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**Benchmarking Entrepreneurial Universities: Testing a
Research Framework**

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Abstract

"An entrepreneurial society refers to places where knowledge-based entrepreneurship has emerged as a driving force for economic growth, employment creation and competitiveness... entrepreneurial universities play an important role as both knowledge-producer and a disseminating institution " (Guerrero, et al (2010, p1).

The research framework is based on two analytical reviews: first, studies of entrepreneurial universities between 1998 and 2010; and second, studies of literature from institutions and organizations, in order to characterize the entrepreneurial university based on organizational theories (this part has been discussed in previous Eu-SPRI Twente May 2012).

Many studies have described entrepreneurial universities by using the case-study approach. However, they lack a robust theoretical framework for understanding it (Guerrero, et al, 2010). In addition, the genuine study of how and what comprises entrepreneurialism in higher education institutions in general, and universities in particular, is still empirically weak (Gjerding et al.,2010, D'Este, et al.2010, Sotirakou, 2004, Etzkowitz 2003, Jacob, et al.2003, Rinne and Koivula, 2005). This is because most studies reveal the important issue of the complexity, conflicts and tensions of the entrepreneurial university revolution. Most studies that have analysed this phenomenon around the world (North America, Europe, Australia, and some Asian countries) by studying examples of entrepreneurial universities, have arrived at common findings. These are related to: core mission; adaptation processes and organizational changes; internal and external strategies; different types of entrepreneurial activities; academic characteristics; the environmental pressures; and cultural behaviours. Having said that,

'entrepreneurialism in universities' requires different management styles and cultural changes. This opens up different areas for research and studies to support successful environmental and organizational changes inside the university, in addition to the flourishing of external collaborations (Lee et al, 2010), and to consider bottom-up activities as well as top-down strategies.

Developed countries have taken steps to move universities towards an entrepreneurial paradigm. This can be seen in the development of their national science, technology and innovation policies at decision-makers' level, in addition to the re-structuring of organizational governances in their quest to foster entrepreneurial culture at institutional level. On the other hand, the developing countries are still facing challenges in initiating policies and accepting cultural changes in universities in order to make them more entrepreneurial. It can be argued that this is particularly evident in the Gulf area countries, which are oil and gas-based economies, and therefore in a comfort zone (Oil-age-syndrome). However, the need to move towards knowledge-based economies has become clear, as the indicators show that this Gulf wealth is drawing to an end: oil-gas production is declining, and the number of job seekers is increasing.

In this context, the paper aims to contribute to a better understanding of entrepreneurial university characteristics by analyzing four European universities and using them as a benchmark for developing countries such as Gulf countries. The paper asks two questions: first, *"to what extent can the theoretical framework be applied to fulfil the entrepreneurial university approach?"* And second, *"which of these examples would provide important lessons for the on-going approaches of Gulf countries in general and Oman in particular?"*. These universities are Strathclyde University, Chalmers University of Technology, the University of Twente, and the Norwegian University of Science & Technology. The selection of the four universities is based on four elements: first, they are all examples of entrepreneurial universities. Second, they have all been used as case studies in academic literature in order to investigate the entrepreneurial phenomenon. Third, they are all European universities with a similar policy environment. Fourth, they all have a focus on technology. In addition, it is easy to obtain access to their secondary data and information.

The methodology used in this paper involves analysing secondary data which includes university strategy documents, annual review reports and published case study articles. This analytical review is used to test the conceptual framework in addition to assessing it as a benchmark for Gulf countries. The analysis is based on the taxonomy that has been developed in entrepreneurial university dimensions as mentioned earlier.

The structure of this part is as follows: section 2 begins by laying out the overview of each university focusing on the importance of its geographical locations; section 3 analyses documents (articles and reports) from each university based on the theoretical dimensions; and the last section, 4, draws concluding remarks about creating a university environment which promotes entrepreneurship.

The paper concludes that the universities' transformation towards an entrepreneurial culture requires significant changes in organizational structures, knowledge-production, and cultural beliefs and behaviour. This has become evident through the analysis of the four European universities that have an entrepreneurial history and are recognized as entrepreneurial universities nationally and internationally.

All four universities have, in the past, made considerable changes at different levels. The four cases show the importance of re-structuring university infrastructure with the influence of strong leadership and professional management. The cases of NTNU and Twente are excellent demonstrations of the way in which strong leadership can transform a university from a failing institution into a successful entrepreneurial university with a strong reputation. In addition, the four cases illustrate the importance of a mixture of funding from public, private and industrial projects, where strong leadership plays a vital role in generating more income and allocating it efficiently. TNUN and Twente also provide evidence for the importance of education in entrepreneurship, and high quality entrepreneurship courses and programs. Moreover, the four universities all implement, to some extent, project-based teaching and research programs.

The analysis provides us with verification regarding the entrepreneurial university. On the one hand, there are common changes which are applied by all the universities. On the other hand, there are specific elements and practices based on each individual university's circumstances and culture which we cannot generalize as being suitable for

all different cultures. This information can be used to address the question: “*which of these examples would put forward imperative lessons for the on-going approaches of Gulf country in general and Oman in particular?*” based on the Gulf context and circumstances.

Key words: Benchmark, entrepreneurial university, oil-age syndrome, analysis, organizational dimensions.

Introduction:

One of the most significant discussions in connection with creating entrepreneurial universities relates to structuring the university environment. As mentioned earlier in part one, several studies have contributed to explaining this phenomenon by using the case study approach. However, the major concern with those studies is the lack of a robust theoretical framework for understanding it (Guerrero, et al, 2010). Despite this absence of a basic framework, however, most studies that have analysed this phenomenon around the world (North America, Europe, Australia, and some Asian countries) by studying examples of entrepreneurial universities, have arrived at common findings. These relate to: the core mission; the adaptation processes and organizational changes; internal and external strategies; different types of entrepreneurial activities; the academic characteristics; the environmental pressures; and cultural behaviour. In this context, this part aims to contribute to a better understanding of entrepreneurial university characteristics by analysing four European universities in order to examine and validate the findings of the theoretical dimensions of the research in chapter one. These universities are Strathclyde University, Chalmers University of Technology, the University of Twente, and the Norwegian University of Science & Technology. The paper seeks to answer the question: *“which of these examples would provide important lessons for the on-going approaches of Gulf countries in general and Oman in particular?”*

The selection of the four universities is based on four elements: first, they all are seen as examples of entrepreneurial universities. Second, they have all been used as case studies in order to investigate the entrepreneurial phenomenon. Third, they are all European universities with similar policies regarding their environment. Fourth, they all have a focus on technology. In addition, it is easy to obtain access to their secondary data and information. The methodology used in this benchmark study is analysing secondary data which includes published case study articles, university strategy documents, and annual review reports.

The structure of this part is as follows: section 2 begins by laying out the overview of each university focusing on the importance of its geographical locations; section 3 analyses documents (articles and reports) from each university based on the theoretical

dimensions; and the last section, 4, draws concluding remarks about creating a university environment which promotes entrepreneurship.

The study approach: This benchmarking study is based on documentary analysis. It starts by identifying the universities which are suitable for use as case studies in relation to university-based entrepreneurship in the context of Europe. The major component has been the availability of published articles on each particular case. The study focuses on the scholars' views and findings in five dimensions: (1) the managerial dimension, (2) the funding resource dimension, (3) the core mission dimension, (4) the external collaboration dimension, and (5) the cultural dimension. A common set of elements has been identified as a template for analysis (King, 2004) (see appendix A).

The documentary materials: Approximately 25 documents have been used in this part of the benchmarking study. These documents include: published articles, strategy reports, annual review reports, and some university website documents and facts. The summary of the findings of the analysis is illustrated in table (2).

Matrix of theoretical dimensions: While a variety of dimensions of the university-based entrepreneurship structure have been discussed thoroughly, this paper will use the dimensions that have been developed in the theoretical framework of the research. A wide range of indicators were considered to be relevant for each dimension. The metrics of the theoretical dimensions were clustered into following categories:

The Managerial Dimension

Definition: "the strategic level of decision making, executive leadership and power that can be viewed as strong executive leadership, and executive strategy and decision-making, where the power should be linked to the formation and use of strategic choice". Three types of matrices have been described: first, shared governance; second, strong executive leadership; and third, professional management. These matrices are used to examine: "*whether the university has strong executive leadership, executive strategy and decision-making, balancing between proactive internal activities and reactive external demands, and balancing between academic values and managerial strategic directions?*"

The Funding Resource Dimension

Definition: "The diversification of funding resources by promoting third stream income through teaching and research programmes, and not depending solely on government". Three sets of matrices have been described: first, block funding; second, project funding (second stream); and third, private funding (third stream). These matrices are used to examine: "*to what extent the university is able to diversify its funding resources from second and third stream income and to what extent it is seen to be academically-led rather than financially-led?*".

The Mission Dimension

Definition: "The orientation of the heartland of the university (teaching and research) to the external environment in order to build relationships and new teaching and research programmes". Three types of matrices have been described: first, teaching activities; second, research activities; and third, entrepreneurship activities. These matrices focus on assessing: "*whether the university is able to enhance its third mission by incorporating it into the core mission through building bridges with industry and the private sector in specific disciplines of academic interest.*"

The External Linkages and Collaboration Dimension

Definition: "The increase in linkages and collaboration with the external environment, to be more responsive to the complexity and uncertainty of the external environment in order to improve the organization's capacity to respond more flexibly". Three sets of matrices have been described: first, organization's capacity development; second, response to external demands; and third, building strong bridges with the external environment. These matrices highlight "*to what extent the university able to cope with the challenges on building linkages and establish bridges with the uncertain socio-economic demands?*"

The Cultural Dimension

Definition: "A pattern of shared goals, values and ambitions that lead the university to adapt to new approaches of action, to seek a high reputation and to secure a strong identity to achieve self-directed autonomy". Three sets of matrices have been described: first, the university's autonomy; second, shared goals and values; and third, reputation

and identity. These matrices are used to examine *"whether entrepreneurship is in the organisation's core mission, and to what extent the university is committed to supporting the approach at all levels (top-down and bottom-up)."*

An overview of the selected case studies

In the history of the knowledge-based economy, entrepreneurial universities have been thought of as key pillars in the socio-economic development of the nations. Therefore, it is becoming increasingly difficult to ignore the huge pressure facing higher education institutions in general, and universities in particular, to respond rapidly to the changing demands of the external environment. The following overviews highlight each case-study's historical path, profile, geographical location, and key strategic approaches.

Chalmers University of Technology

According to Chalmers University of Technology profile, 2012, Chalmers University of Technology is located in Gothenburg, the second largest city in Sweden with around half a million inhabitants. Gothenburg is the capital of a region with a strong industrial base. The university is named after the major benefactor, William Chalmers, one of the directors of the successful Swedish East India Company in Göteborg. Established in 1829, Chalmers is the second largest of the six technical universities in Sweden. Today, Chalmers has around 10,000 students and 2,650 employees (Chalmers for a sustainable future, 2012). Chalmers' turnover is approximately EUR 220 million per year, more than two-thirds of which is related to research. Almost two thirds of the funding comes from the Ministry of Education, while other public and foundation money constitutes about one-third. Direct income from industry is reportedly nine percent of the total budget. The strategic vision (2010-2020) of Chalmers is to be regarded as one of the ten best technical universities in Europe, and the best in co-operation with industry. A vice-rector for external activities has recently been appointed. Chalmers has several units designed to reinforce collaboration with industry, and commercialization. The connections with industry and commerce have therefore been natural from the very beginning. The structure of these organizations has, to a large extent, grown out of individual initiatives as opposed to having been set up as part of a planned strategy. Located on campus is Chalmers Science Park, comprising a number of company R&D labs and various

university bodies involved in the interaction with industry. According to published material, several hundred spin-off companies have emanated from Chalmers, employing more than 4000 people. Sources at Chalmers estimate that 15 knowledge-based companies are established every year as a result of some type of university activity, including student companies. However, the spin-off companies with the greatest potential emanate from long-term research projects. The Gothenburg region has many large technology companies, and this creates a market for new technology and spin-off companies from Chalmers (Chalmers for a sustainable future, 2012).

Norwegian University of science & Technology(NTNU)

As its name indicates, NTNU is the national centre for education and research within the natural sciences and technology fields. NTNU is located in Trondheim. With a population of approximately 150,000, Trondheim is Norway's third largest city. NTNU has traditions inherited from the Norwegian Institute of Technology (NTH) established in 1910. Comprising 20 000 students and a professional teaching and staff of nearly 3300, NTNU is the second largest university in Norway and the only one with a major technological focus. NTNU has 7 faculties and 53 departments (Saetre et al (2006). Its total income is EUR 281 million, of which 83 percent is public funding. In addition NTNU cooperates closely with SINTEF (The Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology) and ALLFORSK (The Arts and Science Research Foundation) which are located in the same city in order to bridge the gap between the academic sector and industry. The activity at NTNU and SINTEF has resulted in the creation of about 120 spin-off companies over the last 20 years, most of them established either in the mid-eighties or in recent years. The focus on commercialization activities has increased, and twenty new companies were formed in 1999, and thirteen in 2000. NTNU and SINTEF are the major shareholders in a commercialization unit which provides business advisory services, incubation space, and capital. A research group at NTNU conducts research and provides courses on entrepreneurship, and is also involved in business development projects. Recently, NTNU has taken a more proactive role in commercialization and new venture creation. NTNU's management has adopted an aspiring strategic plan regarding entrepreneurship and innovation. This plan includes new initiatives for teaching, research, incentives, and

infrastructure, as well as changes in rules and regulations aimed at stimulating the commercialization of research (NTNU, 2003).

University of Twente (UT)

According to TU's profile 2010, the University of Twente is a relatively new institution, and was created in 1961 as part of a broader post-war drive within the Netherlands to encourage a shift towards an economy based on high value-added production rather than cost competition. Despite the relatively recent creation of TU, the University of Twente has had something of a turbulent history. The institution began life as the Technical Polytechnic of Twente ('THT'), and was created with a remit to behave very experimentally and innovatively. The collapse of textiles in Twente in the 1970s, as well as the abandonment of some of the features trialed by THT during this time, left the institution as an apparent luxury which the recession-hit Netherlands could ill afford. This resulted in Parliamentary calls for its closure, and in turn provoked the university to reinvent itself under the leadership of the renowned Rector Magnificus⁵. Prof. Harry van den Kroonenberg. A great deal of effort was put into increasing the impact of the university in the region, culminating in its rebranding as "University of Twente: the entrepreneurial university". Following his retirement from the Executive Board in 1988 for the second time, the university continued on the same trajectory, although subsequent pressures diluted the focus on regional engagement. By 2003, commitment had drifted to the point where the Executive Board once more decided to revitalise the university's emphasis on promoting regional engagement and entrepreneurship. Today, UT consists of six faculties and six research centres. Moreover, it has created: a centre with 9000 students and 4000 professional teachers and scientists, 700 spin-off companies in 20 years; 130 student companies, and as a consequence creates 5000 jobs.

Strathclyde University(UoS)

According to Strathclyde University's profile (2010), The University of Strathclyde is situated in the heart of Glasgow, and is Scotland's third largest University. The University has a long history beginning in 1796, when Professor John Anderson left a bequest in his will for the establishment of 'a second higher education institution' in Glasgow. His vision was the creation of a place of 'useful learning' and of education for all, regardless

of gender or social class. The University developed rapidly, and by the end of the 19th century, had become a major technological institution. It is a leading university, meeting the needs of students, employers, industry and the wider community through its teaching, research, consultancy and knowledge transfer. During the nineteenth century it continued to grow, and although it offered some courses in management, the focus was still on science and engineering. This was until the 1960's, when the college broadened its activities by merging with the Scottish College of Commerce, which offered a wide range of business and arts subjects. The enlarged Royal College was granted the Royal Charter, and became the University of Strathclyde in 1964. In 1993 the University merged with the Jordanhill College of Education, a major teacher training college, and the new Faculty of Education was created. The University continues to grow and is today the third largest university in Scotland. There are currently approximately 29,000 full and part-time students attending the University of Strathclyde, with almost 3,000 staff in four faculties. The institution enjoys a powerful reputation for its commitment to commercially relevant research, experience in entrepreneurship education, and its strong links to industry and commerce. Its location in the city centre provides a strong physical civic presence.

The Documentary Analysis

The aim of this part of the paper is to examine the: *"extent to which the theoretical framework can be applied to support the entrepreneurial university approach?"* . The list of documents that have been used for this particular purpose can be found in appendix (A). The following table (1) illustrates the key indicators in each of the five matrices that have been used as an analysis guideline. However it is worth mentioning that some of those indicators have not been studied or discussed in the documents that have been used for this analysis.

Dimension	Indicators
Managerial	<ul style="list-style-type: none">• Re-structure university governance and mechanisms to adapt entrepreneurial changes (transparency of structure and processes).• Align the top-down incentives and bottom-up initiatives (Collegiate management), vision, mission, goals-oriented decision-making.• Is the university council (decision-making body) representing sufficiently representative from external entities and the internal body including academic staff?

	<ul style="list-style-type: none"> • Is the university strategy, which is established by the university council, reflecting an entrepreneurial approach? • Does the decision-making body have power and influence in lobbying for universities in regional innovation and research policy? • Does the decision-making body have power, and is it involved in the promotion process? • Does the decision making body have the power and influence to seek new income sources, allocate funding resources, and evaluate financial audits?
Dimension	Indicators
Funding	<ul style="list-style-type: none"> • The extent to which the university is financially independent/autonomous. • The percentage of government funding in the total university fund. • The percentage of project funds in the total university fund. • The percentage of private funding income in the total university fund. • The volume of independent/ innovative researchers. • The volume of international students enrolled/ graduates there are per year. • The volume of publications there are per year (books, articles, etc). • The volume of national and international awards there are per year.
Dimension	Indicators
Mission	<ul style="list-style-type: none"> • The volume of new research and teaching programmes that is orientated to the external environment. • The volume of joint projects with industry and the private sector. • The volume of spin-offs and start-up companies. • The volume of research commercialization projects/ patents/licenses. • The volume of multidisciplinary graduate school programmes. • The volume of PhD students graduating in the fields of science, technology and innovation.
Dimension	Indicators
External linkages	<ul style="list-style-type: none"> • The establishment of technology-transfer offices/ innovation office • The number of research centres/ science parks linked with the university • The volume of industry-university projects • The number of researchers and students who have moved to work in industry or external labs • The number of external experts who have moved to work in university labs • The volume of joint ventures • The volume of research projects in collaboration with external groups
Dimension	Indicators

Cultural	<ul style="list-style-type: none">• A clear vision, mission and goals statement in favour of an entrepreneurial culture• Strong executive leadership and decision-makers• Entrepreneurial behaviours among teachers and students• The university's organizational structure reflecting the cultural changes• Building a network culture with the external environment (professional, industry, societies, and regional and international collaboration)• Re-structuring university governance and mechanisms to adapt to entrepreneurial changes (transparency of structure and processes)
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In the pages that follow, the five theoretical dimensions for each of the four cases respectively will be discussed.

Managerial Dimension: Based on the three matrices that describe this dimension, the analysis aims to answer the question: *whether the university has strong executive leadership, executive strategy and decision-making, balancing between proactive internal activities and reactive external demands, and balancing between academic values and managerial strategic directions?"*

Chalmers University of Technology

According to Chalmers' long term strategy (2010/2020, p4), its vision is: "*Chalmers for sustainable future*". This has been described by Chalmers' President and CEO, Karin Markides, as the vision which will inspire Chalmers to adopt a broader perspective as it strives to develop the technology and know-how necessary to meet both the present demands and the future ambitions. In addition, the vision draws attention to the outstanding research and education at Chalmers that provides a motivating, academic environment which facilitates interaction and collaboration with industry and society, locally and internationally. With these criteria, Chalmers University of Technology is highlighting the entrepreneurial approach as a strategic long term plan. On the other hand, according to the studies in relation to Chalmers' development, the long tradition of organisational flexibility in innovation, service-mindedness at administration level, and a flexible action system through all levels of the university demonstrate the historical transformation of the university toward the entrepreneurial approach. Since 1994,

Chalmers University of Technology was able to frame itself in terms of the new language of public spiritedness, collaboration and entrepreneurial intentions. The University gained freedom, after a long dialogue between 1990 and 1994, because of the strong leadership of its chairman and board members: *“The discussions on the Chalmers board were very constructive. Considerable emphasis was placed on the standpoint of the students. The trade unions were initially opposed to the organisational form that had been put forward but we had a very good dialogue. Once the decision was reached they congratulated me and said: ‘We are on board with you’. A very tangible reflection of the Chalmers spirit”* (Anders Sjöberg, Chalmers' president, 1993, Chalmers University of Technology Foundation 2004, p7). This freedom has several aspects: the freedom to build up the University's own funds, the freedom to own and manage its own properties, the freedom to decide on its own organization, the freedom to develop its own career and human resource structure, and the freedom to develop its own recruitment process. As a result, Chalmers was able to accumulate capital from the various entrepreneurial initiatives as a part of the university's landscape which came with privatisation. Moreover, the shift from a research- to an innovation-oriented policy in Sweden has made Chalmers more aware of the need to balance its knowledge exploitation activities with a strong culture of exploration and knowledge creation. On the other hand, fragmentation and a lack of transparency are perceived by many in the university to be problematic. However, it is a logical outcome of the natural way in which the system developed in its earlier stages.

Norwegian University of science & Technology (NTNU)

According to the NTNU strategic plan 2011/2020, its vision is *“Knowledge for a better world”*. This vision has been expanded by the NTNU board to state that NTNU endeavors: *“to create the basis for the development of knowledge and to create value – economic, cultural and social. We will make the best possible use of our main profile in science and technology, our academic breadth, and our interdisciplinary expertise to tackle the large and complex challenges faced by Norway and the world community”*. Therefore, with this explanation, NTNU focuses the attention of the university on technology and responding to social, economic, and cultural values and demands. In addition, NTNU has gained a new overarching document for governance and new faculty

strategies. Broad-based involvement and strong engagement have been features of the university system. Of the eleven members of the Board, three are from the academic staff at NTNU, one represents academic or research staff without tenure, and one member represents the technical and administrative staff. There are also two student members of the Board and four external representatives (all from outside the university). Studies of NTNU development reveal that, NTNU is the first Norwegian university to have appointed a Pro-rector of innovation and external relations. Moreover, NTNU has first-class laboratories and a first-class infrastructure for research and education. According to survey findings, *"Norwegians believe that NTNU is a university with a strong sense of responsibility to society and that it contributes to the creation of value in the country"*. With regard to historical development, the studies reveal that NTNU was established in 1996 as a result of the reorganization of the University of Trondheim. This organizational re-structuring has enabled it to meet the university's drive towards technology and innovation: *"Our main profile in science and technology gives us a particular responsibility to develop the technological foundation for the society of the future Programmes of professional"*.

University of Twente (UT)

According to the UT strategic plan (2009-2014), the university's vision is as follows: *"UT is entrepreneurial university in action"*. This vision has been translated in the UT mission: *"UT is being an entrepreneurial (technical) research university focusing on technological developments in the knowledge society. Internationally recognized excellence in research and teaching is its objective, as well as stimulating economic and social development via the resulting valorisation activities in the region"*.

Studies which relate to this dimension suggest that this vision was inspired by one of the strongest influences in the university, the Rector Magnificus, Professor van den Kroonenberg, who served two terms (1979-1982 and 1985-1988). The Professor was an expert in energy technology, but was also very highly motivated to develop the regional role of UT. Furthermore, the studies reveal further details with regard to UT development in this particular dimension. These are as follows: the UT informal governance structure was replaced with the generic Executive Board and Court mode, and the university has shaped its approach to regional engagement to strengthen the regional economy in order

to meet its vision. In addition, in the 1980s, the School of Technology and Management founded a centre for entrepreneurship, which developed into the Dutch Institute for Knowledge-intensive Entrepreneurship, “Nikos”; and in 2002, Twente Kennispark (Knowledge Park) was also founded. The partnership played a strong role in national funding for UT regional projects.

University of Strathclyde (UoS)

The University of Strathclyde's Vision, set out in their strategic plan (2011-2015), is as follows: "*The Place of Useful Learning: Innovative Learning, Research and Innovation, Knowledge Transfer*". This vision has been articulated by the university's mission statement in terms of having a reputation for excellence across research, education and knowledge. It highlights the idea that knowledge-exchange is one of the three strategic pillars of the university, and reflects the university's desire to move towards an entrepreneurial culture. This ethos has been inspired by the founder of Strathclyde University, Professor John Anderson's (1726-1796) statement: "learning *should be relevant to the new industrial age*". With regard to the university's historical development in this dimension, the studies reveal several actions taken by management. These are: the development of the Research and Knowledge Transfer Strategy Committee, and the International Policy Forum; the assignment of Vice Deans for knowledge exchange within each faculty; the development of connections, networks and collaborations through the alumni office; and establishing the Strathclyde Entrepreneurial Network, Strathclyde Links, and the West of Scotland KTP Centre. In addition, the largest entrepreneurship centre in Scotland, and one of the largest in the UK, the Hunter Centre, has been created by one of UoS alumni.

Resource Funding Dimension

Based on the three matrices that describe this dimension, the analysis aims to address the question: *to what extent the university is able to diversify its funding resources from second and third stream income and to what extent it is seen to be academically-led rather than financially-led?*"

Chalmers University of Technology

According to Chalmers' strategic plan and other studies in relation to this dimension, 3,028 ((SEK million) is their total income, of which: 889 m is from first degree and master's programmes, and about 2,139 m is from doctoral programmes and research projects. This shows that Chalmers' financial resources come from a mixture of public and private money; in other words, a joint investment by the state and the private sector. The percentage distribution is as follows: from Chalmers Foundation 2%, public foundations 3%, other (student fees) 6%, EU 4%, companies and private sectors 11%, other government 23%, and Ministry of Education and Research 49%. This shows that about two-thirds of the funding resources come from government. In addition, there are the Chalmers-owned venture capital funds from Innovationskapital, which was set up in 1994 for independent third-party ventures.

The Norwegian University of science & Technology (NTNU)

According to NTNU (2011), the total budget of the university is EUR 640 mill. This is distributed as follows: from the Ministry of Education 72%, the Research Council of Norway 13%, industry 7%, from state municipal funds 4%, other (student fees) 3%, and from the EU 1%. In addition, some examples of the projects in which NTNU collaborated with companies and generated income during the period 2002-2008, are: PointCarbon (2000) acquired by Thomson Reuters for NOK 1100 million, 2008: FAST acquired by Microsoft for NOK 6600 million, 2008: TrollTech acquired by Nokia for NOK 850 million, 2007: Nacre acquired by Bacou-Dalloz for NOK 840 million, 2006: Falanx acquired by ARM for NOK 170 million, 2005: ChipCon acquired by TI for NOK 1360 million, and in 2002: Atmel Norway with annual turnover of more than NOK 180 million.

University of Twente (UT)

According to UT (2011-2013), the university's total income is over 33 million Euros, and is distributed as follows: 55% from the Ministry of Education, 27% from contract funding, 13% from industry, and 5% from the EU. This shows that for UT, like Chalmers University and NTNU, the largest amount of the total budget comes from the country's Ministry of Education.

University of Strathclyde (UoS)

Studies relating to UoS funding resources show that The University of Strathclyde's annual income are in excess of £200M. This income comes from three sources: (1) *income from public funds via a block grant from the Scottish Funding Council and tuition fees paid by the Scottish Government or by local authorities;* (2) *tuition fee income from both home and overseas students;* (3) *income from private sources including research contracts, services rendered, courses and conferences, endowments, residence and catering operations, grants and donations.* An additional income stream is generated through the provision of supported workspace through the Strathclyde University Incubator Ltd. Company. An important element of income generation is the activity of the Alumni Office. Income generation ranges from small donations, to the generation of large endowments such as the one which helped to create the Hunter Centre for entrepreneurship. Up until now, the university has engaged with over 200 entrepreneurs, assisted in the formation of 28 new businesses, created 47 new jobs and increased sales in assisted businesses by over £800,000. It has also had a huge knock-on effect on other Scottish industries - with £63 million being generated in a range of sectors for every £100 million spent by the University. Overall, the University's activities generated over £305m of output in Scotland, with around £210 million of this in Glasgow and around £95 million in the rest of Scotland. The University's own overseas revenue of nearly £24.4 million, together with the estimated off-campus expenditure of overseas students and visitors (£20.3 million), indicate that the University of Strathclyde was responsible for generating nearly £45 million of export earnings. This is equivalent to around 1.5% of all Scottish Service Sector export earnings. The university also generates income by allowing the community access to its sports and leisure facilities.

Mission Dimension

Based on the three matrices that describe this dimension, the analysis aims to answer the question of: *"whether the university is able to enhance its third mission by incorporating it into the core mission through building bridges with industry and the private sector in specific disciplines of academic interest."*

Chalmers University of Technology

In order to test this dimension within Chalmers University of technology, several studies and reports have been reviewed. The review shows that: privatisation was seen as a move which would afford Chalmers much longed-for autonomy in its teaching and research, but more importantly, in developing its infrastructure for promoting innovation. Furthermore, the university was able to integrate innovative research, entrepreneurial students and action-based training. This led to the situation where research and education became traditionally very strongly linked to industry. In one year, 45 students graduated from the school and a total of 12 new companies were created from this group. These companies together raised more than US\$ 10 million in venture capital and created 136 new jobs. Also, 15 knowledge-based companies are established every year. The indicators of research outcome reveal: 1254 peer-reviewed scientific articles and 845 peer-reviewed conference contributions; in addition, 1147 doctoral students, of which 304 degrees were awarded (138 PhDs and 166 Licentiates).

Norwegian University of science & Technology (NTNU)

According to NTNU's entrepreneurial activities, the indicators demonstrate that education in entrepreneurship is a core mission. This can be seen by: (1) the establishment of the NTNU School of Entrepreneurship for educating future entrepreneurs, (2) several courses related to entrepreneurship at the Centre for Entrepreneurship, (3) NTNU Entrepreneurship Centre Undergraduate to PhD courses in entrepreneurship. In addition, 260 doctoral degrees were awarded in 2010. There have been more than 2000 research projects, 64 projects in the EU's 7th Framework Programme, 62 EU projects from 2002–2006, and more than 300 cooperative agreements with universities globally. More than 90 companies have also been created from NTNU since 2003. Research output indicates that NTNU has generated 2385 scientific papers and review articles, 4139 scientific presentations, 225 books, 642 reports and theses, and 1189 book chapters/reports. In addition, prizes were awarded to staff in a variety of disciplines: medicine, technology, natural sciences, architecture, humanities and visual arts. These provide evidence of the academic breadth at NTNU, and reflect the high level of their activities.

University of Twente (UT)

Based on the indicators of this dimension, UT demonstrates a strong focus on entrepreneurial activities through promoting talent to develop (student-) entrepreneurship. Nikos is involved in two extracurricular courses, incubators and spin-off support, and it moved from being extracurricular toward curricular. Significant amounts of UT's research were co-ordinated through multi-disciplinary research institutions and regional engines for innovation, with 330 companies on site and 5900 commercial jobs. In addition, the University of Twente and Saxion had joint projects that generated 750 spin-offs (40 -50 start-ups per year), and created 6500 jobs. Furthermore UT established TOP (Temporary Entrepreneurial Positions) program which resulted in creating 290 jobs between 1979 and 2004. Other education programs are designed to: facilitate starting and growing businesses (Entrepreneurship), and stimulate innovation in existing companies (Innovation). Altogether, 3300 scientists and professionals, and more than 9000 students have created more than 700 successful spin-off companies

University of Strathclyde (UoS)

The studies show that UoS has taken significant initiatives toward promoting entrepreneurial education. Teaching entrepreneurship at UoS currently involves 701 students, 640 undergraduates and 61 postgraduates. All faculties have strong links with industry and professional bodies and place great emphasis on the influence of these connections on the curriculum. Specific programmes such as KTPs and the CPD initiatives have impacted upon the organisation of teaching and learning. In addition, the university has a long-established track record of generating research patent royalty income, and is one of the UK's most successful universities in this arena. UoS is also working with representatives from industry to discuss curricula and new degrees in order to meet industrial demand. It is working in cooperation with industry in respect of industrial placements and project-based learning, the demand for continuing professional development, and research projects between academics and industry.

External Linkages Dimension

Based on the three matrices that describe this dimension, the analysis focuses on answering the question: *"to what extent the university able to cope with the challenges on building linkages and establish bridges with the uncertain socio-economic demands?"*

Chalmers University of Technology

The external linkages and collaboration dimension at Chalmers University of Technology can be examined by highlighting the following university activities:

- Chalmers is constantly developing new models for interaction, ensuring that education, research and innovation will be of benefit to the community.
- Chalmers Innovation comprises new, innovative companies based mainly on research and education at Chalmers.
- Johanneberg Science Park is developed in order to clarify the link to three of the Chalmers areas of advancement: built environment, energy, and materials science.
- Lindholmen Science Park brings together high-tech, development intensive companies within mobile communication, intelligent transport and the modern media industry.
- Sahlgrenska Science Park is a business incubator and technology park that gives people with ideas, and new companies working in life sciences the best possible start to their new ventures.
- Chalmers' spirit, which was characterised by a strong alumni network that linked both staff and former students, and open and trust-based relations.

Norwegian University of science & Technology (NTNU)

Studying the external linkages and collaboration at NTNU can be described through the following university initiatives:

- NTNU has more than 4000 industrial contracts.
- NTNU is home to three centres of excellence, four centres of research-based innovation, and two centres for environment-friendly energy research.
- Stimulation of student enterprise and relations with industry.
- Centres at NTNU: Leiv Eiriksson Nyfotek (LEN) Gloschaugen innovation centre.
- Outside incubators and on-campus incubators.
- Gløshaugen Innovation Centre (18 companies in-house, April 2011)
- NTNU Technology Transfer Office (AS) help and support for people with business ideas.
- Start NTNU – a student-run organization for innovation.
- NTNU Alumni (network for former students) has 24 000 members and about 300 alumni groups.

University of Twente (UT)

The external linkages and collaboration dimension at the University of Twente can be explored through the following university initiatives:

- Establishment of Commercialisation of University Knowledge (“Kennis”)
- 150 events per year with partners, such as entrepreneur associations.
- MESA+ Institute for Nanotechnology Micro-electronics, Materials Engineering, Systems and Actuators
- Developing an office within the University Entrepreneurship Promotion and external engagement, in 1979. This was originally called the Transferpunt.
- Establishing Business Technologie Centrum-Enschede in an industrial estate
- Research Joint Ventures: Jointly run with industrial partners: TPRC, Boeing, ten Cate, Stork, CMI, Siemens, UMCG, High Tech Factory, 20 nano companies, Centre4Cloud, and Google, IBM, KPN

University of Strathclyde (UoS)

The external linkages and collaboration dimension at University of Strathclyde can be examined by looking at the following university initiatives:

- The development of external partnerships, and engagement with business and the broader community, is a priority within the university’s future strategic plans.
- Individual faculties also manage relationships with external organisations and learners independently from the central team.
- Close engagement with industry & business
- A strong tradition of knowledge exchange
- Balance between fundamental and applied research
- Responsibility for regional regeneration

Cultural Dimension

Based on the three matrices that describe this dimension, the analysis aims to answer the question: *“whether entrepreneurship is in the organisation's core mission, and to what extent the university is committed to supporting the approach at all levels (top-down and bottom-up).”*

Chalmers University of Technology

The entrepreneurial university may be seen not as a policy outcome but as an internally driven process that may be better explained by the culture of an engineering school rather

than responses to top-down steering. The following indicators can be used to examine the cultural dimension at Chalmers University of Technology:

- Chalmers prides itself in being a university where individual initiative on the part of students and/or faculty is highly valued.
- The existence of an embryonic infrastructure for entrepreneurial activities combined with the new spirit of the times as represented in the macro research policy initiatives meant that Chalmers was at least formally better equipped than most of its counterparts to transform itself into an entrepreneurial university.
- The shift in research policy focus on the national level was significant in that it created a climate which legitimized what had been taking place within Chalmers.
- Chalmers has greater freedom of action and more scope for exploring new paths, without sacrificing the current standard of education and research.
- Different components of the structure are 'owned' by a few strong individuals and each component has its own legal structure and board of directors.
- Chalmers' spirit, which is characterised by a strong alumni network that links both staff and former students, and open and trust-based relations.

Norwegian University of science & Technology (NTNU)

The studies and reports with regard to the cultural dimension at NTNU provide the following indicators:

- NTNU attracts the best students and staff, and is internationally renowned for the quality of its student life.
- Students and staff members feel that they belong to NTNU and are proud of their affiliation.
- In 2011, NTNU won approval for several major projects in the infrastructure programme of the Research Council of Norway, including NORBRAIN
- The main profile and unique attributes of NTNU provide an advantage in academic competition at national and international level, and in collaboration with private- and public-sector organizations.

University of Twente (UT)

The studies and reports in relation to the cultural dimension at UT provide the following indicators:

- The universities have developed a unique profile and culture in their specific environment leading to a strongly-rooted regional presence
- Culture and behaviour shaped and developed over 30 years

- Excellent English taught education for BSc, MSc and PhD degrees: Times Higher Education World University Ranking: place 185, and number 6 in Europe in research
- Entrepreneurship and Innovation in all programmes: Full support for starting up your own business – more than 700 spin-off companies in the last ten years.
- Beautiful unique campus: great facilities, relatively low living costs

University of Strathclyde (UoS)

The studies and reports with regard to the cultural dimension at NTNU provide the following indicators:

- Strathclyde has a long-standing, worldwide reputation for excellence in academic research and innovation which not only benefits society, but which is also commercially-relevant.
- Strathclyde has generated more than 40 spin-off companies to date, placing it seventh in The Times Higher Education Supplement's league of entrepreneurial universities in the UK.
- It has one of the largest industrially-sponsored research portfolios for a university of its size anywhere in the UK. It has in excess of 160 patents and licence agreements which, over the years, have generated more than £42 million in royalty income.
- UoS is an entrepreneurial university and all Strathclyde undergraduate students have access to its courses at the Hunter Centre for Entrepreneurship.

The Summary

To summarise, the above analysis shows that the four universities have a high national, regional and international recognition as entrepreneurial universities. Looking at university history, Chalmers is revealed as having the longest history, whereas the other three universities have relatively similar historical experiences. The four universities are relatively close in size in terms of faculties, students and staff numbers. In addition, all the universities are situated on sites that have significant industrial potential and knowledge facilities. This has given the universities an important element of success, although (Graham, 2013, p16) points out that, "*Some effective strategies appeared to be relatively independent of the university size, location and profile*". Generally speaking, the analysis of the entrepreneurial university dimensions of each of the four universities reveals, on the one hand, some common elements, and on the other hand, some different

elements specific to each university, as key factors for success. The common elements can be seen in the mission dimension, as all four universities have strong entrepreneurial education (depending on the type of courses), a high level of research performance which is oriented towards technology and industrial demand, and strong commercialization performance. In addition to this, they have significant mechanisms and infrastructures to help them create companies, great businesses, and spin-off, and start-up companies. The second characteristic that the four universities have in common is that they all have relatively strong linkages and partnerships with industry, the private sector, government, and the community, with regional involvements. On the other hand, the managerial dimension analysis shows some significant differences. While NTNU and the University of Twente encompass strong executive leadership and professional management which helps to accelerate an entrepreneurial culture, Chalmers appears to face some problems with a lack of transference between top management, middle line, and the academic community. In addition, the funding and resource dimension also shows some important differences. Whereas Chalmers depends mainly on public funds with the majority of its funding (49%) coming from the Ministry of Education, NTNU and Twente generate funds from a huge number of national and regional projects (public and private, including industry), and Strathclyde has a mixture funds from all three different streams (public, project, and private). The following table summarises the findings of the analysis of the four universities:

Table (1): Entrepreneurial University: Organization Dimension Analysis- Chalmers, NTNU, Twente & Strathclyde

Dimension	Chalmers	NTNU	Twente	Strathclyde
Managerial: <i>whether the university has strong executive leadership, executive strategy and decision-making, balancing between proactive internal activities and reactive external demands, and balancing between academic values and managerial strategic directions?"</i>	Strong executive leadership, autonomous, and there is balance between internal and external demands, clear strategy toward entrepreneurship	Strong executive leadership, clear strategy toward entrepreneurship	Strong executive leadership, clear strategy toward entrepreneurship	clear strategy toward entrepreneurship
Funding: <i>to what extent the university is able to diversify its funding resources from second and third stream income and to what extent it is seen to be academically-led rather than financially-led?</i>	Highest % comes from Gov. Then Second and third stream	Highest % comes from Gov. Then Second and third stream	Highest % comes from Gov. Then Second and third stream	Mix fund (Public, project, Private)
Mission: <i>whether the university is able to enhance its third mission by incorporating it into the core mission through building bridges with industry and the private sector in specific disciplines of academic interest</i>	Strong entrepreneurship education Project-based research High performance of commercialization and spin-offs	Strong entrepreneurship education Project-based research High performance of commercialization and spin-offs	Strong entrepreneurship education Project-based research High performance of commercialization and spin-offs	Adequate entrepreneurship education Project-based research High performance of commercialization and spin-offs
Linkages: <i>to what extent the university able to cope with the challenges on building linkages and establish bridges with the uncertain socio-economic demands?</i>	Strong bridges and linkages with regional and international	Strong bridges and linkages with regional and international	Strong bridges and linkages with regional and international	Strong bridges and linkages with regional and international
Cultural: <i>whether entrepreneurship is in the organization's core mission, and to what extent the university is committed to supporting the approach at all levels (top-down and bottom-up)</i>	High ranked university and Strong commitments at all levels Difficult to measure the believes	High ranked university and Strong commitments at all levels Difficult to measure the believes	High ranked university and Strong commitments at all levels Difficult to measure the believes	High ranked university and Strong commitments at all levels Difficult to measure the believes
Geographical location	Industrial region	Industrial region	Industrial region	In the heart of the city

Concluding Remarks

The purpose of this paper is to examine and validate the entrepreneurial dimensions that have been explored in paper one. Notably, universities' transformation toward an entrepreneurial culture requires significant changes in organizational structures, knowledge-production and cultural beliefs and behaviour. This has been evident through the analysis of the four European universities that have an entrepreneurial history and are recognized as entrepreneurial universities nationally and internationally. All four universities have made considerable changes at different levels. The four cases show the importance of re-structuring university infrastructure with the influence of strong leadership and professional management. The case of NTNU and Twente are excellent demonstrations of the way in which strong leadership can transform a university from a failing institution into a successful entrepreneurial university with a strong reputation. In addition, the four cases illustrate the importance of a mixture of funding from public, private and industrial projects, where strong leadership plays a vital role in generating more income and allocating it efficiently. NTNU and Twente also provide evidence for the importance of entrepreneurship education and high quality entrepreneurship courses and programs. Moreover, the four universities implement to some extent project-based teaching and research programs. The strong industry and private linkages and partnerships are also revealed to be a vital dimension in university transformation. Finally, despite the fact that cultural behaviour and beliefs are to some extent difficult to measure, they have a role in setting up a flexible and attractive entrepreneurial environment for the university students, the academic researchers, the top management and for external entities. All of the analysis provides us with verification regarding the entrepreneurial university. On the one hand, there are common changes which are applied by all the universities. On the other hand, there are specific elements and practices based on each individual university's circumstances and culture which we cannot apply generally to all cultures. Finally, it is worth mentioning that the some of the secondary data that has been used in this part is dated 2006 and 2008, and we are assuming that entrepreneurial activity will have increased in all four cases. A further empirical study might be advisable for more robust verification and validation. Interviews

with strategic-level members at each of the four universities would provide some valuable discussion and in-depth perspective in relation to the entrepreneurial dimensions. This vision will help to reflect and verify the GCC situation.

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Appendix A: List of documents used for data analysis

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