can be effectively exploited in product development (see e.g., von Hippel and von Krogh, 2006), and in both marketing and internationalisation (Collinson and Gregson, 2003). However, it should be noted that customer involvement may also be a negative factor in commercialisation processes, since it may spread the limited resources of a small firm and hinder commercialisation (Allocca and Kessler, 2006).

In order to increase growth among high growth T-KIBS firms it is essential to understand the process and to dedicate resources to its improvement. This study shows that innovation support services for small technology firms should be adjusted by regional developers and local policy-makers to enhance support for the commercialisation process. It would be beneficial to develop innovation support services and a commercialisation process model based on the identified needs of small high growth technology firms. In addition, innovation support service providers should focus more on the content of the services they provide and orientate the delivery of their

services more towards meeting the real challenges that small technology firms confront during commercialisation. For example, the study indicates that the funding and innovation support services provided by the government are sometimes too bureaucratic and inflexible (see also Abetti and Rancourt, 2006) to rapidly react to changing requirements during the commercialisation process.

The basic infrastructure and facilities of these organisations (e.g., office space and services), are commonly regarded as being suitable for small high growth technology firms. However, the results of the study indicate that the services they provide could still be improved. In particular, more attention should be paid to developing the innovation support services provided by these and other organisations. According to Collinson and Gregson (2003) entrepreneurship-support organisations (e.g., technology centres) have varying objectives in the guidance and services they offer to small technology firms. Some are highly focused on supporting the creation of new firms and promoting regional economic benefits by maximising the rate of successful start-ups. These organisations are intended (*inter alia*) to enhance commercialisation, together with university-industry collaboration, in order to spur economic development and promote technology diversification by the creation and diffusion of new knowledge (Van Looy et al., 2003).

According to Howells (2006), intermediary organisations (e.g., technology centres) can provide concrete help for small technology firms by brokering activities (e.g., seeking business partners and helping to find advice and funding) during commercialisation. However, in the Kuopio region the technology centre and university's innovation and research services are relatively fragmented (i.e., consist of separate support services) and mostly targeted to help administer activities such as patenting and licensing. This, and the results of the study presented here, suggest that a more strategic and coordinated approach to providing innovation support services is needed, if the aim is to strengthen the commercialisation process in small technology firms in the region. It would be desirable to create a new support service that encourages small technology firms to access a wide range of innovation support services for commercialisation processes through an intermediate service. It is also important to ensure that innovation support services can enhance all the critical phases (at least) of the commercialisation process without any major discontinuity. Therefore, there might be a need for flexible integration of the regional innovation services into the wider support system.

The findings of this study need to be reviewed critically in the light of several limitations. Notably, there are several primary limitations regarding the definitions of the key terms, the size of the dataset acquired and the scope of the research. The national-level study limitations are based on the cross-sectional nature of the data analyses (short time period). Further, the research results are strongly influenced by the way we have defined the specific terms and concepts (which represent narrow, conventional views). Nevertheless, they provide opportunities to focus the specific study and offer a possible platform to at least make some comparisons and/or estimations.

It should be noted that very few small technology firms can survive solely by their own efforts, without maintaining significant relationships with universities, or large companies operating in their technological sector (Pellikka, 2008). Such relationships range from licensing agreements, through export-import connections to various forms of alliances for R&D, product development and marketing (see e.g., Bagchi-Sen, 2007). However, in this study licensing was excluded in order to focus on small technology firms that have commercialised new products by themselves. The case data analysed in the study were gathered from case firms located in a single area (the Kuopio region of

Eastern Finland) with specific features in terms of the business environment and infrastructure (e.g., availability of innovation support services etc.). Further, all the case firms operate in either the healthcare technology or ICT industries, and thus, have the typical characteristics of such firms, such as the need to meet various international regulations and standards. In addition, the approach relied heavily on the opinions of the entrepreneurs and might thus be biased. A further limitation was that since the case study method was employed, the sample size was small. Thus, even though multiple cases were examined, the results of this study should be verified by examining further samples, preferably using data acquired by quantitative methods. In addition, the case studies were mostly based on interviews with the entrepreneurs of the small technology firms, and even though the entrepreneurs were regarded as key informants, the possibility of self-selection bias should be recognised in the interpretation of the results. It is also important to note that there is a lack of clarity about the process of building theory from cases, and that building theory from cases may result in narrow theory (Eisenhardt, 2002).

Further, since the study is based on the healthcare technology and ICT industries, many findings may specifically apply to these industries and may not be directly transferable between these two industries and/or to other industries, although there may be similarities to other high technology sectors. In addition, there is increasing evidence of significant differences in basic characteristics among small technology firms even within the same industrial sector (see Galbraith et al., 2008). Notably, there are some industry-related characteristics, such as the need to meet official standards (Altenstetter, 1996) and specific risks associated with medical devices (Worning, 1994) in the healthcare technology sector, which may influence activities during the commercialisation process. Furthermore, this research examined the commercialisation processes at a regional level, but it is important to note that Northern Savo (another part of Finland) is defined as a peripheral area (Pasanen, 2003), which might possibly affect the internationalisation rate and the requirements related to collaboration with international business partners such as distributors, agents and resellers.

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Appendix 1

Variables used in regression equations

Dependent variable

Turnover growth in the preceding three years (2003–2005)

Independent variables

Product or service innovation or renewal

- Enhancement or renewal of present product or service
- Introduced complete new product or service

Market and marketing innovation or renewal

- Enhancement or renewal of market area
- Enhancement or renewal of client relationship
- Enhancement or renewal of marketing (communication)
- Enhancement or renewal of new market knowledge
- Introduced complete new market or marketing innovation

Network innovation or renewal of partnership

- Enhancement or renewal of partnership in KIBS firm's own industry
- Enhancement or renewal of partnership between KIBS firms
- Enhancement or renewal of partnership between KIBS firms from other industry
- Enhancement or renewal of relationship with subcontractor or supplier
- Enhancement or renewal of relationship with public organisations
- Enhancement or renewal of partnership with client
- Introduced complete new network innovation

Process innovation or renewal

- Enhancement or renewal related to present process of business operations
- Introduced complete new process innovation

Organisational innovation or renewal of human resources or management

- Enhancement or renewal of human resources
- Enhancement or renewal of human development and motivation
- Enhancement or renewal of leadership
- Enhancement or renewal of internal communication
- Enhancement or renewal related to business
- Introduced complete new organisational innovation

Appendix 2

Background information on the interviewees and the firms

1 Sex and age M = male F = female	*2 Level of business experience (years)*	*3 Business experience of the current firm (years)*	*4 Year of establishment*	*5 Number of personnel (2003)*	*6 Level of turnover (2002)*
M27	1–3	1–3	2003	1–3	0.05 M€ >
M38	10<	10<	1990	4–7	0.06–0.2 M€
M55	4–7	4–7	1998	1–3	0.05 M€ >
M54	10<	1–3	2003	12–15	0.3–0.5 M€
F42	4–7	4–7	1995	4–7	0.3–0.5 M€
M46	10<	4–7	1987	15<	0.8-1 M€
M56	4–7	4–7	1996	8–11	1.1–1.3 M€
M55	10<	4–7	1998	8–11	0.6–0.75 M€
M43	10<	4–7	1992	4–7	0.3–0.5 M€
M45	10<	1–3	1994	8–11	0.6–0.75 M€
M34	4–7	1–3	2000	8–11	0.06–0.2 M€
M47	4–7	4–7	1997	4–7	0.3–0.5 M€

Note: Variables (1–3) 'sex and age', 'business experience' and 'business experience of the current firm' describes the background information of the interviewees. Variables (4–7) 'year of establishment', 'number of personnel', 'level of turnover' and 'performance' presents the basic information of the firms.

The purpose of this dissertation is to increase understanding of the characteristics of innovative, high growth and highly successful (IHGS) SMEs. Relationship examined in the studies this dissertation is based upon includes those between: 1) Innovation and Growth, 2) Growth and Success and 3) Growth, Innovation and Support.

The starting point of the innovation and growth study has been analysis of growing innovative SMEs in diverse locations. The connections between growth and success have been analysed by examining the influence of selected variables on growth, success and simultaneous growth and success. Longitudinal case study approach was utilized to elucidate behavioural aspects of growing ventures. In addition, challenges associated with the use of statistical analyses in growth and success studies were addressed. Finally, attempts were made to identify the kinds of innovations that may promote high growth and to assess the needs for innovation and support services.

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