

Competitive Capacity of Knowledge Driven Institutions and the concept of

LEAD PRINTING



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Foreword

The work underlying this study was compiled in 2018 – 2020 on the basis of relevant data and interviews with experts held at the end of 2018 and beginning of 2019 in Australia, China and Europe. The author thanks all cooperation partners for their support.

The opinions expressed in this study reflect the opinion of the author and do not necessarily reflect the official views of any institution.

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The institution...

...the main task of the Austrian Council for Research and Technology Development consists in systematically, independently and thoroughly consulting the Austrian Federal Government in all issues of research, technology and innovation policy.

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Table of Contents

<i>Executive Summary</i>	5
1 Introduction and Limitations	7
2 Literature Review and Theoretical Framework	10
2.1 Literature analysis of cultural framework conditions	12
2.2 Leadership and imprinting in knowledge driven institutions.....	16
2.3 Measurement of the impact of regional macro-economic systems	21
2.4 Links and interfaces between knowledge generation and implementation.....	22
3 Methodology	24
3.1 Case Study Design	24
3.2 Case Study Interview Questions	25
3.2.1 Sample of Interview Questions	25
3.2.2 Selection of experts for the interviews	26
3.3 Data and Indicators	27
4 Analysis/Findings	28
4.1 Case Study Australia	28
4.1.1 The Australian Knowledge and Innovation System.....	28
4.1.1.1 Institutional Structure Case Study Brisbane.....	31
4.1.1.2 Institutional Structure Case Study Melbourne.....	31
4.1.2 Leadership and Imprinting in the Case Study regions Brisbane and Melbourne.....	32
4.1.3 Regional economic framework in Brisbane and Melbourne.....	35
4.1.4 Links between knowledge generation and implementation in Australia	35
4.1.5 Findings from the Case Studies in Australia	38
4.2 Case Study China	42
4.2.1 The Chinese Knowledge and Innovation System	42
4.2.1.1 Institutional Structure Case Study Hangzhou.....	44
4.2.2 Leadership and Imprinting in the Case Study region Hangzhou	44
4.2.3 Regional economic framework in Hangzhou (Zhejiang region)	45
4.2.4 Links between generating and implementing knowledge in China	45
4.2.5 Findings from the Case Study in China	46
5 Conclusions.....	48
6 Literature	51

Abbreviations

ABS	Australian Bureau of Statistics
AUD	Australian Dollar
ARC	Australian Research Council
CSIRO	Commonwealth Scientific and Industrial Research Organization
ERA	Excellence in Research for Australia
EY	Ernst&Young
GDP	Gross Domestic Product
IHS	Institute for Advanced Studies
IP	Intellectual Property
IPO	Initial Public Offering
ISA	Innovation and Science Australia
ISR	Innovation, Science and Research
KPI	Key Performance Indicator
MIT	Massachusetts Institute of Technology
NDRC	National Development and Reform Commission
OECD	Organisation for Economic Co-operation and Development
PwC	PriceWaterhouseCoopers
QS	Quacquarelli Symonds
R&D	Research&Development
RMIT	Royal Melbourne Institute of Technology
US	United States
VC	Vice-Chancellor

Executive Summary

“The box is not black; it is as colorful as people and their cultures.” (L. Garzik, 2020)

This wording is referring to the wording of “black box” when it comes to the discussion about how input is transformed into output: The issue is heavily debated in many innovation/knowledge eco-systems and was one of the motivating factors for embarking upon this research project.

Many economies invest heavily in their education and research ecosystems. In order to maintain these investments, the regional innovation system has to transform knowledge into money through business models which are successful on the market. Furthermore, the money earned can be reinvested in new knowledge. By following the stream of money flowing into the knowledge ecosystem, a region should be able to find the best places to bridge gaps to innovation: universities, research institutions and industry.

One of the key findings is that a major part of the human capital available each year flows into risk averse career models and do not require knowledge to be transformed into innovation. The impetus for that development is to be found in the cultural framework of the respective ecosystem. The hypothesis is that the mindset of management at the relevant knowledge driven institutions has a significant role to play. Entrepreneurial spirit is inherited and transferred top-down, meaning that it has the potential to be a major driver for the capacity of those institutions to improve the competitiveness of their regions.

This study focuses on the link between input, i.e. knowledge generation in knowledge driven institutions such as universities, and output, i.e. implementation of knowledge in regional economies.

Analysis of the case studies provides us with a set of new insights and tools to use and implement in our system. Therefore, we should discuss similarities and differences between the regional innovation systems in the case study regions and in Austria. This will be undertaken in a further study that to be undertaken in cooperation with the Institute for Advanced Studies (IHS) in Vienna. The major finding in this current study is the importance of combining leadership and imprinting: this expressed by a new concept introduced as “lead printing”:

Lead printing...

...is the flow of leadership impetus from upper management transferred by the imprinting capacity of the downstream hierarchical chain and facilitated by an institutional governance model which allows for this transfer. (L. Garzik, 2020)

Lead printing - Competitive Capacity of Knowledge Driven Institutions

1 Introduction and Limitations

Knowledge driven institutions are organizations with structures and processes which are influenced by the generation of new knowledge or the management of existing knowledge. In most ecosystems, these are organized in the form of universities, universities of applied sciences and research organizations, or companies for whom a significant proportion of their activities involve generating knowledge.

These institutions form the cornerstones of every regional innovation system. A deep insight into these processes is provided by the “Triple Helix Analysis” introduced in the mid-1990s by Henry Etzkowitz and has since been further developed in various directions. As stated in Etzkowitz (2000), links between universities, industry and government provide the foundations for a regional innovation system’s efficiency and impact. Thus, if the university in a region does not perform well, the regional innovation system will be unable to develop to its full potential.

Among knowledge driven institutions, universities play a special role because of their many functions: from educating students (including shaping their mindsets) to providing interfaces for research cooperation with industry. In practically every regional and national budget, expenditure for universities represent an important part of their total R&D expenditure. Therefore, this study will concentrate on the role of universities as representatives of the group of knowledge driven institutions. Further research will be needed at a later stage on the potential impact of other types of institutions in this context.

“Leadership and Imprinting”

The performance of a university correlates with autonomy in hiring and wage-setting, the degree of public ownership, budgetary autonomy, budget per student and many other factors. Although not all of these factors can be directly or indirectly influenced by management decisions, leadership remains more than formal decision-making: it involves imprinting a mindset for engagement and impact.

Imprinting itself should be understood in the context of every hierarchical level, not only that of upper management. Imprinting influences the culture and socialisation of employees by their leaders. In Azoulay, p. et al (2009), we can find proof that if a superior happens to have a certain mindset in favour of entrepreneurial activity, employees will be more likely to found companies during their later careers.

As stated above, knowledge driven institutions are established to generate new knowledge or manage existing knowledge. Another important part of an ecosystem is the “Third Mission”, which refers to efforts to actively provide knowledge for use outside the institution. Similarly to knowledge driven institutions’ other missions, the third mission also requires impetus from management in order for it to be activated and shaped so as to have the best possible impact.

Leadership and imprinting are necessary for carrying out the third mission at a knowledge driven institution, in order to provide knowledge for interfaces with external stakeholders who will use it for societal innovation or to be successful on the market. According to the hypothesis of this study, most European knowledge driven institutions and an even higher proportion of Austrian ones neglect the third mission; this is assumed to be a major factor explaining the gap between investments in new knowledge (input) and macroeconomic impact (output).

The core of this study consists of two components: a discussion of the importance of leadership and imprinting, and the effects on the regional macroeconomic system.

There are indicators and performance measurement tools for both these aspects. Despite the somewhat technical nature of these indicators, functions in a governance system are always carried out by human beings, whose culture and socialization have specific characteristics.

The importance of this human factor was highlighted in the edition of the Global Innovation Index in 2014, entitled, *Releasing the Global Innovation Index 2014: Nurturing the Essential Human Factor in Innovation*. In the preface to that edition, the Director General of the Confederation of Indian Industry points out that “creative and critical thinking, and the appetite for taking risks and thinking entrepreneurially, often matter at least as much as technical qualifications”. As a consequence, “the nation that can nurture and attract the best talent becomes the innovation trendsetter”. The question how this can be accomplished is answered by “provide them enough resources and incentives to chase their dreams. Innovation will follow.”

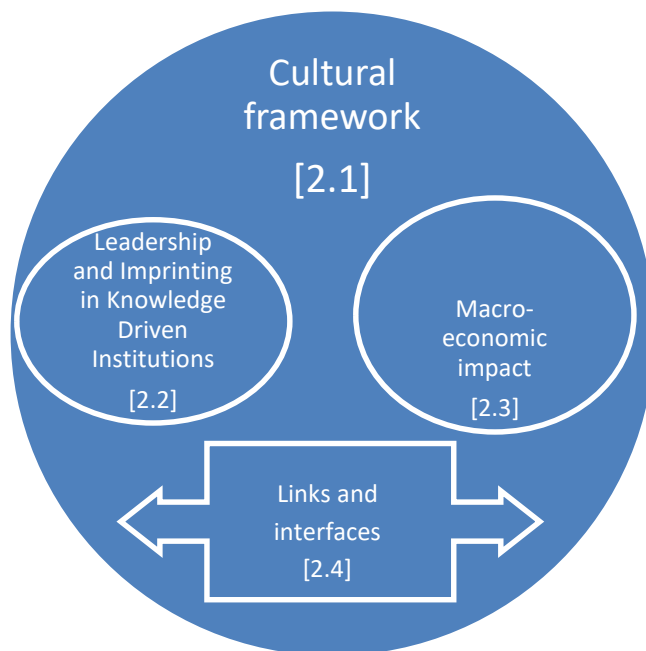
Given that the mindset and socialization of human capital in a region is very important for the ability of the system to generate and implement knowledge, so to is the cultural framework in place. This cultural framework is discussed in terms of its differences in the regions where the case studies were carried out, as well as in terms of its differences to the corresponding system in Austria.

2 Literature Review and Theoretical Framework

According to Acemoglu et al. (2006), the “importance of innovation for the productivity growth is growing the closer the region is to the world frontier”. In a regional innovation system, knowledge driven institutions, especially universities, play a key role in improving the efficiency of how knowledge is generated and implemented. The spaces of knowledge and innovation, in conjunction with a third space consensus space correspond with core elements of the Triple Helix in Ranga and Etzkowitz (2013). While applying the Triple Helix analysis, Garzik and Ranga (2015) stated that “a major responsibility for the lack of innovation out of the knowledge in a region is within the management of those organisations that generate and involve most of the well-educated human capital” – i.e. universities in a region.

Knowledge driven institutions and how they transfer knowledge into markets is embedded into an ecosystem consisting of human capital, institutional settings and, most importantly, the cultural framework in the region. Analysis of the literature will be structured according to these areas, in order to provide a clearer view of the relevant scientific basis:

Figure 2 a: Links and interfaces of leadership, imprinting and the regional macro-economic system, Source: author's own graphic

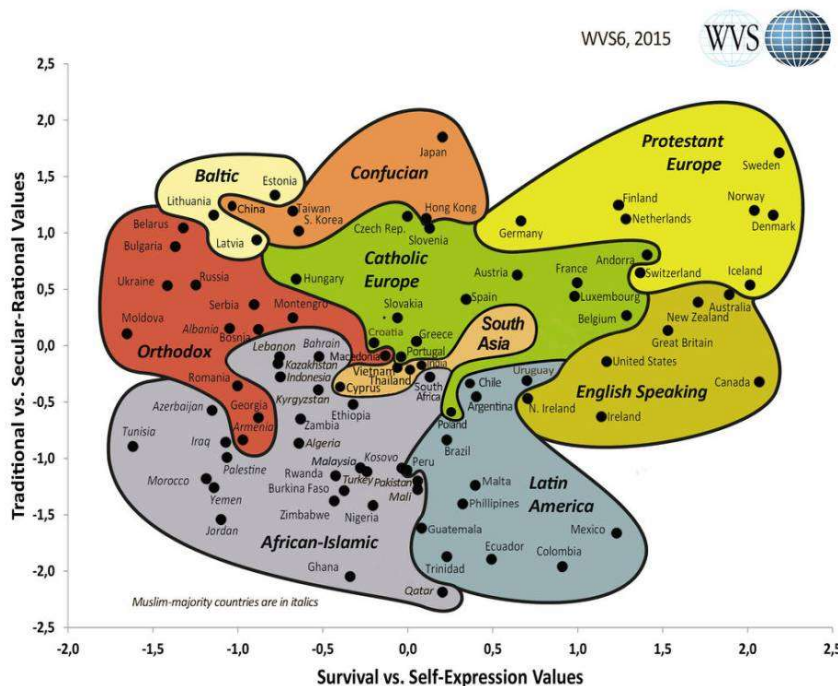


- Cultural framework conditions [Chapter 2.1]
- Leadership and imprinting in knowledge driven institutions [Chapter 2.2]
- Measurement of the impact of regional macro-economic systems [Chapter 2.3]
- Links and interfaces between knowledge generation and knowledge implementation [Chapter 2.4]

2.1 Literature analysis of cultural framework conditions

A comparison shall be made of the cultural dimensions of those regions involved in the case studies from Australia, China and Europe/Austria. Ingelhart et al (2013) proposed the Cultural Map of the World based on the World Value Survey which has been updated regularly since first being introduced in the early 1990s. Figure 2.1.-a shows the current status of the map based on religion and language.

Figure 2.1 a: Cultural Map of the World, Source: Ingelhart et al (2013)



The “Shared Values” of the different global regions are shaped by history, societal development and religion. While ecosystems can be very efficient at developing analysis and strategy, when it comes to implementation, there are strong currents of culture and socialization running counter to the system changes foreseen in the strategy. This phenomenon has been succinctly described in the statement “Culture eats strategy for breakfast”, attributed to management consultant Peter Drucker.

According to Frenkel et al (2014) “culture is essentially a given”: there should be no attributes such as good or bad; it is “simply there”. If people ignore it, there is a fair chance that the output objectives, which have often been politically defined, will not turn out as expected based on inputs and processes. Sometimes this part of the process is referred to as the “black

box”. However, this “black box” is more often than not a get-out for authors who are unwilling to dig more deeply into the complex influences which transform an input into an intended output.

From this perspective, a knowledge and innovation ecosystem is like a machine: you enter input parameters at one end and the crowd waits at the output end, full of expectations concerning what will come out of the machine. It is wonderfully convenient to refer to the machine in between as a “black box”, because then we have no responsibility whatsoever to analyze in depth what might be happening inside it. Additionally, we assume various time lags in order to create a sense of mystification around this black box.

Yet the fact is that an innovation system is not a machine: there are humans working within it, with their socialization, mindset and history. In order to prevent traffic-related deaths, we try to remove the human factor through autonomous driving. Obviously, we have realized that human emotions are a significant causal factor in traffic accidents. A further example is the hospital environment: nobody would deny the role played by the human factor here. Everybody tries to find the most experienced, “clever” doctor, who is not normally actually the head of the department but the one who has seen most cases and can judge the implications of various treatments. When discussing the ecosystem, we have to take the human factor into account. ***The box is not black; it is as colorful as people and their cultures.*** It is culture which determines how efficiency we make use of the “black box machine”.

In order to be able to define and discuss its effects on innovation, it is necessary to analyze the dimensions of culture in greater detail. Gee and Miles (2008) focused on the spatial and organizational dimensions, both of which are relevant for the discussion in this paper. They introduce the spatial dimension as being connected to “nations, regions and city-regions” with topics such as “the attractiveness of specific locations to the creative class” or “assessing the amount of creativity and innovative activity underway in a given area”. The question of the organizational dimension is addressed in respect of economic organisations by looking “at how corporate, small business, and/or public sector cultures facilitate, inhibit, or otherwise shape innovation”.

Theories trying to explain differences in innovation culture are manifold. As existing literature suggests, the important question of if and how competitiveness and capabilities of regions are influenced by cultural parameters has not yet been resolved. Didero et al (2008) structured the discussions underway at that time and found significant contributions to the cornerstones of the discussion in Hofstede (2001). Hofstede observes cultural settings from a systemic view of collective values and beliefs held by regions and nations, using the following set of five dimensions:

- Power Distance
- Individualism
- Masculinity
- Uncertainty Avoidance
- Long-Term Orientation

The two dimensions *power distance* and *uncertainty avoidance* provide the foundation for entrepreneurial activity. The results for European regions show quite low rates of *uncertainty avoidance* in the Nordic region, which coinciding as it does with low *power distance*, results in vibrant entrepreneurial activity which does not rely on power and leadership. In southern European countries, the picture is completely different with high *uncertainty avoidance*, but even higher *power distance* rates which more or less compensate the level of uncertainty with incentives and impetus from above.

Austria, for example, is in a very special situation with quite a high *uncertainty avoidance* score but the lowest *power distance* rate of all European countries analysed. This situation leaves the country with a low level of entrepreneurial risk taking due to the high uncertainty avoidance; meanwhile, there is no leadership or incentive structure to compensate for this risk avoidance by virtue of alternative impetus.

According to Hofstede, the “power distance scores are high for Latin, Asian and African countries” as is the case in southern European countries, whilst “uncertainty scores are lower in countries influenced by Anglo-American, Nordic or Chinese culture. This places China in a situation which is diametrically opposed to Austria: low uncertainty avoidance and yet additional power in incentives for more entrepreneurship.

Belitz, et al. (2011) take innovation culture and merges it with “attitudes towards science and technology as well as social capital and trust”, resulting in a rating of the “societal climate for innovation”. Regarding the entire national innovation system, that information can provide a measure of “innovative capacity of a country as the most important source of prosperity and growth”. The score that Belitz obtains from her measurement itself “cannot be interpreted but it allows for country rankings”.

Licht and Siegel (2006) also referred to social conditions with their statement that “the documented richness of entrepreneurial motivations suggests that entrepreneurial behavior

responds to a rich set of cues from the social environment”. Even if as yet, there is no sufficient evidence of the case for social capital, “theory has predicted that entrepreneurs who invest the most in social capital will enjoy the highest overall financial returns”. Hence, entrepreneurs have to “build reputation and bond themselves by affiliating with a social network”.

Culture defines the framework for the cultural setting and all activities in the region.

2.2 Leadership and imprinting in knowledge driven institutions

The discussion on an “entrepreneurial university” started in the early 1990s with an article by Burton Clark on “Leadership and Innovation in Universities”. He was inspired by the words of Kerr (1993) who stated: “For the first time, a really international world of learning, highly competitive, is emerging. If you want to get into that orbit, you have to do so on merit.[...] You have to develop entrepreneurial leadership to go along with institutional autonomy” (p.33). Based on these thoughts, Clark (1998) developed a set of questions that if answered could provide the necessary steps and the process for universities to compete within a globalized education setting. One of the main questions he raised is “how to establish change-oriented leadership?”. When examined in closed detail, this leads us to consider “is initiative exercised mainly by an individual campus head, or by a small group of central administrators, or by a combination of one or more central administrators and central faculty leaders?”. He also expresses this through an initial hypothesis: “Innovating universities depend heavily on leadership at middle and lower levels of management that successfully reconciles the entrepreneurial drives of central leaders with the drives of disparate academic professional groups”.

In one of his discussions on entrepreneurial universities in 2004, Clark found that “universities can transform themselves into a highly pro-active character that is largely under their own control”. In this process of change it is mainly impetus from management that can turn the wheel from “the old bureaucracy which looked to the prevention of error” to the “the new bureaucracy that looks to the stimulation of initiative”. As in other institutions, in universities it is the leadership of the management team that defines speed and direction of change. As Clark points it out: “there are many institutions pinned down in their traditional postures, with heavy constraints leaving them largely committed to the status quo – unless they get up and do something about it”.

Universities face different kinds of challenges in their effort to reach excellence in education, research and impact. Taking Sweden as an example for a European university system, we can rely on an assessment by Bienenstock et al (2014). In their analysis of the Swedish system, they pointed out that a significant contribution to societal development is best achieved where universities manage to “attract the best students and faculty” – as for example US universities such as Stanford or Berkeley have demonstrated. This can be accomplished by “linking education and research”, focusing on “recruiting mechanisms” and highlighting the “importance of career development paths”. The authors find that Sweden’s “universities’ different roles and tasks are poorly integrated, we see no clear or coordinated leadership and above all we see an inability in the universities to shape and take charge of their own destiny. If these challenges are not addressed, there is a risk that Sweden’s ability to attract promising students, teachers and cooperation partners, will be undermined”.

The Swedish example certainly provides a blueprint for several other European university systems, especially if we take Inglehart's cultural map into account (Figure 2.1-a) showing the European situation. Apart from for the Anglican regions, there is a broad overlap in the cultural heritage of European countries. Recommendations in the paper emphatically point out that there is a need for changes in the recruiting and funding system in order to maintain international competitiveness. Recommendations for leadership propose changes in order to achieve excellence in teaching and research. Unfortunately despite its title, this paper does not suggest the options for enabling leadership to influence impact.

"Literature Deep Dive Leadership"

"Trying to manage faculty members is like herding cats". With that statement, McCormack et al (2013) describe the difference between traditional management and leadership theories and the challenge of managing staff at a knowledge driven institution. In their own words "there is a lot of difference in managing a group of employees in a plant and (managing) faculty members,...". The management of universities is as important as that of every other institution, but the implementation of familiar management tools does not follow the established rules. Therefore, the task is more complicated and even more fascinating. If academics have a high degree of intrinsic motivation, management tools intended to motivate them do not demonstrate the same impact as with other groups of people. Besley and Ghatak (2005) as well as Bénabou and Tirole (2006) have emphasised that "sharp incentives may not be as important or effective when agents are motivated".

The role of knowledge driven institutions and especially universities is described by Coe et.al. (2009) who find "evidence that countries where the ease of doing business and the quality of tertiary education systems are relatively high tend to benefit more from their own R&D efforts, from international R&D spillovers, and from human capital formation" (p.21). Furthermore, the same paper states that effects have the strongest impact when these institutions rank in the top third.

Combined with the statement of Aghion et al (2007) that "American universities dominate European universities in the top tier, but Europe has many good universities in the second and the third tier" (p. 103), the impact of the lower tiers will not be as efficient on turning input into output as that of the leading group of knowledge driven institutions.

Furthermore, Aghion et al (2007) state that "European universities suffer from poor governance, insufficient autonomy and often perverse incentives" (p.101) and "policymakers have only recently started to realize that Europe's growth is intimately linked with the

research performance of its universities”. In order to be able to describe differences in performance of European and US universities in international rankings, the paper provides the following findings for university performance; performance is

- positively correlated with the size of budget per student
- negatively correlated with the degree of public ownership
- positively correlated with budgetary autonomy
- not correlated with building ownership
- positively correlated with hiring and wage-setting autonomy
- negatively correlated with the degree of endogamy in faculty hiring.

Concluding, Aghion et al state: “What Europe lacks most is top-class universities” (p. 112).

The same group of authors addressed output of universities in some detail three years later in Aghion et al. (2010) and found “that university autonomy and competition are positively correlated with university output, both among European countries and among US public universities”. That statement confirms the findings of various other research groups who have found a positive correlation between university autonomy and performance, especially output oriented performance.

“Literature Deep Dive Imprinting”

Besides the effects of leadership in a knowledge driven institution, imprinting is also needed in order to transfer impetus and mindset to all levels of the hierarchy. Imprinting is basically the social influence of one individual on another. This has been a familiar term since ground-breaking research by Konrad Lorenz with grey geese. Lorenz (1937) proved that the learning process of “imprinting” in early experience, which determines subsequent social behavior, is distinct from other learning processes. Incidentally, the term imprinting had already been used by Spalding (1873) to describe the tendency of domestic birds to follow the first moving object they see and how this behaviour is integral to their nature.

In more recent analysis, Azoulay et al (2009) demonstrate social influence on career imprints in the development of academic entrepreneurs. As a primary result, they find that “postdoctoral advisers’ patenting behavior is imprinted on their trainees...moreover, the social influence effect is statistically large”.

The trainee's search for a mentor is mainly driven by their scientific discipline and by geography. The trainee does not anticipate being imprinted by the mentor during the supervision period, rather this result "seems to arise by chance...whether or not an advisor is a commercialist orthogonal to the search process, but it is highly relevant to the development of the advisee's career".

According to Marquis and Tilcsik (2013), the process can also be described in a more generalized way using the term "sensitive period", during which "an imprint is stamped onto the focal entity in limited time intervals during which the entity exhibits intensified receptivity to external influence" (p. 199). On a scientific career path, there will be several "sensitive periods". Of course, one of the most receptive will be during the relationship between the PhD candidate and their adviser. These sensitive periods can also be regarded as "periods of transition". The path of imprinting shall be regarded as the flow of leadership from top level management at knowledge driven institutions down to the most junior researchers, who might be the most likely to leave their academic career and thus to transfer their imprinted social setting to the region local to the institution, in whatever role or function.

Imprinted human and social capital is reflected upon in detail by Murray (2004) with an emphasis on the social capital aspect which is broken down into two dimensions: the local laboratory network and the cosmopolitan network. The results show that "through these two elements of an inventor's network, critical and complex technical information and advice seem to flow into the entrepreneurial firm" (p. 656).

There is an interesting connection between leadership and imprinting when it comes to the question of the effect of new department heads on existing departments. Goodall et al. (2014) found that "a longitudinal predictor of a department's future research success is the cumulative number of citations to the incoming Chair's own research." Even if this evidence is just proven for the number of citations and not for the number of publications itself and there are also no empirical claims as to why this effect exists, the "imprinted" role of the new, highly cited leader of the department provides an important input for the discussion on leadership and imprinting throughout knowledge driven institutions.

In a prior analysis Goodall (2009) derived the factors influencing the impact level of imprinting: "If the leader of a university is a former scholar, he can have a higher impact in his leadership and imprinting on his employees" and furthermore "will gain greater respect from academic colleagues and appear more legitimate. Legitimacy extends a leader's power and influence" (p.3).

According to that analysis, the four levels of impact of a former scholar are:

- Credibility through his previous academic career
- Expert knowledge about the core business of universities
- Standard bearer because he sets the quality threshold
- Signal to share their values

One finding of this paper which will be further connected to the discussion of the case studies is: “The characteristics of a leader today are correlated with the future performance of the organization” (p.29).

In her analysis, Goodall also cited interview partners such as university vice chancellors regarding their view on the imprint they leave on their institutions and its employees:

- “Trust is very important to have as a leader.”
- “I am driven by a passion for science and technology. This passion influences my world.”
- “Good people always want to work with other good people.”
- “Top scholars can be challenging people. They ask a lot of questions. The alternative is to shelter behind mediocrity.”

2.3 Measurement of the impact of regional macro-economic systems

The measurement of input and output effects relies on a set of indicators which is sufficiently robust to be used for interpretation purposes. According to Allman et al (2011), the early sets of indicators in the 1960s and 1970s recorded basic S&T activities on the input side and to some extent, patenting and S&T publishing activities on the output side. These early measurements were not very robust in comparison to current sets of indicators. Since then, the discussion on the robustness of sets of indicators has further developed and this “has resulted in a wider range of indicators that better capture the more nuanced aspects of the innovation process” (p.16). The set of indicators provided in this paper will be taken into account for the discussion of the case studies.

More evidence for the influence of “entrepreneurial culture” on economic growth has been provided by the analysis of 54 European regions by Beugelsdijk (2010), who concludes that “regions that have experienced higher economic growth rates and which are more innovative have a culture that can be characterized as entrepreneurial”. Beugelsdijk defines the entrepreneur as an “input completer”.

Brenner (2014) confirms the “contribution of innovation output and scientific research on economic growth”. He also derives an indication for the time lag between the investment and the effect on the output. The time lag according to his dataset of 114 countries is around two years.

In order to judge the level of importance to growth of a given factor, we also have to take into account policies, geography and historic development among other issues.

2.4 Links and interfaces between knowledge generation and implementation

The link between knowledge driven institutions as knowledge generators and the efficiency of knowledge implementation has been analyzed by generations of researchers, with research in this field gathering speed in the 1990s. Anselin et al (1997) analysed local geographic spillovers between university research and high technology innovation by using four indices of local geographic interaction. The results “confirmed the positive and significant relationship between university research and innovative activity” (p.440). Furthermore, the authors also confirmed that the “spillovers from university research into innovation extended over a range of 50 miles from the innovating metropolitan statistical area”. The dimension of spillover effects is dependent on the industry, as shown by evidence found by Audretsch and Feldmann (1996) that “industries in which knowledge spillovers are more prevalent – that is where industry R&D, university research and skilled labor are the most important – have a greater propensity for innovative activity to cluster than industries where knowledge externalities are less important”.

Chatterton and Goddard (2000) expanded the discussion on the links between higher education institutions and the regions where they are located, into the broader needs of these respective regions regarding learning and research. Enlarged regional engagement includes “a desire to increase the uptake of graduates into employment within the region (p. 491); they later add that “the most significant barriers remain the difficulty of matching the attributes of graduates and the skills needs of local employers”.

There are yet more dimensions to the interfaces of knowledge driven institutions and the regions where they are based. Goddard and Puukka (2008) discussed the engagement of higher education institutions in regional development from both perspectives. For example, in regional policy the issue could arise of whether economic development should receive support initially and then as demand rises, support systems including educational institutions should be built up. Or should the educational institutional setting be built up first, in the expectation that spillovers from human capital and research might then drive economic development. Goddard and Puukka answered this chicken and egg question with two examples from the US, where regional states are responsible for their institutional system. They argued that “state investment in higher education to tackle industrial decline in New England and to attract new federal investment in areas facing structural adjustment in agriculture in California laid the foundation for subsequent high technology corridors such as Route 128 and Silicon Valley.

The connection between education systems and economic performance was discussed by Andrews et al. (2015) and resulted in the statement that “within-firm productivity gaps between national frontier and global frontier firms tend to be smaller in countries in which education systems are of higher quality, product market relations are more cumbersome,

business and universities collaborate intensively, and where markets for risk capital are more developed”. That argument is also supported by Guellec and van Poettelsberghe (2004) who stated that “R&D performed in public institutions has a large effect on productivity growth” (p.24).

A detailed view on universities, innovation and the respective competitiveness of the local economies was provided by Lester (2005), who focused on the dynamism of local economies which depend on “the ability of local firms to adapt to changing markets and technologies by continually introducing commercially viable products, services and production processes – that is, by innovating successfully”. Contributions made by local universities to support these capabilities are analyzed from various angles. Patenting and licensing as well as further support measures are able “to attract new knowledge resources from elsewhere” and even “to adapt this new knowledge to local conditions” (p.30). The most important indirect contribution is education, but it can also be public spaces such as conferences or investor forums. Whatever the nature of the contribution, it always has to take into account the specific characteristics of local industry and the development pathways it has followed.

3 Methodology

3.1 Case Study Design

Due to the scarcity of comparable regional economic data in the case study regions, the core of the study consists of a qualitative analysis. This analysis was conducted by using expert interviews and linking them to available information sources from data and literature for discussion.

Expert interviews were conducted according to a recent work of Bogner et al. (2018): “Generating Qualitative Data with Experts and Elites”. There are various framework conditions to be covered when conducting interviews, such as “inviting interviewees to engage in detailed and extensive narratives may be helpful to gain insight into their worldviews and patterns of thought” (p. 653), or which provide the foundation of the interview, such as “based on the assumption that they are able to exercise power in a particular social context by applying special knowledge” (p. 655). There are also hints that “the focus on knowledge and power may serve as a good starting point to come to a methodologically appropriate definition of experts and elites” (p. 656).

The study is conducting “theory-generating interviews” in the sense that “the researcher obtains useful information and elucidation of the issue under investigation with the consequence that this procedure seeks to generate theory via the interpretative generalisation of a typology” (p. 659). The analysis of the expert interviews in the case study regions [Chapter 4.1 and 4.2] is followed by a discussion of the results and an interpretation of the main findings.

The case study regions were selected to provide a picture of various cultural settings and, at the same time, a setting for knowledge driven institutions including surrounding regional economic elements, which are to a certain extent distinct from other economic influences. For this reason, there were two main criteria applied for selecting a region for a case study:

- small number of influential tertiary education and research institutions;
- regional economic system surrounding these institutions which can be regarded as independent from other economic influences to a certain extent.

3.2 Case Study Interview Questions

For every case study region, experts for interviews were selected according to the structure of relevant institutions such as universities and public institutions. The mix of experts was selected according to the structure of the knowledge institutions in the region, as well as the background information that was needed for the discussion of leadership aspects and information on economic conditions in the region.

3.2.1 Sample of Interview Questions

The expert interviews were conducted in an open questions and answers mode, in order to detect patterns for typology in the case study regions. The following sample questions were used as guidelines:

- What is the role of cross-cultural experiences for the C level management of knowledge institutions?
- To what extent can university management influence the performance of the institution and the impact on regional economy?
- Which tools in management are the most effective in a university to improve performance?
- What kind of mindset should students have when they graduate from the university?
- Does it make sense for universities to be involved in spin-offs?
- What kind of influence is there from the mindset of management of knowledge institutions on the one side and from political and cultural framework conditions on the other?
- What are the characteristics of smart management as you understand it?
- How can a region attract smart management capacity?
- Is the region able to build the elements of sustainable innovative capacity?
- If you built a new university from scratch, how would the governance structure be different from current ones?

- Do you feel yourself in a position to actively guide your team to your preferred patterns of performance, or are there other influences, either internal or external preventing you from doing so?
- Do you prefer to lead your team using bilateral meetings or large groups?

3.2.2 Selection of experts for the interviews

The experts for the interviews were selected from various levels of management at the knowledge driven institutions, as well as from management of administration and evaluation bodies of the Australian and Chinese higher education system.

It was agreed with the interviewees that no individual citation of the contents of the interview will be published, in order to protect the privacy of individuals and the business context. This enabled all the interviews to be held in an open and confidential atmosphere.

3.3 Data and Indicators

Measurement of regional macro-economic performance is a complex issue due to the manifold options for the selection of indicators, and the scarce availability of these indicators on the regional level. Additionally, there are very few indicators which are available in different regions or on a timeline that would allow time series analysis. When the first discussion on indicators came up in the 1960s and 1970s, only patenting activity and S&T publishing was measured in most cases.

Colecchia (2007) noted that this early set of indicators was perhaps too successful. It became established in the heads of the management of knowledge driven institutions as well as those of politicians, who based their decisions on this weak basis of evidence. Since then many scientists have tried to find a set of indicators adequate to map the complexity of the systems of science, technology and innovation. This complexity was also described by Salter and Martin (2001) when they stated that “the relationship between publicly funded research and innovation is interactive and non-linear. Short, simplistic models of cause and effect are deeply misleading. Science often follows technology and the market often leads technology and science”.

Even if papers aim to “measure the wider framework conditions for successful innovation” as Allman et al. (2011) maintain, they do so from the universities’ point of view and leave out the option of taking the viewpoint of the regional economy.

4 Analysis/Findings

This chapter will not only provide deeper insight into the case study regions framework conditions, but also present the case study interview analysis and findings. It is important to link the qualitative analysis to the findings due to the differences between the regions. The findings for every region will then be discussed, merged and summarized in the following [Chapter 5] “Conclusions”.

4.1 Case Study Australia

4.1.1 The Australian Knowledge and Innovation System

Before we look at the situation of the Australian National Innovation System, we shall take a broader view on the overall economic and societal framework conditions in the country. Australia has a world-champion track record for sustainable growth with consecutive 26 years of uninterrupted GDP growth.

Australia owns a large portion of the world’s natural resources, which appears an advantage at first glance, but could also become a major challenge, for example when we think of the “Dutch Disease” in the 1970s/80s, where the income and wealth of natural resources (natural gas in the Dutch case) led to a status of complacency and risk averse investments (Caimcross, 1979; Égert, 2012). In effect, in the long term, most countries with vast amounts of natural resources tend to grow more slowly than countries without natural resources. This was an issue in Queensland and Western Australia where income from coal mines in particular, dropped off drastically over recent years and formerly rich people had to look for new opportunities. The government was forced to look for alternatives such as future-oriented investments and start ups to overcome the crisis and shift priorities.

As is the case in many other countries with a wealth of resources, research and innovation have not been very high on the political agenda. The foundation of “Innovation and Science Australia” (ISA) Board with its initial report in 2016 was the first sign of a political awareness that in future, it will be vital to make science and innovation a political priority.

In the Strategy Paper “Australia 2030”, the chairman of the ISA Board calls for immediate action and points out that there is no longer any time for complacency (“clarion call for national action”). That strategy paper has a clear structure from the vision for vital action to a roadmap for implementation. The paper not only looks at the amount of investment needed,

but also at the “level of ambition” which needs to be accelerated. As mentioned before, the influence of the availability of natural resources is stressed as being one of the biggest barriers for innovation over recent decades: “With the resources boom easing, [...] Australia needs to find new sources of growth.”

The migration issue is also tackled indirectly with the statement that by 2030 there will be “a 6 per cent shortfall in the number of workers needed to maintain current gross domestic product.” The change in skills in demand is mentioned referring to interpersonal skills, entrepreneurialism and hypothesis-based problem solving. There is no direct argument linked to the idea that the universities are educating students who will then be in a position to encourage these skills in their workforce. As an interesting detail, there is a definite mention of “maths” being able to maximize students’ choice of advanced studies at a later stage. This presents the opinion that maths provides a basis upon which other disciplines can be built at later stages of education.

In Figure 1 of the strategy paper, five imperatives are introduced. Surprisingly, the R&D section prioritizes a strong commitment to the commercialization and translation of knowledge over the quality of knowledge management and basic research itself.

The Australian higher education system has undergone two major changes. Both are relevant for discussing the case studies with regard to the impact of knowledge driven institutions on regional economic performance. Before the first major change in the late 1980s, little attention was paid to the role of these institutions on economic issues, with a greater focus on their social and cultural roles. After the change, there was an increase in discussions on marketization and competition. The second change around ten years ago brought an intense discussion on the role of universities as business competitors in the global education market. This part of the change process was also driven by an evaluation of income levels, for which Queensland in particular was last in the rankings, leading the regional government to devise a “Smart State Strategy”.

Since then this role has developed further due to the increasing pressure on universities to attract students who pay tuition fees. Competition among Australian universities for fees from international students has become more intense in recent years and lead to an effect that will be analysed in [Chapter 4.1.5] as an “Accidental Strategy of Excellence”. One example is the University of Queensland which has a budget of around 1 billion AUD, of which about 600 million AUD are generated by tuition fees.

Another new aspect is the expansion of KPI for graduates. Familiar KPIs of knowledge of the content in the respective disciplines and soft and social skills have been augmented by skills such as entrepreneurial thinking. Australia is working on a credit system to establish a permanent role for KPIs such as entrepreneurship.

The present situation of the knowledge system with respect to higher education and research reflects a diversified landscape of institutions, whose budgets are dependent on competition to a great extent. Basic funding more or less covers administration costs, while most of the research budgets have to be raised via grants and block grants. This process is organized as a peer review system by the Australian Research Council in Canberra which is based on a government act specifically for the purpose. Its annual budget is around 1.8 billion AUD. International researchers have to apply to the Australian Research Council through Australian universities. Around 75% of the peer review processes include international peers.

At a central government level in Canberra, the ministry is supported by a Chief Scientist who focuses on basic research and what is known as the “Innovation Science Board”, which supervises the process of implementing and commercializing knowledge. Currently, the boards of universities are in the middle of a fierce political discussion about their structure. To date, they have renewed themselves with all the advantages of independence, but also the disadvantages of becoming dependent on insider relationships. The Government would like to gain more influence over decisions in universities. Therefore, they are trying to break up the system of self-renewal. As the legislative period for the federal government in Canberra is only three years, there is normally too little time to implement changes in the system. This limits the Canberra government’s competence for strategic matters, including dependence on political decisions, and at the same time it blocks of the decisions needed to adapt the system to changes in the overall framework. Regional governments have longer legislation periods and can therefore be more flexible when implementing political strategies.

In Australia, the structure of education system funding in particular is mainly federal. In the development of the national and regional innovation system, knowledge driven institutions played a key role: according to Goddard and Puukka (2008) the “so-called sandstone universities in each of the state capitals of Australia were the gateways to the individual states and played the role of magnets for starting the internal migration of bright minds.”

According to the analysis of the Grattan Institute 2018 which performs mapping of Australian universities, “the Australian University System is becoming more international”. This results in the fact that “one major source of income nowadays are the fees of international students [...which] are also a motivation for university management to foster internationalization at student level”.

Furthermore, the report states that the ranking positions of Australian universities are improving which will be considered in [Chapter 4.1.4.]. Despite all these improvements, it is also stated that the “government share of funding decreased from 2017 to 2018 for first time since 2003”. This may also be an important factor for universities in their ambition to broaden their budgetary sources to include those such as fees from international students.

4.1.1.1 Institutional Structure Case Study Brisbane

There are three main players in the field of tertiary education and research in Brisbane, see [Figure 4.1.1.1 a].

Figure 4.1.1.1 a: Universities in Brisbane, Sources: University Webpages

University	Type (Public/Private)	Inception year	No. Students Y19/20	Vice-Chancellor born in
University of Queensland	Public	1909	53600	Denmark
Queensland University of Technology	Public	1849	49800	Australia
Griffith University	Public	1971	43100	Australia

The three universities shown in [Figure 4.1.1.1 a] represent the major part of university infrastructure and around 78% of students in the state of Queensland. Other institutions do exist, but they are far smaller and therefore have not been included in this study, so the interviewees for this case study region were recruited from the above-mentioned institutions.

4.1.1.2 Institutional Structure Case Study Melbourne

There are four main players in the field of tertiary education and research in Melbourne, see [Figure 4.1.1.2 a].

Figure 4.1.1.2 a: Universities in Melbourne, Sources: University Webpages

University	Type (Public/Private)	Inception year	No. Students Y19/20	Vice-Chancellor born in
Monash University	Public	1958	778200	Australia
RMIT	Public	1887	84200	United Kingdom
Swinburne University	Public	1908	42100	Canada
University of Melbourne	Public	1853	52400	United Kingdom

The four universities shown in [Figure 4.1.1.2 a] represent the major part of university infrastructure and represent around 75% of students in the state of Victoria. Other existing institutions are far smaller and consequently have not been included in this study, so the interviewees for this case study region were recruited from the above-mentioned institutions.

4.1.2 Leadership and Imprinting in the Case Study regions Brisbane and Melbourne

Management of knowledge driven institutions in Australia enjoy an advantage over their peers in other global regions. They influence and/or distribute parts of the university budget. This provides them with the leverage to motivate the institution to follow changes in university strategy. If – as in universities in other global regions – large parts of the budget are managed at the faculty level, CFOs try to acquire control over some of these budgetary resources for common interests.

According to their own statements, senior managers at universities in Brisbane and Melbourne have very high “global exposure”, meaning that their origin and socialisation is international. People are recruited from China, India, Europe and the US, and display a “high level of entrepreneurship”. This does not apply to all the universities. In fact, some of them are described by interview partners as if “they are still in the 70s”. These institutions had above average time periods of stable upper management. Maybe that is one reason for university boards to actively look for management personnel with international backgrounds, even if there might be Australians suitable for the job.

The obvious advantage of hosting international managers who bring in a toolbox acquired from experience in other global regions can also evolve into a barrier, if those managers are unable to communicate to the deans and faculty, what the benefits are of these tools – which are new to the region. Taking the interviews with management and faculty in combination, we see that there is a sensitive balance of new tools that are introduced by international management staff, and a level of “new public management” that is introduced along with these new tools.

This sensitivity arises with the perceived distance from the academic world that comes in with managers who have not been socialized in a knowledge driven institution, such as a university. In the opinion of faculty “many non-academics have been appointed in management who do not understand what teaching means because they’ve never done it”. Additionally, faculty members perceive that strategy processes are run by upper management only, without their inclusion. This is implicitly confirmed by interview partners from management level, who state that “the strategy is devised at senior management level and then implemented across the university”. Communication within the university is described as “not easy” by both sides.

There is only one university in Australia that has a non-academic VC. The rhythm of change has picked up speed and is perceived in a positive manner; everybody who didn't want to get on that bus had been invited to leave the playground. As a consequence, there is a higher rate of support for the changes necessary. That may not have happened if there had been an academic connection between the new VC and established faculty.

Another issue is political sensitivity. Australia is an active player on the global political scene. It will be interesting to consider whether an Australian university with a Chinese vice chancellor is negotiating top-secret projects with the US department of defense. Interview partners expect immediate security concerns in such a situation. This may be the reason why there has only been one Chinese national in the position of vice chancellor at an Australian university so far.

The management style of general managers in the university institutes is described as more traditional than future oriented. As business development is organized separately from the academic structure, these entities often have a different level of ambition than their counterparts at the research level. Business development endeavors to motivate researchers to think about commercialization. Imprinting cannot develop its full potential because the hierarchies are distinct from each other. A medium sized institute in the universities has around 200-250 employees. Researchers in Australian universities have to make considerable effort to maintain their research budgets. Most of them are award by competition and have to be renewed regularly, in some cases every year. This leaves less energy and awareness for the commercialization of the knowledge gained, including establishing close contacts with industry.

Brisbane

One major achievement cited by the interview partners is communication between different institutions in Brisbane. Manager at the largest universities maintain close contacts with their counterparts in other institutions. One of the explanations for this could be these managers' career paths: some of them had previously worked together in Canberra, for the Australian Research Council for example, which is a major source of research budgets. A further consequence of this collaboration is a sensitive balance of disciplines in the sense that not every institution has to have every discipline in their portfolio. This system could be described as one of co-opetition.

The focus has moved from basic research to applied research in recent years. Following the example of Niels Bohr, who invented the laser quite unintentionally, university management is endeavoring to shift the focus back to blue sky research.

Interview partners are aware that "university managers shape the future and are responsible for collaboration". Shaping the future takes time; one university manager who came from industry estimates the time lag from the launching strategy change to visible results at about three years.

Melbourne

Due to its development over time, the areas surrounding Melbourne and the Victoria region are stronger economically than the environments of Brisbane in Queensland. Looking back some decades also helps to understand why some of the universities have closer and well-established links to industry and others do not. Swinburne university for example emerged from a technical college in the 1980s, meaning it still cooperates closely with industry as a result. Swinburne undertook some major restructuring, in which many researchers were laid off and others taken on board. The latest trend in Swinburne is an enforced internationalisation effort.

RMIT is implementing a new system of assessment for teaching, research and impact. However, they are also trying to refocus on their involvement with industry and to stimulate industry projects. This university has also devised a new strategy which endeavors to provide a new, more holistic view on the role of the university in the regional system. Long-term faculty members complain about the changes, because in their view the university is being “cooperatized”.

Monash university intends to overcome the gap between management and faculty with frequent meetings to discuss the university strategy and obtain feedback from faculty. Monash also runs a campus in Malaysia with around 9000 students. The effort required from management for the administration of the remote campus is quite high, but it helps them to recruit international students from South East Asian countries such as Indonesia, Laos or Vietnam. During the period when the interviews were carried out, the prime minister of both the regional and national governments were Monash alumni.

The University of Melbourne is about to change the way it conducts research, but the process of changing education and didactics seems to be more uphill, since the university remains a very conventional setting. Change is driven by senior management of which around 50% is academic and 50% non-academic. A special effort has been made by introducing a separate strategy for engaging staff with the university objectives. Now everybody involved in management has to contribute to frequent reports on engagement.

4.1.3 Regional economic framework in Brisbane and Melbourne

The regional economic framework is quite different in Brisbane and Melbourne. Brisbane has a tradition of being the center of the natural resource industry of the outback in Queensland and New South Wales. Due to a lack of high-tech industry, it is not easy for knowledge produced at the universities to reach counterpart in local industry.

The industrial base in Melbourne and the Victoria region is stronger, but still does not always match with the disciplines focused upon by the universities.

Both regions show an institutional structure that is more or less typical for Australia. There are some large companies, most of them with headquarters outside Australia. Besides these, there are a large number of small companies which are not in a position to form a critical mass for implementing the knowledge generated by the universities and other knowledge driven institutions. According to interview partners at a government level, there is a complete lack of medium sized companies which are often drivers of new businesses – sometimes they are called hidden champions because of their activity in as yet unknown niche markets.

4.1.4 Links between knowledge generation and implementation in Australia

The ISA performance review 2016 states that “the ISR System is failing to capitalize on its above average performance in knowledge creation. Transferring and applying that knowledge into radical innovation is what generates greater impact and higher rewards to business, the economy and broader society”.

The review points towards a generally high level of skills among the Australian workforce. However, there are also “concerns about the quality of Australian managers with respect to innovation leadership and management”. This leads to an overall perspective that “business innovation can be characterized as incremental rather than new-to-the-world”. Interview partners stress the different expectations of universities and society, but even universities and industry seem to live on different planets.

One of the major barriers is the link between generating and applying knowledge. Sometimes researchers move to industry and take their experience from one sector to the other. However, it is still not common for people working in industry to move into the knowledge sector during their career. This means that understanding of industrial processes and needs in the research sector is very limited in academia. Consequently, business R&D investment at universities is quite low.

Universities are trying to establish a bridgehead to industry from their side. Some of them have been quite successful in doing so by establishing commercialisation entities which

specialize in commercializing intellectual property. These entities have up to 70 employees and provide simplified and transparent links for industry to find out the best point for connecting to the university's disciplinary portfolio. Success stories about license fees generated by the transfer offices prove the relevance of this concept. There are not only entrepreneurship labs for undergraduates, but also workshops on commercialization for faculty members, who subsequently become multipliers, sharing the workshop content with their peers in the institutes.

One shortcoming of this strategy is that license fees are predominantly generated with partners who are not situated in the university's region. In the case of Brisbane, license partners often come from China, with all the advantages of a large market and disadvantages of different understanding of intellectual property rights.

An additional challenge could arise, if university management regards IP and the licence fees expected as a future cash cow for their university. This will hardly ever happen: the most successful university in IP management is MIT in the US; it generates around 2-3 % of its budget through this income channel. Compared to other parts of the budget IP will never be a major source of income. Nevertheless, some university managers attempt inappropriately tough negotiations with industry in order to raise more money, and will soon realize that industry will lose interest, resulting in a "no deal" scenario. As a consequence, there will be a stock of knowledge which will not be transferred; this cannot be to the benefit of the regional economic system.

On the other hand, barriers can also arise on the industry side. It will not be in industry's interest to strengthen their university partners' position in negotiations too much, so they will block initiatives such as contract templates, which could be used by all the universities in a given region.

The regional government has tried to place emphasis and budgets on life sciences. They have managed to establish quite significant research capacities. However, in an international context, competing with regions such as Boston in that field will always be difficult. Therefore, in recent years the focus has been redirected to regional specifics in research such as mining, agriculture and tourism, for which routes to transfer new knowledge into the regional economy are easier.

In doing so, it is not only important to commercialize technology or the results from research in the natural sciences, but to find ways to commercialize knowledge generated in social science disciplines as well. There are some successful examples such as the web platform "train the trainers".

The campus of Monash University in Clayton/Victoria provides a perfect context for industrial engagement. Many industry partners have built up infrastructure around the campus, such as the Australian synchrotron. While many other universities are quite distant from the objective

of harmonizing the disciplines they offer with the needs of regional industry, Monash is already fairly strong in this respect and in its strategy is committed to further improvement. For two years, there has been a special management role for developing industry engagement. This person is also responsible for developing the technology transfer offices.

4.1.5 Findings from the Case Studies in Australia

The ISA performance review 2016 states that “our education system is not equipping young Australians with the skills and entrepreneurial perspectives necessary for achieving a stronger ISR System in the future. [...] Complacency will endanger the shared prosperity Australians have historically enjoyed” (p. xv).

Accidental Strategy of Excellence

One of the major findings in the Australian RTI system is the establishment of an “Accidental Strategy of Excellence”. This strategy arose due to the following factors:

- The importance of fees from international students to university budgets is increasing.
- Nowadays Asia, especially China, is a major source of international students.
- Asian students select their universities mainly on the basis of international rankings such as the Shanghai ranking, the QS or the Times Higher Education ranking.
- Universities endeavor to improve their ranking.
- One source of improved ranking is better publishing and citation rates, as well as the number of Nobel prize winners employed at the university.
- Universities set aside a portion of their budget to recruit highly cited researchers or Nobel prize winners in order to provide them with a “research party zone”, i.e. flexible infrastructure investments, separate research groups or long-term visas for themselves and their families.
- Top researchers and noble prize winners form centers of excellence in their field at the universities which focuses resources on these fields.
- As a consequence, the rankings improve and more international students apply.

In this way, the universities have unintentionally established a strategy of excellence, whereby they reserve a significant part of their budgets for world leading basic research and the recruitment of the best people to carry that research out. The motivation to do so is simply that it attracts international students and their tuition fees. This may not be the most noble source of motivation, nonetheless, it has triggered the emergence of a “strategy of excellence”.

There is one more side-effect of the necessity to improve rankings. University management regularly travels the world in search of highly cited researchers. On these trip, they not only find their prey, but they learn about global regions and become motivated to explore other cultures and the management tools used by those cultures more deeply.

Dependence on international students

The growing dependence of the knowledge management system in Australia on foreign money in the form of international students' tuition fees may become a political issue. Therefore, the government's reaction in recent years of further reducing basic funding from federal sources seems contra-productive. An explanation can be found in Australia's overall economic structure. Tuition fees represent the second largest export for the Australian economy. There are no figures available on total tuition fee income for the individual universities, but looking at the "Group of Eight", i.e. the eight leading universities representing around 380,000 students, provides an indication of scale. They receive an income of around 9.5 billion AUD each year. On this basis, it is clear that the government has an interest in pushing these numbers in order to demonstrate success in terms of economic growth. This effect has been intensified by a reduction in public funding for infrastructure. Up until 2009, there used to be a dedicated program for infrastructure investment; since that time, these expenses have had to be borne by universities own budgets or by industry.

Interview partners report on large infrastructure investments to attract foreign researchers in order to optimize rankings. The overall opinion at the universities is that these investments pay off.

A second consequence of this dependence on international students' tuition fees is that the content and structure of lectures is being aligned with the needs of these valuable international guests. Such redirecting of curricula is often not in line with the needs of local students or regional industry.

LEAD PRINTING

Leadership is a necessary precondition for successful management. If leadership meets a governance system where imprinting is possible, the energy of change can penetrate to all levels in the faculty. One of the findings from the interview sessions is a higher probability and pace of change, where there are less pronounced past academic connections between newly appointed management and faculty. This comes to a peak in the rare situations where non-academic people are appointed to upper management positions at universities. The positive effect of a higher likelihood of change comes with the potential barrier of the perceived distance of these managers from the academic world, with the consequence that faculty will reduce or block lines of communication.

Two management tools that have been introduced by non-academic managers at universities shall be discussed. Firstly, no deputies are allowed in executive meetings. If somebody is not able to join the meeting, their seat remains empty. There are multiple effects of such a policy.

For one, people are more motivated to join meetings themselves if they do not have the easy alternative of sending somebody else. Another even more important effect is that trust between the individuals in the meeting group rises significantly, because it is always the same group and they have a better understanding of their colleagues' motives and incentives, making everybody more open in the discussion.

A second tool introduced was direct channel for feedback from student level to upper management.

Programs that are not found in conventional university portfolios are typically implemented by university managers who have not been socialized in the region, or who have moved into university management from a different industry. Examples such as entrepreneurship boot camps not only for faculty, but for teacher training schools have a broad impact on the regions' education system are implemented by managers from regions where entrepreneurship is high on the agenda.

The same spirit of global exposure applies for newly implemented policies in Australian universities which focus on a balance between publishing papers and increased importance and awareness of entrepreneurial activities. Many of the universities have already established such policies; they are now focusing on the next step which is a "register of impact" which will be part of a university career path in future.

The global exposure of university management also leads to cultural distance from faculty members, who in most cases have been socialized in the region where the university is located. Cultural distance can evolve into a barrier for communication if the process is not accompanied by appropriate measures. At some universities, there is the impression that management and faculty members are living on different planets. Each side is aware of the other, but there is no interest in establishing efficient communication channels. Combined with well-established bottom-up thinking at the universities, management can do little to implement strategy without using tough financial measures.

Opportunities for and Barriers to Commercialization

The structure of technology transfer offices is well established. They act on a highly professionalized basis and create a strong pull effect to draw knowledge out of universities and onto the market. However, the fact that the impetus from the faculty side is quite weak creates a drain on their effectiveness. The push from universities depends on the attitudes of general management at an institutional level, where there are some examples of successful commercialization. Pressure from upper management is often blocked in the hierarchy by poor lines of communication between management and faculty level.

Barriers to commercialization are a a major issue for all Australian knowledge institutions. There are impact calculations in evaluations and performance reports. Measurement is either carried out on the publication/citation level only and therefore on knowledge management side, or it involves calculation methods used by the “Big 4” (Deloitte, EY, KPMG, PWC), which measure regional economic impact based on theoretical indirect profitability.

The other formidable barrier to commercialization is failure to match the strength of disciplines with the strength in industry. Due to past development, especially in the 1990s, all Queensland universities are strong in life sciences. Unfortunately, there is hardly any noteworthy industry in that field: neither regionally nor nationally. This means that commercialization takes place not in Australia, but in the US, Europe and first and foremost in China.

Interviewees stated that “there is no tradition of industry financed research at Australian universities.” Nevertheless, regardless of whether there is a tradition or not, the link between industry and science has not been developed sufficiently. Furthermore, as previously mentioned, interview partners used wording such as “topics and priorities of universities are disconnected from regional strengths.”

Institutional and economic structure

At a government level, adequate attention to achieve a balance of input and output can be observed. At first glance, it seems positive that there is not only a Chief Scientist as in other Commonwealth countries, but also an “Innovation Science Board”; however, the two functions of knowledge generation and knowledge implementation remain distinct from each other.

Who can take the role of fostering output, if not the government? It might not be the knowledge driven institutions themselves. They lobby for increased investment from public funds. As long as this goal of growth is reached, their mission is accomplished. There will be no motivation left to concern themselves with output or impact. That said, most universities have studies on their regional impact in order to justify their very existence.

4.2 Case Study China

4.2.1 The Chinese Knowledge and Innovation System

For several decades now, China has been achieving impressive growth. GDP, publications, patents and the number of engineers leaving university each year show higher growth rates than for most other countries. All figures have to be checked for validity, but even if GDP growth were not 6% but somewhat lower, China would still be outperforming most OECD countries. The rise of the research and innovation system can also be seen as a way to return to former strength. Up until the early 19th century, China led in many fields of science and innovation, outperforming the European economies, which were developing more slowly at that time. Due to inward looking political decisions, they lost their place on the way to the industrial revolution. Since opening up to global markets under the leadership of Deng Xiaoping at the end of the 1970s, the country has been able to make its way back onto the global scene.

Before we embark upon a discussion on the status of the research and innovation system, two cultural cornerstones should be mentioned because they strongly influence the ability of the system to adapt itself to changing framework conditions. In any regional or national innovation system, three steps are required in order to change system elements. These can be summarized as: an analysis that shows an up-to-date picture of reality; a strategy that works on a vision of where the system should head to in the medium and long term; and finally, an implementation process to guide the system from the status quo to the intended destination.

The first structural difference between China and many other regions is on the analysis and strategy side. This work is carried out by civil servants and selected scientists in organizations such as the National Development and Reform Commission (NDRC). Throughout its history, China has always had a tradition of “Chinese Imperial Examinations”, in order to select the brightest minds for the state bureaucracy. As they followed a selection process that started in local communities and went up step by step to the highest positions in the country, the best people were available to draw up strategic goals for future development.

The second structural difference relates to the process of implementing strategic goals. Top-down implementation is accompanied by guidance from the evaluation of implementation at every level. No matter if there are companies, universities or other public entities, in addition to the institutional management, there is always political supervision ensuring that strategic goals are met.

This is not a judgement about desirable political systems or societal claims, but a structural observation of the effectiveness of strategy and implementation processes.

The shift in global power, with the US turning its back on the world and Brexit undermining the integration of European countries, has had a powerful effect on the Chinese ambition to take over global leadership in education and economic development. As Kirby and van der Wende (2018) pointed out “the growing uncertainties in the West may only make China more successful in its aim to attract Chinese talent educated abroad back to China and to enhance its impact on the global higher education landscape”.

There are a large number of papers available on the Chinese research, technology and innovation system, with views from inside and outside China. Recent publications, e.g. Xielin et al (2017) report a shift in China’s innovation policy with “government increasingly acknowledging the importance of markets, private enterprises and favorable institutional conditions as determinants of a well-functioning innovation system”. This shift in policy has also been triggered by increased pressure from international performance monitoring. Some years ago, the OECD (2008) stated that according to the available statistical data “the impressive investment in resources [...] has not yet translated into a proportionate increase in innovation performance”. Slowly, China is developing into a high-income country and ongoing adjustments to policy are necessary to accompany that development.

According to Xielin Lu et al. (2017), another deficit of the Chinese innovation system is a the lack of collaborative innovation. “The small proportion of the R&D expenditure which enterprises channel into either domestic research institutions or universities are a clear indication of this. [...] Establishing the necessary trust for collaboration thus might be one of the biggest challenges for Chinese innovation in the future”.

4.2.1.1 Institutional Structure Case Study Hangzhou

There are two main players in the field of tertiary education and research in Hangzhou, see [Figure 4.2.1.1a].

Figure 4.2.1.1 a: Universities in Hangzhou, Sources: University website

University	Type (Public/Private)	Inception year	No. Students Y19/20	Vice-Chancellor born in
Zhejiang University	Public	1897	47300	China
Zhejiang University of Technology	Public	1953	43000	China

The two universities shown in [Figure 4.2.1.1 a] represent a major part of university infrastructure and student numbers in the region of Zhejiang. Other institutions do exist, but they are smaller by far and therefore have not been included in this study, so the interviewees for this case study region were recruited from the above-mentioned institutions.

4.2.2 Leadership and Imprinting in the Case Study region Hangzhou

Chinese become accustomed to strong hierarchies in their early youth. Examinations, scores and rankings are part of the whole chain of education as well as a stable component of societal interaction. The Japanese scholar Ichisada Miyazaki called this system “China’s examination hell” – leading to the question of whether it is possible to turn students who are completely focused on obedience and test scores into innovators. The heavy focus on rankings also forms the basis for the discussion about foreign (Asian) students in Australia in [Chapter 4.1].

Managers and employees at lower levels in the hierarchical system are prepared for and accustomed to strong top-down governance. This opens up a channel for skilled leaders to make their impact felt throughout the hierarchy.

4.2.3 Regional economic framework in Hangzhou (Zhejiang region)

The "Chinese Cities of Opportunities 2018 Report" by PwC and the China Development Research Foundation ranked Hangzhou as number 1 amongst the Chinese "Cities of Opportunity". The economic development of the Zhejiang region and Hangzhou as its most populated city and capital has been highly dynamic since the opening up of the economy in the late 1980s.

Hangzhou offers a very diverse environment of disciplines and industries, starting with textiles in the early 1990s and developing to cover high-tech industries, including medicine, information technology, heavy equipment, automotive components, household electrical appliances, electronics, telecommunication, fine chemicals, chemical fibres and food processing.

The basis of this dynamic development is the *Economic and Technological Development Zone*, which covers an area of more than 100 square kilometers. Since then, some other development zones such as the *Export Zone* and the *Hi-Tech Industrial Development Zone* has been established to support industrial growth. There is always a strong intention in China to develop the regions by stimulating domestic value chains and setting special economic conditions for steering industries in and out of a region. The establishment of high-tech zones is one of these instruments and was first implemented in Shenzhen in the early 1980s.

One of the best known examples of this region's success is Alibaba, which is the world's largest online store in terms of market value and has been listed on the New York Stock Exchange since its IPO in September 2014.

4.2.4 Links between generating and implementing knowledge in China

Successful knowledge transfer from universities into the regional economy is dependent on consistency between the strategic goals for the two sectors. If one follows the strategic goals of a university upstream, there will be a responsible authority in charge of drawing up and implementing the strategic goals for the sector. Downstream regional economic development goals are also drawn up and decided upon by the authorities. In most global regions, including Europe, these are "loose ends", meaning the authorities responsible for different sectors do not communicate very much and have a silo mentality for strategies within their responsibility.

In China, agenda setting for a breadth of sectors, including all future investment such as knowledge driven institutions and innovation oriented economic development zones, takes place at the highest political level. The resulting top down implementation process is constantly evaluated for its effectiveness; at this stage of the process, counterparts in most other global regions are usually already in their administrative silos, with little communication happening between them.

According to the analysis in [Chapter 4.2], Xielin et al (2017), there is a particular lack of communication and collaboration between industry and research institutions at universities. This can be explained by a rapid increase in public funding of universities, which has reduced their dependence on industrial cooperation and funding in order to secure their budgets. Complacency in large institutions due to basic funding is a major barrier to motivating them to undertake external cooperation or the transfer of newly gained knowledge into regional economies.

4.2.5 Findings from the Case Study in China

Strategy and Implementation

The success and dynamics of a change in the regional or national innovation system depend upon the quality of a strategy and how effectively it is implemented. In the introduction to this chapter, this is addressed as two basic, cultural elements with which the Chinese system demonstrates great success.

In order to obtain a clear picture of the situation in China, we have to draw comparisons to regional innovation systems in Europe, which are successful only at one of these cultural elements – strategy development: there are a number of quite sophisticated strategies in place. The responsible authorities order and launch the implementation of a strategy, but there is then a loss of momentum along the pathway through ministerial hierarchies, agencies and other intermediary institutions. Every level in the implementation process would have to make changes to systems that they themselves had established in previous years. If there is no guidance and additional impetus at every level, such as the implementation evaluation in the Chinese system, there will be little motivation for change.

The link between management and faculty members also has to be considered. There are a number of soft or external factors involved in the issue of whether leaders have an academic background or not. In a study that examines whether university performance is linked to leadership, Goodall (2009) found in her interview sessions that: “It is noticeable that all those who emphasized credibility and intellectual values were leaders with traditional academic backgrounds. None of the non-academic leaders presented these kinds of arguments”. One of the vice chancellors interviewed expressed it as follows: “It is important that a leader’s value system is not too far from the values of those who are being led”.

The most important issue that Goodall confirmed in her study is the fact that “the characteristics of a leader in position today are correlated with the future performance of the organization”. The study used regression analysis to prove that a leader’s expertise influences the quality of research. As this study presents proof of the imprinting of leaders’ expertise, it can also be expected that leaders’ other soft skills, such as an entrepreneurial mindset would

also be imprinted onto the institution and its faculty members. An important further step in research would be to prove this hypothesis.

5 Conclusions

The overall question for this study concerns the competitive capacity of knowledge driven institutions: how great is their ability to transfer their knowledge capacity into successes in the regional economy. In other words, the focus is on the effectiveness of the link between input or knowledge generation and the ability to transfer this knowledge onto the market in order to earn money.

The findings of the case studies show that there are three main components for generating an impact of academic knowledge on the regional economy:

- ☺ The governance model and institutional structure of the knowledge driven institution has to allow for cross-hierarchical communication, including bridging the gap between management and faculty members.
- ☺ Leadership in upper management of the knowledge driven institution needs to focus on a mix of international cultures and entrepreneurial mindsets.
- ☺ Imprinting of leadership energy throughout the knowledge driven institution must reach from upper management to PhD advisers, using the ability to transfer knowledge into economic success models

There are also obvious obstacles to successful transfer of knowledge into the regional economy:

- ☹ Increasing the funding of basic budgets of knowledge driven institutions without accompanying measures for competitive funding reduces leaders' motivation and the incentive for the whole institution to seek cooperation with external partners, such as regional economic players.
- ☹ The implementation of progressive strategic goals is hindered by mid-level bureaucrats, who try to maintain their familiar system of quantifiable evaluation indicators instead of changing to a model of qualified parameters for outcomes and impact.
- ☹ Incentives at knowledge driven institutions to evaluate researchers for their patenting activities increase the motivation to patent all new knowledge in these institutions and provide the regional economy with commercialization opportunities.

Two major structural findings are derived from the case studies: “Lead printing” and the “Accidental Strategy of Excellence” are among the most effective factors for increasing the impact of knowledge driven institutions on regional economies:

Lead printing...

...is the flow of leadership impetus from upper management transferred by the imprinting capacity of the downstream hierarchical chain and facilitated by an institutional governance model which allows for this transfer.

As is clear from the findings of the case studies, leadership and imprinting are major drivers for spillover from knowledge driven institutions into regional economies. First the knowledge driven institution has to be able to recruit globally exposed and experienced management staff. The next step is to develop a successful link between management and faculty members; if this link is not well established, it can be a major barrier, blocking the lines of communication with entrepreneurial leadership. The success of this link can be supported by a strategy from the institution itself, from regional government or from industry. Faculty members’ perception of the ability of the management to create a direct line of communication with them is a decisive factor for the level of imprinting.

Accidental Strategy of Excellence

This is how this kind of strategy arises:

- The importance of fees from international students to university budgets is increasing.
- Nowadays Asia, especially China, is a major source of international students.
- Asian students select their universities mainly on the basis of international rankings
- Universities endeavor to improve their ranking
- One source of improved ranking is better publishing and citation rates
- Universities set aside a portion of the budget to recruit highly publishing researchers
- The top researchers and noble prize winners form centers of excellence
- Rankings improve and more international students apply.

In this way, the universities unintentionally establish a strategy of excellence, whereby they reserve a significant part of their budgets for world leading basic research and the recruitment of the best people to carry that research out. The motivation to do so is simply that it attracts international students and their tuition fees. Despite the unrelated source of motivation, this still triggers a “strategy of excellence” and can create successful outcomes.

Lessons Learned

In order to complete the link to the Austrian Innovation Ecosystem there are some lessons to be learned:

- No filters in the process of appointing members of the management team of knowledge driven institutions, as is presently the case
- Attracting international students shall be regarded as a strategic goal for skilled migration
- International student fees shall be regarded as a source of motivation for a strategy of excellence
- The boards of knowledge driven institutions should try to create an international mix in upper management
- Balance budgets in favor of competitive funding

6 Literature

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