Knowledge Triangle Configurations at Three Swedish Universities

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10.1 Introduction

Universities are currently facing mounting policy expectations to assume a broader societal responsibility. As part of these expectations, policy institutions such as the European Commission and the OECD (EC 2005; OECD 2016a) have stressed the need to strengthen the two- and three-way linkages between research, education and innovation,[1] which they refer to as the Knowledge Triangle (KT).

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[1] The third corner in the KT has been referred to as the third mission or innovation. Although largely overlapping, these concepts are not synonymous. In this chapter we frame the third corner of the knowledge triangle as innovation, since it is the most commonly used term in the KT concept. In the

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Although the value of linking research, education and innovation is well known, strengthening links has often proved challenging (Maassen and Stensaker 2011; Sjoer et al. 2016), revealing tensions between different tasks and institutional levels (Pinheiro et al. 2014). These tensions are to some extent inevitable, as the logics and reward systems of universities' tasks differ: education is place-bound and localised in its practices and reward systems, research is primarily valued according to its contributions to international communication, whereas innovation takes many different forms, from the tangible to the tacit. Hence, the task of aligning the tasks and creating meaningful and rewarding linkages between them is fraught with tensions. Moreover, these tensions can be assumed to play out differently in different types of universities. Universities are conditioned by factors such as their history, societal connectivity, operational focus and size (Clark 1998; Stensaker and Benner 2013). This means their strategies and procedures for creating KT links can be expected to vary: teaching-intensive universities start out from their educational mission and align research and collaboration to that ("vocational drift"); research-intensive universities can be expected to use education and research as prolongations of their research strengths ("research drift"), whereas universities with strong societal connections will mobilise their research and educational tasks to meet specific needs and demands of their societal environment ("societal drift") (Martin and Etzkowitz 2000). These developmental paths can then be related to and compared with the ideals behind the KT conceptions, namely that the three missions and tasks develop in parallel and without a hegemonic centre (cf. Etzkowitz and Leydesdorff 2000).

Given the significant policy interest in the KT, we see a need for a comprehensible understanding of real-world manifestations of the concept. Without such an understanding, resources may be misspent, and a misguided pressure on academics and universities may emerge. Although significant policy attention has been directed towards the KT, the scholarly interest has been lukewarm: only two studies explore the three-way linkages of the KT in universities and both focus solely on the individual level (Holmén and Ljungberg 2016; Sjoer et al. 2016). The question of how institutions organise for supporting KT principles, therefore, remains unexplored.

Against the above, we set out to study how the principles of a KT are orchestrated at universities, guided by an exploratory research question: how are the principles of a KT manifested in the organisation and strategy of different types of universities? Given this ambition, Swedish universities are of particular interest as an object of study. All Swedish universities are expected to cover the three corners of the KT within the same organisation and serve as "research institutes of society" that undertake a broad range of activities from basic research and education to contracted research and training. In addition, all educational programmes are included in the academic system, and all universities are included in the same unified university system with a similar remit. Furthermore, due to recent reforms, Swedish

context of this chapter, we define innovation as the exploitation of university-based knowledge outside the academic realm.

universities hold a large degree of organisational independence from the state: their reward system, organisational matrixes and structure of positions can be decided without governmental approval. This creates an opportunity to study a diversity of institutions within a unified system with similar expectations and opportunities to incorporate the principles of the KT.

10.2 Analytical Framework and Method

In line with Markkula (2013) and Goosens and Sjoer (2012), we regard the notion of a KT to be a conceptual and normative framework for understanding the creation and dissemination of knowledge as a multifactorial and systemic process that integrates education, research and innovation in a synergic way. The KT may be manifested in a rhetorical or political way, or through the build-up of new structures and processes on micro- (individual or research groups), meso- (faculty, departmental or organisational) or macro- (national or international policy) level. The KT builds on the assumption that linkages are fruitful and thus should be strengthened; our starting point is instead that such linkages will be temporary and conditional in the multipurpose setting that contemporary universities form (cf. Maassen and Stensaker 2011).

10.2.1 Literature Review

To our knowledge, only two scientific studies explore the three-way linkages of the KT on an institutional level: Holmén and Ljungberg (2016) find reinforcing spillovers between tasks, with research being the task that contributes most, and Sjoer et al. (2016) show that individual perceptions on the nature of a task is the main barrier for creating linkages. However, there are other relevant contributions covering two-way links that help us set a framework for capturing KT manifestations.

Firstly, the link between research and education (the Humboldtian tradition) has received significant scholarly attention. Studies offer evidence of mutually nurturing links between research and teaching (Robertson and Bond 2001; Holmén and Ljungberg 2016), and task integration (Colbeck 1998). Concurrently, others show that the Humboldtian ideal is hard to live by. Geschwind and Broström (2015) provide evidence of a division of labour on staff level between the tasks, and Marsh and Hattie (2002) show that there is no significant relation between research productivity and teaching quality. Debated causes of the divide include the concentration of research and the factual cost-effectiveness of the division of labour on individual or institution level (Clark 1997; Maassen and Stensaker 2011; Pinheiro et al. 2014).

Secondly, the link between research and innovation has been explored through studies of research collaboration (Sonnenwald 2007; Bozeman and Boardman 2014), university–industry interaction (Mansfield 1998; Scott et al. 2001; Perkmann and Walsh 2007; Perkmann et al. 2013), modes of knowledge production (Gibbons et al. 1994), triple helix (Etzkowitz and Leydesdorff 2000), the entrepreneurial

university (Clark 1998), the third mission of universities (Laredo 2007; Pinheiro et al. 2015) and universities in innovation systems (Fagerberg and Verspagen 2009; Jacobsson and Perez Vico 2010). Many such studies describe fruitful complementarity (Gulbrandsen and Smeby 2005; D'este and Perkmann 2011; Wigren-Kristoferson et al. 2011; Fogelberg and Lundqvist 2013), and underline the embeddedness of innovation in research (Etzkowitz and Leydesdorff 2000; Pinheiro et al. 2015). However, other studies raise concerns that short-term commercialisation comes at the expense of long-term research and undermines the efficiency of the division of labour between public and private science (Larsen 2011), and even deteriorates academic virtues (Slaughter et al. 2002). Although empirical evidence predominantly shows a positive relationship between commercialisation and research performance, there are notable exceptions: Perkmann et al. (2011) find no uniform relationship between industry involvement and faculty quality, and Buenstorf (2006) identify an occasional negative correlation between entrepreneurship and scientific performance as well as weak evidence of benefits from entrepreneurship on scientific undertakings. Indeed, the direction of causality in the link between research and innovation is unclear (Larsen 2011).

Thirdly, and as to the education-innovation nexus, Holmén and Ljungberg (2015) studied how experiences from innovation feed into education, and vice versa, albeit to a lesser extent. Other studies indicate that conflicting logics hamper this particular form of interplay: Maassen and Stensaker (2011) argue that the standardisation of academic programmes within Europe stands in contrast to ambitions of renewal and creativity associated with innovation, with decoupling as a possible consequence.

This review reveals that linkages include both task combination and mutually reinforcing spill-overs. However, it also reveals tensions, trade-offs and a misalignment between formal and informal institutions in the pursuit of KT combinations. In exploring the nature of KT manifestations, the concept of institutions as formulated by North (1991) and Scott (2014) therefore appears useful as it helps us identify and structure observations. Institutions are the humanly created rules that condition interaction and thus the evolution of organisations. Institutions may be regulative (Scott 2014), or as North (1991) puts it, formal, and include laws, regulations or constitutions. They may also be of an informal character and include normative and cognitive dimensions, such as attitudes, beliefs, sanctions and codes of conduct.

Against the above, we explore KT manifestations as formal and informal institutions at universities on micro- (individual or research groups) and meso- (faculty, departmental or organisational) levels, and contrast this to macro (national or international policy) level conditions. Formal institutions encompass manifestations such as policy priorities, documented strategies, work routines, evaluation schemes and other tangible incentive frameworks. Informal institutions in this context include cognitive interpretations of and attitudes towards the KT held by individuals representing different levels, as well as their culture and norms.

10.2.2 Method

We conduct our analysis through a two-step mixed-method approach. Firstly, we search for insight into the conditions of the current Swedish policy landscape of relevance to the KT using scholarly articles and policy reports from public and private research funders, public agencies, non-profit organisations and interest groups. Secondly, we conduct case studies on three universities selected for their representativeness of the Swedish university population in terms of size and type (i.e. comprehensive, specialised or regional). The selected universities are Lund University, Chalmers University and Malmö University. Lund University is one of Sweden's large, comprehensive universities with long-standing traditions and experience in all three areas of the KT, but a clear budgetary focus on research. Chalmers represents a specialised university with ambitious management traditions and extensive industrial collaboration; research-oriented as Lund University but with a stronger emphasis on innovation. Malmö University is one of Sweden's newer regional universities, where the articulation with the local community (including the city and industry) has been central to the formulation of research and educational programmes; it is also a heavily teaching-oriented university with roughly two-thirds of its turnover in education.

The case studies mainly build on 17 interviews conducted between November 2015 and November 2016: 5 at Lund University, 7 at Chalmers University and 5 at Malmö University (M1 interviewed twice). Interviewees made up a representative sample of individuals with regard to research group, department, faculty and university management level (including Professor, Dean, Pro Vice-Chancellor and Vice-Chancellor levels), as well as to the universities' three tasks (see Appendix for details on interviewee positions). The interviews are labelled in numbered order with the initial letter indicating the affiliation (e.g. L1 for the first interviewee at Lund University, C2 for the second interviewee at Chalmers and M3 for the third interviewee at Malmö University). In addition to the interviews, university policy documents and previous studies of relevance have been reviewed, and a relevant workshop was attended at Chalmers. This allowed us to triangulate findings.

10.3 Knowledge Triangle Configurations at Three Swedish Universities

In this section, we first provide a brief overview of significant elements in the Swedish system and then analyse how the KT principles manifest themselves at the three selected universities.

10.3.1 The Contextual Policy Setting

Ever since the KT concept was introduced during the Swedish EU presidency in 2009, Sweden has been at the forefront of related policy development (Benner and

Sörlin 2015). The Swedish innovation agency Vinnova was commissioned by the government to operationalise the concept. Consequently, and in line with Vinnova's focus on innovation, the work with the concept has been narrowed down to the strengthening of the third mission. Thus, despite the overarching ambitions, Sweden lacks policies and instruments explicitly targeting the KT as a whole. However, there are several different policy strands that influence and relate to KT principles.

Firstly, as in many other countries, Sweden has seen an increased focus on research excellence and concentration as a motive for significantly increasing R&D expenditure dedicated to universities (Bienenstock et al. 2014). Funding instruments targeting excellent or strategic research environments and areas have been abundant, and in 2009 the Swedish government introduced a partially performance-based, excellence-focused research funding scheme for block funding (OECD 2016b). Consequently, an already strong prioritisation of research has been reinforced (Pinheiro et al. 2014). As advanced research and education are combined in one organisation, scientists can "liberate" themselves from teaching and transfer the task onto individuals with lower research ambitions or less success in gaining research funding (Carlsson et al. 2014; OECD 2016b).

Secondly, in line with international trends, the Swedish education system has undergone a dramatic increase in the volume of students and staff. Between 1985 and 2014, the number of full-time students in Sweden tripled (Eriksson and Heyman 2014). Even though public funding for teaching has grown, universities' funding for R&D has increased significantly more (Swedish Higher Education Authority 2015).

Thirdly, policy has encouraged a more systematic way of handling societal interaction at universities which indeed have started to embrace more systematic views, albeit evidence of causal links is lacking (Benner and Sörlin 2015). Indeed, the historically close societal interaction of Swedish universities has been unsystematic, revolving around certain individuals, groups or communities. During the 1970s and 1980s, policymakers applied an institutional approach to societal interaction (Benner and Sörlin 2015), setting up publicly funded programmes for university–industry interaction and "intermediaries" (e.g. offices and technology parks), which has created a strong focus on the business sector in general and technology-based firms in particular.

Fourthly, a scattered research funding landscape together with dispersed management and funding of the policy areas of research, education and innovation creates significant challenges from a KT perspective. Sweden's research funding system is characterised by a large number of funding organisations that mainly target selected research groups or individuals who obtain considerable resources and leverage (Jacob 2015). Changes in strategy occur through specific R&D programmes that thus yield effects that are limited to specific research groups or academic disciplines (Benner 2013). In addition, Sweden has, since the late 1990s, deregulated its academic career system: individual universities control the content of positions, including relative shares of research and education, as well as funding sources., It is quite common to have permanent positions on the basis of external funding alone, with little or no education tied to them (Government of Sweden 2016).

Table 10.1 Key figures for the universities for the year 2014 (Swedish Higher Education Authority 2015). This includes funding from research funding organisations that require the participation of non-academic actors, such as from VINNOVA or the Knowledge Foundation. This data was provided directly by VINNOVA and includes an elaboration by VINNOVA on data from Statistics Sweden

	Lund University	Chalmers University	Malmö University
Year founded	1666	1829	1998
Vision	"To be a world-class university that works to understand, explain and improve our world and the human condition"	"Chalmers for a sustainable future"	"A world where diversity, knowledge and creativity is transformed into action for sustainable development"
Full-time students (undergraduate and graduate students)	27,702	8926	12,340
Of which graduate students	7146	3137	1438
Full-time faculty	2997	1173	753
Professors	708	201	77
Total revenue	7.5 million SEK (app. 815 KEUR)	3.4 million SEK (app. 370 KEUR)	1.3 million SEK (app. 141 KEUR)
Research revenue as a share of total revenue	67.6%	71.5%	20.8%
Share of block funding (research and education)	56.2%	48.4%	75.7%
Share of public funding requiring collaborative research with actors outside academia (2013)	9.7%	22.5%	14.8%

Consequently, much of the steering power lies in the hands of research funding agencies and research groups.

Fifthly, in line with international arguments that increased autonomy strengthens research performance and societal connectivity (Aghion et al. 2008), Swedish universities have seen their autonomy increase. Consequently, the expectations of task integration fall on universities themselves.

10.3.2 The Three Cases as Exemplars of the Swedish University Population

The Swedish university population includes three types of universities: comprehensive, specialised and regional universities. The three cases are selected as exemplars

of these categories. An overview of key statistics is provided in Table 10.1, illustrating the differences in the character of the three.

Lund University is one of Sweden's large comprehensive universities with a long tradition of embeddedness in and interaction with its local contexts. Although the university carters to a large number of students, it is strongly research-oriented as 2/3 of the revenues come from research (see Table 10.1). Chalmers represents a specialised technical university with extensive and long-standing "natural" ties to related industries.[2] It has ambitious management traditions and is even more research-oriented than Lund but with a stronger emphasis on innovation, as revealed by the relatively large share of collaborative public research funding (see Table 10.1). Malmö University is one of Sweden's newer regional[3] universities, where the articulation with the local community (including the city and industry), particularly with regard to the demands of the local labour markets and the public sector's demand for skills in education and healthcare, has been central to the formulation of research and educational programmes. In contrast to Lund and Chalmers, Malmö is heavily teaching-oriented with roughly two-thirds of its turnover in education (see Table 10.1).

In the following cases, the manifestations (in terms of informal and formal institutions) and observed challenges in realising the KT are explored.

10.3.3 Lund University

Founded in 1666, Lund University (LU) is one of the oldest universities in Northern Europe and is ranked among the top 100 in the world.[4] LU is comprised of eight faculties[5] located on campuses in Lund, Helsingborg and Malmö. LU is also home to a number of institutes, specialised research and innovation environments, and platforms for societal interaction. Two major facilities for materials research are currently under construction in Lund: the MAX IV Laboratory (a synchrotron radiation laboratory) and ESS (a European facility that will be home to the world's most powerful neutron source). These will be of decisive importance for materials and life sciences and for industrial development.

[2] Other specialised universities in Sweden include agricultural and medical universities.

[3] The term "regional" may be seen as a misnomer, as these universities recruit students and faculty as broadly—sometimes even more so—than comprehensive and specialised universities. The term "regional" indicates that they were founded as part of the regional mobilisation of resources after the industrial crises of the 1970s and 1990s.

[4] LU ranked 70th in QS ranking 2015/2016 and 90th in Times Higher Education World University ranking 2015/2016.

[5] Engineering (LTH), Social Sciences, Humanities and Theology, Economics and Management, Medicine, (Natural) Science, Law, Fine and Performing Arts.

10.3.3.1 Informal Institutions

At LU, the attitudes towards and perceived value of pursuing each task of the KT vary—resulting in fragmentation or unbalanced linkages between the tasks.

Central management at LU expresses the importance of the interplay between research, education and innovation—highlighting the university's vision "to be a world-class university that works to understand, explain and improve our world and the human condition" (Lund University 2012). At the same time, central management recognises that the faculties have no common interpretation or way of operationalising the KT.

> On an ideological level, the importance of the interplay is well understood and embedded in our strategy and employees' understanding. However, there is a long way to go before we realise our aim of having 'complete' learning environments—with a well-functioning and balanced integration between research, education and innovation—across our faculties. (L1)

On an individual (or group) level, there is a general perception that research, education and innovation should be mutually reinforcing activities, as more "integration" can enhance the quality of each aspect. Yet the approach for linking the various elements differs broadly across LU's faculties and departments. For some faculties or disciplines with more direct and practical application to societal issues (e.g. engineering or social sciences), there is a more natural integration and responsiveness to societal needs. This has led to differing levels of competence and experience across the faculties in engaging with "outside" actors in the local/regional system and understanding and addressing their needs.

> Certain institutions are doing well to integrate research and education. These are often the same environments with well-defined strategies for interacting with society. In other cases, the three missions are developed in isolation of one another. (L2)

Many interviewees highlighted the importance of the culture and attitudes towards the different dimensions of the KT. The general perception is that efforts to integrate research, education and innovation are not recognised or rewarded.

> People don't get paid or recognised in any way for the third mission. Third mission activities are not seen as enhancing research and educational tasks, but rather taking time away from 'core' tasks such as securing research financing. (L2)

> LU is a rather traditional university—where a focus on research excellence has top priority. It is not easy to change a culture or an orientation towards scientific excellence. It's a long-term process, but also necessary to undertake to ensure that LU is well-positioned in the future. (L5)

10.3.3.2 Formal Institutions

The central management at LU is comprised of a Vice-Chancellor, a Deputy Vice-Chancellor (responsible for education and international relations), a Pro-Vice-Chancellor for Research, a Pro-Vice-Chancellor for External Engagement and a University Director. Each of the eight faculties has similar management

structures, with a Dean and Vice-Deans with separate responsibilities for education and research (and, in some faculties, for innovation and/or international relations). Management of financial resources and personnel is highly decentralised.

The Strategic Plan for LU 2012–2016 sets out the overall goal of "highest quality education, research, innovation and interaction with society" and outlines four strategies for achieving this goal (cross-boundary collaboration; internationalisation; quality enhancement; and leader, teacher, and employee excellence). These strategic ambitions are reflected in a number of recruited positions or support functions within the University's central administration, which were initiated or further developed under the leadership of the previous Vice-Chancellor.

> It is important to work proactively with developing collaborative relationships. The central administration can play an important role as a 'development motor'. [LU management] developed a number of structures, including LU Open[6] and the Research and Innovation *Council* of Skåne, recruited personnel, and initiated activities to strengthen the interplay between research, education and innovation. (L3)

The current Vice-Chancellor and leadership team[7] are in the process of formulating a new strategic plan for LU and undertaking a number of changes to central support functions—including a shift of responsibility for initiating and leading cross-boundary collaborative activities from the centre (through LU Open) to the faculties to ensure stronger embeddedness with core operations, that is research and education (Lund University 2015).

> All faculties should have their own platforms for developing relations with external actors, proactively initiating and following-up on collaborative projects. It's understandable that the central level may be involved in initiating some platforms, such as cross-disciplinary ones, but these should be integrated and developed within the faculties and departments. (L4)

> There are examples of 'integrated knowledge triangles' within departments, but cross-disciplinary programs or platforms are rare. The central administration has limited resources to support cross-disciplinary efforts, and those activities that have been initiated are not always viewed in a positive light. It seems to work better if one faculty has the lead—with the responsibility of involving other faculties. This ensures structures are stable and are perceived as 'core'. (L2)

The forthcoming strategy will play an important role in signalling LU's priorities for a stronger interplay between research, education and innovation (guiding the respective strategies at the faculty level). There is also a need for more concrete guidance on how the University will work operationally with the KT.

[6] LU Open was initiated in 2011 as *a development unit (under the central administration's section for research, collaboration and innovation) specialized in matching external stakeholders with researchers and students, and designing and executing projects with the objective of solving complex challenges.*

[7] As of January 2015.

> The University leadership needs to provide a strategic direction, support structures and incentives, as well as visibility of good examples. [Integration of research, education and innovation] won't happen by itself. (L1)

> There seems to be a need for simplifying and clarifying the central support functions—clearly communicating a service offering to the recipient faculties and departments. (L4)

In addition, the central administration and faculty management see a need for changing the financing system to enable a better integration between research, education and innovation. Needed changes include flexible use of existing budgetary allocations and financial support (or other incentives) for societal and cross-disciplinary collaboration.

> It is difficult to finance the development of new educational programs or research areas, as the financing system does not allow for flexible use of budgetary allocations in research and education. A strengthened integration between research, education and innovation needs to be not only interesting, but also financially viable. (L2)

> There should be better incentives and financing for working with the third mission. It is important to have accessible financial support or seed money to start new things and weave in the third mission as part of educational and research activities. (L4)

> Collaboration across disciplines and with external actors [on education and research] can be strengthened through financing—or by making collaboration a requirement for accessing [certain] research financing. (L5)

10.3.3.3 Observed Challenges in Realising Knowledge Triangle Links

There are two main tensions that challenge the implementation of the KT at LU: the tension between the tasks, and the tension between the role of central administration in relation to the faculties.

There are different ways of interpreting and implementing the KT across the faculties of LU. In general, most effort is focused on securing financing for and producing high quality research. Education is also a core priority, but may be viewed as a "second place" priority behind research. Innovation and societal interaction is conducted on a very ad hoc basis (driven by individual values and passion, mostly in free time). The result is a fragmentation between the various tasks and a lack of clarity about the benefits of strengthened integration.

LU also experiences a tension between having centralised or decentralised support functions and platforms for collaboration. Thus, LU seems to be navigating between different integrative models. One is the centralised model (including formal institutions such as LU Open, that actually initiated activities). The other is the current distributed model that anchors notions of integration among its faculties (which have very different structures, financing models, and attitudes towards both the importance and the operationalisation of the KT). This results in diverging views on how resources should be used and which activities provide the most value, and barriers to establishing cross-disciplinary collaboration for LU as a whole.

10.3.4 Chalmers University of Technology

Chalmers University of Technology (CUT) is a research-focused technical university situated in Gothenburg, Sweden's second-largest city. Gothenburg has a rich industrial history and high R&D intensity (Fogelberg and Lundqvist 2013). CUT's industrial connectivity is reflected in its position as the fifth university worldwide (2015) with the highest share of industrial co-publications according to the Leiden Ranking. CUT was founded as a vocational school in 1829 through a donation by an industrialist but soon became state-owned. In 1994 the university transformed into a private foundation with greater autonomy than other Swedish universities (Jacob et al. 2003). Education (chiefly engineering) and research are conducted within 18 departments.

10.3.4.1 Informal Institutions

At CUT, there are diverse cognitive understandings of what a KT includes. Consequently, attitudes towards its usefulness vary, as illustrated by two vice presidents:

> Through [. . .] a fruitful KT, we can create arenas for change [. . .] We have to train our organisation to enable this. (Holmberg 2015)

> We do not work with the knowledge triangle [at CUT] because we do not think the concept fits with our integrated picture of the utilisation of research and education. The KT polarises the three tasks by placing them in corners. (C6)

One first point of divergence in understandings regards whether the KT implicates something new. According to some interviewees it does not:

> I feel that I truly work with the KT, but I seldom use the expression, maybe because it's self-evident. (C1)

Others emphasise that the concept brings much-needed attention to the third mission (C2, C3).

A second point regards whether the realisation of the KT implies additional activities (C4), or redesign of existing tasks:

> The relation between education and innovation should not be about activities that 'season' education [. . .] but about revising entire educational programmes on the basis of universities' wider societal role. (C5)

A third point concerns diverse third mission perceptions. While some equate the third mission with innovation and focus on its link to research (C4, C7), others emphasise wider societal responsibilities including sustainability (C5, Holmberg 2015).

This diversity in understandings adheres to the various cultures and values of individuals that both reflect CUT's industrial and entrepreneurial spirit and traditional academic norms. Researchers with strong traditions of doing basic research in

industrial contexts embrace the integration of academic and applied cultures (Fogelberg and Lundqvist 2013). Others mainly identify with academic norms and perceive integration as problematic (Jacob et al. 2003; Fogelberg and Lundqvist 2013):

> Some researchers need to go upstairs in the ivory tower [. . .] and only come out every now and then to say things that amaze everybody [. . .] if we only direct our research toward the needs and issues of specific actors [. . .] what about the future societal needs? (C7)

The link between research and education is often combined in the same persons. However, division of labour appears partly due to the higher status of research that materialises through attitudes and norms (C3, C5). The link between education and innovation is often driven by the commitment of teachers who use their networks to introduce practical elements (C3). The interest and motivation of students are also significant (C5).

10.3.4.2 Formal Institutions

CUT applies a process-oriented management model, where vice presidents lead education, research and utilisation, respectively. Education has its own organisation that procures courses from the departments that employ researchers and teachers.

On top of these layers runs the eight Areas of Advance (AoA)[8]—an organisational structure introduced in 2010 with the vision to "match [CUT'] scientific excellence to global challenges" and the mission "to create a unique integration of the KT" in thematic areas (CUT 2011). The AoA vice president holds the formal KT responsibility. The AoA were a response to a government initiative to strengthen strategic research areas that provided AoA with significant funding. A national evaluation of the initiative praised the AoA and recommended increased funds (Swedish Research Council 2015). Lately, rhetorical KT references in relation to the AoA have faded (C6) and the AoA have developed into platforms for third mission activities and cross-cutting research targeting scientific excellence (C1, CUT 2016).

The AoA is a unique initiative but a somewhat natural trajectory for an ambitious university with strong management and industrial traditions. During the last decades, CUT has strived to transform into an entrepreneurial university and established innovative structures such as a venture capital firm, a seed financing company and an entrepreneurship school (Jacob et al. 2003; Fogelberg and Lundqvist 2013). This has successfully integrated innovative research, entrepreneurial education and action-based training (Jacob et al. 2003). However, these structures emerged as ad hoc experiments without clear guidelines under diverse legal structures and were steered by strong individuals. This created opacity and fragmentation (Jacob et al. 2003) that increased with additional, often government-induced, third mission initiatives. One example is the innovation office, a service function installed in

[8]The areas are Energy, Materials Science, Nanoscience and Nanotechnology, Production, Transport, Life Science, Information and Communication Technology and Built Environment.

2010 targeting research utilisation. Despite revisions during the latest decade, the sense of opacity somewhat remains. Thus, the current vice president of utilisation has a strong focus on integration and coordination (C6).

Despite CUT's AoA and innovation support structure, management schemes seldom target KT integration. Recently (2016) CUT introduced a faculty fund allocation system and guidelines for staff appointments that account for the three tasks. However, task integration is not in focus and some researchers and deans argue that staff appointments will become less flexible and that emphasis is on traditional academic excellence at the expense of societal engagement (C2, C3). Relevant management schemes targeting the third mission also appear in individual departments. Examples are appointments of vice-deans of utilisation, long-term strategies and key performance indicators as well as employee support and encouragement through salary negotiations and rules of procedure (Hillemyr et al. 2015, C2).

10.3.4.3 Observed Challenges in Realising Knowledge Triangle Links

Although CUT's AoA and innovation efforts have been advantageous, significant tensions related to the KT remain. Firstly, the division of roles between the departments, the infrastructure for innovation and the AoA is unclear. The AoA have the KT responsibility, but the departments hold the human resources and are responsible for core tasks. AoA-induced KT connections appear to be rare (C1, C7). Rather, induced connections mainly include intra-departmental research (C3, C1). As a researcher puts it:

> We had developed our connections [before the AoA]. We had the application, international relations, government relations, etc. [. . .] For us [AoA] has been more of a hassle and created ambiguity [. . .] it's getting so much more complex, and you do not know what to expect from whom anymore. (C7)

Secondly, tensions stem from a perceived distance between management and researchers. Some faculty perceive that management steering is over-ambitious and inaccurate:

> I perceive the steering to be over-ambitious [. . .] management is trying to steer things that they have little influence over, and limited information about. (C7)

> The steering is somewhat inconsistent [. . .]one moment we should focus on innovation, the next we should be excellent [. . .] but we know our business, it is through [the faculty] that the knowledge triangle is realised. (C3)

Thirdly, although research-innovation tensions at CUT have been perceived as minor (Fogelberg and Lundqvist 2013), there is still a distance between support structures and needs (C6). While some faculty utilise the support to act entrepreneurially, others perceive that the structures signal a too narrow view on utilisation (C7). Also, a tension adheres to the focus on excellence:

> I notice an augmented pressure to strive for academic excellence, but there are significant trade-offs [. . .] I am concerned because this increased pressure may potentially hinder societal engagement [. . .] and the development of new research venues. (C3)

There are however also concerns about the ability of academia to conduct unbiased and curiosity-driven research in the light of third mission ambitions (C7).

Fourthly, significant tensions concern education:

> The education task has at times been taken hostage by innovation and research players [. . .] that have influenced the content of education dominantly based on perspectives from research and innovation that aren't necessarily in line with those of education [. . .] Strengthening the connection between education and the third mission is not about matching students to the direct needs of beneficiaries or introducing individual elements where students are utilised to reach [innovation goals]. Instead, [strengthening the connection] should be about producing students who can formulate problems that address societal challenges and critically observe society to push social development in the right direction. (C5)

The organisation for education and the AoAs have both worked with integrating societal engagement in education, but rather uncoordinated and unsuccessful (C1, C5, C2). However, interviewees are sceptical towards a stronger integration of education into the AoA due to the risk of increased complexity.

Finally, tensions have emerged between faculty or department initiatives, external initiatives, and university-wide strategic schemes—mainly due to overlapping missions, resources and mandates. For example, the innovation office was created as a government-induced add-on organisation. Although their activities have been significant for third mission developments, they have not yet been successfully integrated (C1, C6).

10.3.5 Malmö University

Malmö University (MU) was founded in 1998 as a state-accredited university college, granting it powers to award first- and second-cycle degrees and with a restricted remit for awarding third-cycle qualifications. MU is the ninth largest higher educational institution in Sweden with five different faculties, providing over 100 programmes of study and 350 courses to well over 20,000 students and almost 200 graduate students. In 2016, it was announced that MU would become an accredited "university" in 2018, which—inter alia—means that it will be empowered to award third-cycle degrees without restrictions, as well as receiving increasing state appropriations for research.

10.3.5.1 Informal Institutions

Interviews contained few direct references to the KT itself, but societal interaction was a recurrent theme in the self-understanding of MU. One interviewee (M1) described MU as "quick and flexible", keen to engage with social challenges

such as migration and inequality. Societal engagement thus emerged as a core value for Malmö, including "social innovation" in a very broad sense: "it's about processes, not things—meetings, feelings, experiences" (M1). This attitude helps to cement and embed KT principles within the university, and students and faculty are inspired by interactive attitudes and possibilities. Hence, the articulation between education, research and innovation is viewed as an integral and attitudinal part of all activities of the university. The approach is more cultural than formalised:

> I don't think in a triangle way—I try to look at the strategy and the vision that we have—dynamic system thinking is more useful here. A triangle model is perhaps not so helpful. (M2)

In line with the broad understanding of the university's role, its representatives articulate an eclectic perspective on innovation. One of the interviewees (M3) emphasised a belief that there should be a variety of forms of innovation rather than merely commercial applications. Involving external parties in the early stages of research processes is seen as having an impact on what "knowledge" is for MU and is a valued form of interaction.

Achieving this is not seen primarily as a matter of drawing on experiences developed elsewhere; important knowledge on societal collaboration resides within the university itself, and there is a need to generalise these experiences beyond the specificities of these individual undertakings (M1). One way in which Malmö could better structure their KT activities is by generalising the experiences made inside the university (M2). More research could be done, for example, to evaluate collaborative projects in a way that forms a subject for research in itself. Another way to enhance the structuration of K3 is to move from spontaneous interactions with societal stakeholders to a more focussed and conscientious model, where the rich and dense societal networks of MU can be translated into research strongholds:

> People are very committed to solving societal challenges at MU, it is in their mindset. People already have the drive, although they need to develop awareness about relating work to research in a more focused way. Research at MAH needs to be boosted via these collaborative projects. (M2)

Regarding the topics for societal engagement, one interviewee stressed that social sustainability could form a particularly good platform, relating strongly to the KT as well as to many different societal issues, while still putting the university at the centre (M4). This approach has also been used in forming alliances within different calls based on principles of "grand challenges", for instance within the European Union Horizon 2020 programme (M1).

As a very recently established university college, MU has been more heavily focused on teaching, particularly professional education, and practical, socially contextualised benefits. MU's identity is shaped by comparisons with the older universities of Sweden, which tend to be research focussed and with a broader educational profile; in contrast, MU is focussed on professional training and expectations emerging from a societal context.

> We are more heavily focussed on education, particularly professional education. As a very recently established university, we put emphasis on these more practical, socially contextualised benefits. (M4)

This shows also in its recruitment patterns. As an example, one-third of MU doctoral candidates are employed outside of academia, most often working on their doctorate part-time. This brings in a lot of outside influence, giving the university a clear "imprint" outside in the world beyond its doors and providing opportunities for gaining commissioned research (M3).

10.3.5.2 Formal Institutions

MU leadership brings different backgrounds that combine many years of public organisational experience, private sector management and experience in running long-term collaboration with societal actors (M1, M2, M4). The MU leadership sees the combination of these sectors as a major driver of quality in education and research. As an illustration, societal challenges form the core mission for the entire university, rather than an add-on (M2, M4). Even though models like the KT are seen as somewhat too rigid and unimaginative to function as organisational blueprints, they serve as mementos and ideals stressing the virtues of aligning the three missions. There are also tangible organisational signs of the significance of societal connectivity, for instance as the university functions as a national hub for social innovation. This is an important profile for the university and is seen as a way to attract potential external funding and collaborators (M2, M4).

There is much innovative work being done by staff and students that senior management would like to harness, in particular by evaluating their collaborations in more detail and therefore providing an opportunity for further research projects (M2, M4). As societal interaction is such a strength at Malmö, "there is a huge communication task ahead" (M4) with raising the profile of these kinds of collaborative activities with civic society, explaining what they do and how they are beneficial. One example is MU's active engagement in crime prevention research, a key issue for the long-term viability of Malmö as a city (M1).

MU continues to integrate KT corners predominantly through its overall value-based approach to innovation and inclusivity within its internal systems for recruitment and promotion. Its own merit system for employment takes into account experience with innovation and collaborative processes (M2). The university has a model for the distribution of faculty research funding based on an average from the last 3 years' external funding that does not discriminate between different sources (e.g. EU, regional or corporate). This becomes an incentive for making contacts with outside partners. Another example is trainee teachers working in the local community who are being used as "change agents" by creating "innovation hubs" for education, and who subsequently become links that create research opportunities (M4).

Senior management would also like to create a common space where faculty, staff and students can "get out of their daily life and work" and where external partners can more easily gain access. MU has also developed value-based leadership at the

Anna Lindh Academy[9] with a special focus on large public and private organisations (M2, M4).

A core aim at MU is to extend research into society and bring society into research. The principles of embedding knowledge flow between actors are "not really top-down" and are "built-in" to the core activities of education and research (M3). Often MU works with the NGO sector and these kinds of cooperations are embedded, becoming the "regular way of thinking and acting" (M3). Collaborative efforts are a serious added dimension to teaching and research, and experience with collaborative activities is now seen as an important consideration in the recruitment process.

10.3.5.3 Observed Challenges in Realising Knowledge Triangle Links

The many societal interaction activities taking place at MU are being used to strengthen the university's research base which is currently scattered: Some areas are well-endowed and resourceful whereas others are nascent or non-discernible. This is dependent on proactive measures from other levels, including national policy: Senior management feels that better facilities for interaction and innovation projects are needed and that more than just economic goals should guide the steering mechanism of research funding at the national level (M2, M4). This may, however, be partially alleviated by the elevation to university status in 2018. Hence, MU straddles between positions: wanting to expand its research basis (which would necessitate an adherence to the current model of funding competition) but also securing a protected and growing space for interactive activities, which would cater to a broader constituency of interests. According to MU leadership, social innovation—MU's niche in the Swedish university system—has different needs from other forms of innovation, and specific tools, goals, financing and structures are required to serve this purpose (M2, M3, M4). There are structural problems in Sweden as regards funding for higher education, particularly in terms of facilitating societal interaction (see Sect. 10.3.1). In the view of MU leadership, all sides must come together to solve societal problems, but currently, there are not enough incentives as funding is lacking. Also, the feeling is that state funding is still benefitting traditional universities for structural and political reasons (M2). In addition, at MU 80% of the revenue is dedicated to education and 20% to research, so there is a great imbalance and limited resources to build a doctoral education and broad-based research environments. Thus, MU leadership sees an integration of the funding of education and research as necessary to better align the different tasks of higher education institutions.

[9] "Anna Lindh Academy has been formed with the aim to contribute to a new generation of value-driven leader who promotes human rights and democracy both in Sweden and internationally" (http://annalindhacademy.se/om-anna-lindh-academy).

10.4 Discussion on Findings

The previous section revealed KT manifestations at three universities. CUT is purposefully orchestrating the KT through a matrix organisation. Tensions have risen as the new organisation complicates resource flows and governance, both vertically between organisational levels, as well as horizontally between the three tasks. LU has a weak steering centre and considerable variation between its different constituent parts. The organisation of KT activities reflects this variation, where a recently adopted top-down approach co-exists rather uneasily with bottom-up activities, and where some faculties have profound and elaborated models whereas others have only minimal experience. MU has predominantly been oriented around education. As a result of limited research funding, they have been pushed to find innovative ways of seeking external funding, primarily through interaction with the local community. However, tensions exist between current structures for research funding in Sweden and the principles of KT integration that MU aims to realise.

Combined, the cases leave us with four key observations on KT manifestations at universities. Firstly, there are contradicting views within the universities related to the third mission and the KT. This observation is in line with those of Sjoer et al. (2016) who identify a great diversity in perceptions that concerned actors have of their tasks, and that not all actors adhere to KT virtues. While this may be expected at a broad and decentralised university such as LU, or a young and evolving university as MU, the observation of contradicting views at a management-driven university as CUT is less expected. When contrasting the experiences, funding patterns and mandates of interviewees with their views, we find indications of how the fragmented Swedish higher education and research system contribute to this diversity. The separated funding streams (for the three tasks, and for research in particular) each channel divergent views on the third mission and task integration, which strongly influence concerned actors at the universities. A clear consequence observed in all three cases is that innovation is conducted on an ad hoc basis, either enabled by different funding actors or driven by individual initiatives. The result is a fragmentation between the various tasks and a lack of clarity about the benefits of strengthened integration.

Secondly, it is clear that education has fallen into second place and the focus on research excellence and attaining research financing has overshadowed the incentives of an integrated KT. These findings are in line with Geschwind and Broström (2015) who found signs of a growing division of labour between teaching and research at Swedish universities. However, the task separation and research dominance are less clear at MU. Dominated by educational activities and adhering to a civic context, MU does not oblige to traditional academic expectations in the same way as CUT and LU.

Thirdly, the ongoing macro-level process of professionalisation and integration of the third mission has been challenged by the drive for research excellence. At LU, challenges have varied with the diverse prevailing conditions within different faculties and groups, while at CUT the conflicts in goals between research and the third mission appear clearly. MU has provided good examples of KT principles in

practice by using societal interaction to maximise investment in research but still suffered from the misalignment to existing research funding structures. For instance, MU exemplifies how creative approaches to KT integration through societal engagement can be underfunded due to a preoccupation by funding bodies with industry collaboration over civic engagement, or when a societal impact is disregarded altogether.

Finally, the universities have used their increased autonomy in different ways with diverse consequences for orchestrating KT principles. Following its proactive management tradition of responding to external expectations, CUT has continued on the road of creating structures and defining processes by mediating visions of KT integration through the new organisational-wide AoA. However, vertical tensions have emerged due to unclear mandate distribution between overlapping structures, and since incentives for researchers to strengthen KT principles at the individual level are not in line with political ambitions on institutional and national levels. LU has mainly redistributed the increased autonomy to the faculties by increasing their mandate. This has led to a more dispersed orchestration where KT initiatives must emerge bottom-up to gain legitimacy. The result is a federation of faculties that are not uniformly directed. Consequently, the decentralised (and autonomous) faculties further exacerbate the aforementioned task separation due to excellence. MU is more agile given its youth and modest size but is however limited by its rather small resources. The result is promising visions combined with the potential of being an evolving university species, but a lack of strength for execution.

10.5 Conclusions and Implications

This chapter deals with how universities blend their tasks. We set out to study how KT principles are manifested in the organisation and strategy of different types of universities. The exploratory approach has provided us with rich descriptions from three universities. We observe a great diversity in the way in which the principles of KT (conjoining education, research and innovation) are orchestrated at the universities, both in terms of informal institutions such as interpretations and attitudes and in formal institutions such as articulated strategies and incentive schemes. On the macro-level, the KT remains a policy priority and living concept, yet task integration is increasingly expected to be arranged by universities themselves. Our study reveals limited ambitions from university managements to forge new combinations of remits. This in turn mirrors the structure of policymaking in Sweden, where the areas of research, education and innovation have been compartmentalised in terms of funding and governance. As this structure trickles down to the individual and group level, we observe that the articulation of tasks is weak. What we do find is that some individuals take on the task of aligning the three missions despite the obstacles, and thus serve as role models and KT exemplars. We also observe tensions as the responsibilities of operationalising the KT fall on individuals who sometimes lack the mandate and resources to create enabling conditions and tackle divergent expectations. With these findings, we make a

significant empirical contribution to the understudied phenomenon of the KT. To sum up, our major empirical observation is that there is a misalignment between the political goal of K3 and the actual policy mechanisms of the three areas. Despite the ambition to reduce the political steering of universities, the resource flows (and concomitant evaluation and assessment criteria) foster a compartmentalised strategy.

These observations offer implications for policymakers and universities. A key group of actions concern supporting the knowledge development needed to fill the aforementioned gaps. If future research indicates that we are in fact to create well-balanced and nourishing links between research, education and innovation within a single university, we need to create a credible, sustainable but also reasonably malleable (allowing for variation) operational model of the KT, to serve as a flexible starting point for the articulation of the different tasks. Our results suggest that this would require extensive and profound changes in the Swedish academic system. The increased resources and autonomy that the sector has experienced so far has not proven to be sufficient to foster better linkages; indeed, it could be argued that they were better aligned when state steering was more pronounced. Initiatives for change can not only emerge through external funders' initiatives and programmes but must also stem from universities themselves. This would require an academic leadership that, together with the collegiate, can formulate and implement the ambitious goals and strategies required to realise a fruitful KT.

These findings also raise questions for further research. Firstly, a significant but methodologically necessary delimitation is that we see the KT linkages as given in the setting that contemporary universities form and take them for granted in our point of departure. Consequently, what remains is the question of the factual cost-effectiveness of division of labour vis-à-vis the benefits from complementarities stemming from the integration. Secondly, it is unclear whether the university is the most suitable level on which the KT should be enacted.

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Appendix: List of Interviewees and their Position

Interviewees from Lund University:

L1: Pro-Vice-Chancellor (for external engagement)
L2: Pro-Vice-Chancellor (for research and research infrastructure)
L3: Previous Vice-Chancellor
L4: Professor (and Principal Campus Helsingborg)
L5: Professor

Interviewees from Chalmers University:

C1: Leader of an Area of Advance
C2: Former Dean
C3: Professor A
C4: Vice-principal A
C5: Vice-principal B
C6: Vice-principal C
C3: Professor B

Interviewees from Malmö University:

M1: Dean and incoming Deputy Vice-Chancellor
M2: Vice-Chancellor
M3: Research coordinator
M4: Pro-Vice-Chancellor

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