
LSE Cities Next Urban Economy Series

Munich Metropolitan Region

Staying ahead on innovation

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The Next Urban Economy

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Conference Paper

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The LSE Cities Next Urban Economy series

Munich: staying ahead on innovation

Torino: reclaiming and diversifying local strengths

Barcelona: global repositioning of an emerging metro

Seoul: orchestrating an innovation-led economy

In the context of strong metropolitan growth, and the promotion of innovative approaches to urban and regional development policy at city, regional, national and European Union (EU) levels, over the past two decades, the *Next Urban Economy* project looks to three European cities for investigation and analysis. The three cities - Munich, Torino and Barcelona - have each overcome challenging crises in the past and shown significant economic progress and urban transformation in the recent past, especially in terms of promoting innovation, global repositioning and internationalisation, and the fostering of a greener economy. The *Next Urban Economy* series also includes one of the fastest growing cities in Asia, Seoul, as shifting patterns of urban growth increasingly require us to look beyond Europe and North America. Taken together, these city profiles provide city leaders, policymakers and practitioners with valuable resources as they respond to the challenges posed by the current global economic recession and develop their own next urban economy. The city profiles will be available at www.lse.ac.uk/lsecities and www.globalmetrosummit.net.

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Executive Summary

Munich is a leading German metropolitan region for high-tech activity, with a powerful innovation system. It is, arguably, Germany's Silicon Valley – with dominant positions in electronics and advanced manufacturing. For over two decades, the Munich region has the country's highest share of ICT patents and had the third largest share of patenting activity across Germany in 2007. Capital of the State of Bavaria, Munich today is one of the top performing cities in Germany, Europe's strongest economy and the fourth largest economy in the world.

Munich's economy grew rapidly in the post WWII period, with a wide range of company sectors and sizes—the famed 'Munich mix'—including world-leading firms like BMW, Siemens, and MAN. During the early 1990s, the metro's competitive position was under threat from the impacts of German re-unification, off-shoring and the 1993-4 recession. Economic output per capita and patenting rates both fell during this period. Munich's challenge was to stay ahead on innovation and diversify the metropolitan economy in the process.

To stay ahead under increasingly competitive conditions and market, Munich has exploited its strong base of assets, including its 'institutional thickness'—a highly interactive mix of private, public and research-oriented actors that induce economic growth. The region's economic strength and capacity to innovate has further been linked to a particularly strong 'service-manufacturing-nexus' – a key characteristic of Germany's economy which is centrally based on interacting knowledge-intensive services and advanced, knowledge-intensive industries. Munich has also leveraged its strengths, such as strong leadership from the State of Bavaria in the area of economic development and innovation.

Exploiting institutional thickness to propel innovation

With over 55,000 R&D full time equivalent positions, 13 universities, an abundance of government-financed research centres, and strong intellectual capacity in government, Munich has become a model of 'institutional thickness'. While there are many factors underlying this phenomenon, the profound level of connections between the business, university and research community is one of Munich's most valuable assets which was successfully exploited.

Strong State leadership in innovation

While numerous actors have contributed to Munich's success, the State government has been the predominate leader in enhancing the region's innovative capacity. It is due to Munich's dominant role within Bavaria that the metropolitan region benefited significantly.

The State of Bavaria has also experienced a lengthy reign of visionary leaders, who have dedicated significant resources to build crucial metropolitan infrastructure (such as the regional rail lines and a new airport) and rebuild Munich's universities. These investments provided the exact kind of infrastructure that fostered innovation at the metro scale. Lastly, Munich has also benefited from decades of political stability at the state and city levels, enabling economic development policies to play out fully. Described below are two recent policies directed to increase and accelerate Munich's innovation capacity:

The Future Bavaria Initiative: A program with three overlapping activities: investments in 'knowledge' infrastructure, knowledge transfer and a 'public venture capital', and high-tech firm formation. Funded through the sale of government-owned shares in a range of enterprises such as the region's energy company, this €2.9bn initiative included over individual 80 projects including the construction of eight new polytechnic colleges and support to create over 450 innovative (but risky) start-ups through subsidies and low interest loans.

The Cluster Program: A program initiated with limited funding but with a highly targeted approach of supporting maturing clusters. The program manages 19 specific clusters, such as biotechnology, energy and environmental technologies, to support networking and collaboration between firms, researchers and venture capital.

The results culminating from these and other efforts have been impressive. Munich has strengthened its presence in science and advanced manufacturing for example with output related to transport equipment more than doubling since 1990. At the same time, Munich is diversifying into new activities, notably biotech and increasingly, 'cleantech' activities such as green energy and low carbon vehicles with a three-fold increase in patents related to climate change mitigation over the last 20 years. Innovative activity in the metro rose markedly during the 1990s, especially in ICT, biotech and green industries. Munich's share of patents in Germany has grown from 11 per cent in 1980 to 13 per cent 2007. 2008 economic output per capita has doubled since 1991 (from €32,078 to now €64,625) and is now comfortably above regional and national averages.

In general terms, Munich's success story can be summarized by four key success factors. First, deep connections between public, private and third sector actors – 'institutional thickness' – have produced a clear sense of common purpose, and long term, focused policy interventions. Second, consistent state-led policies have supported and advanced economic clusters and innovation. Third, Munich's economic diversity and some world-beating firms have provided economic resilience and helped to spark new ideas. Fourth, the State and the City of Munich invested in the assets that matter, notably in human capital (via public education system) and infrastructure (such as the new airport).

1 Introduction

‘We know each other’s problems. And that results in a willingness to agree on shared goals or even several goals.’

Prof. Christiane Thalgot, Head of Department of Urban Planning 1992-2007, City of Munich

1.1 Background

Munich is a leading German metropolitan region for high-tech activity, with a powerful innovation system. It is, arguably, Germany’s Silicon Valley – with dominant positions in electronics and advanced manufacturing.¹ In 2008, the metropolitan region had Germany’s highest number of research and development (R&D) workers with about 55,000 full time equivalent positions, and in 2007 had the country’s highest share of information and communication technologies (ICT) patents, a position held for over two decades (von Streit et al 2010, OECD 2010, Prognos 2010).

Munich’s economy grew rapidly in the post-WWII period, hosting a wide range of company sectors and sizes – the famed ‘Munich mix’, with some world-leading technology firms such as BMW, Siemens, MAN and Knorr-Bremse as well as global insurance companies Allianz and Munich Re headquartered in the city. Munich also has several world-class universities, and a number of partly Federal-funded public research institutes, notably the headquarters of the Max Planck Society and of the Fraunhofer-Gesellschaft, Europe’s largest applied research organisation.

During the early 1990s the metropolitan region’s competitive position was under threat – from the impacts of German reunification, off-shoring and the 1993-4 recession. Gross Value Added (GVA) per capita and patenting rates in the metropolitan region both fell during this period. Munich’s challenge was to stay ahead on innovation, and to diversify the metro economy in the process.

State government led the process of enhancing innovative capacity following the low-point of the early 1990s. Exploiting strong public institutions and public-private networks, State and metropolitan region leaders developed a powerful, 20-year innovation strategy. This was delivered through overlapping initiatives to spark ideas flow, grow high-tech firms, invest in education and infrastructure, and green the economy of the metropolitan region.

1.2 Munich remix?

The results of this process have been impressive. Munich has strengthened its presence in science and advanced manufacturing – while diversifying into new activities, notably biotech and increasingly, ‘cleantech’ activities such as green energy and low carbon vehicles. Innovative activity in the metropolitan region rose markedly during the 1990s, especially in ICT, biotech and green industries. Economic output per capita and employment rates have recovered, and are now comfortably above Bavarian and national averages.

Three key programmes by the State of Bavaria – the Future Bavaria Initiative in the 1990s, the High-Tech Initiative in the early 2000s, and the 2006 Cluster Programme – have helped push Munich forward. More broadly, there are three key success factors behind Munich’s recent success story. First,

economic diversity and some world-class firms, which have provided economic resilience and helped to spark new ideas. Second, critical public investments, notably in human capital (via the public education system) and infrastructure (notably the new airport).

Third, deep connections between public, private and third sector actors – ‘institutional thickness’ – have produced a clear sense of common purpose, and long-term, focused policy interventions. Behind this, Germany’s ‘active state’ approach has allowed Federal, State and city public agencies to make and shape new markets, especially in the green economy.

1.3 Method and caveats

This is a mixed-methods study, involving a) academic evidence review, b) Bavarian and Munich policy review, c) descriptive statistics, d) ten semi-structured interviews with key stakeholders and experts which are listed in the appendix, plus a stakeholder workshop. Quotes from the interviews and workshop are given in italics.

There are two important caveats to the results. First, we have consciously focused on Munich’s ‘innovation story’ and the forces behind this, rather than the overall story of urban change. Further research could concentrate on (for example) land management and the built environment, the creative economy or quality of life issues.

Second, it is never easy to identify the causal role of policy, and in the Munich case, it is especially difficult to separate policy factors from longer-term path-dependence. Our interviewees consistently argue that policy has had a strong role (as might be expected). We also find clear correlations in the data between public investment ‘inputs’ (such as the €2.9bn Future Bavaria Initiative) and innovation ‘outputs’ (such as metro-level patenting rates). It is plausible that at least some of this is due to policy.

1.4 Structure of the report

The rest of the report is structured as follows. Section 2 introduces the metropolitan region and its history, and sets out the key challenge faced by the region: how to stay ahead of the curve on innovation.

Section 3 sets out responses to this challenge: how metropolitan region leaders reacted, the strategy-building process, key priorities and programmes. Section 4 discusses the outcomes, and identifies key success factors. Section 5 briefly considers the recent financial crisis, and future issues for the metropolitan region. Finally, Section 6 identifies some broader lessons.

¹ A point first made by Castells and Hall, 1994

2 The metro context

2.1 Geography

Munich is located in South East Germany. It is the capital of the State of Bavaria and the third most populous city in Germany. Of Bavaria's 12m inhabitants, almost half (5.5m) live in the European Metropolitan Region Munich (EMM). 1.31m people live in Munich itself.

Figure 1 shows the city of Munich and the surrounding metropolitan region. Unlike some American metropolitan statistical areas (MSAs), German 'metros' include several urban cores – in this case, not only Munich but also the cities of Augsburg, Ingolstadt, Landshut and Rosenheim with a population ranging from 60,000 to 260,000. Munich, however, dominates the metropolitan region both in terms of population and economic strength. It accounts for approximately 2% of the land area, but around 30% of the population and 40% of employment subject to social security contributions in the region (Prognos 2010).²

2.2 Economic history

Economically, Munich is one of the strongest-performing cities in Germany. Productivity (as measured by GVA per worker) and employment rates are well above the national average (Table 1). Munich generates one third of Bavaria's total output (von Streit et al 2010). The city performs less well than the metropolitan region on unemployment, but the EMM area outperforms the national average in this measure.

Munich's economy is driven by a strong innovation system. In 2007, the metropolitan region had Germany's third-largest share of patenting activity (just behind Stuttgart and the Rhein-Main metropolitan region). More significantly, Munich is well ahead on critical high-tech innovation such as biotech, ICT and 'cleantech' activities (Table 2).

The innovation system is underpinned by several factors. First, the metropolitan region has high human capital, with an above-average share of graduates (Table 1) and over 88,000 students in 13 universities. Munich has two of the nine elite universities awarded Germany's 'University of Excellence' standard.

'This is certainly an important contribution to the success of this location – the academic potential here. LMU Munich University, Technical University of Munich, Max-Planck-Institutes of Biochemistry and Neurobiology, also the Max Planck Institute of Psychiatry in the city centre, and the Helmholtz Zentrum München. It really is this science base, if you like.'

Dr. Mathias Lamparter, Cluster Manager, Bavarian Biotech Cluster

Second, Munich has a critical mass of public research activity, not only in universities, but in numerous public research institutes. Besides the headquarters of the Fraunhofer-Gesellschaft, Europe's largest applied research organisation, Munich also houses the Max Planck Society, which, besides its headquarter, includes three institutes around the city (in Biochemistry, Neurobiology and Psychiatry), as well as the Helmholtz Zentrum Muenchen (German Research Centre for Environmental Health) and a key branch of the German Aerospace Centre. Around 33,000

Table 1
Munich's economic performance: headlines for 2007

	Munich City	Munich Metro*	Germany
GVA per worker (€)	70,030	64,875	51,530
Employment rate (%)	-	83.9	74.0
Unemployment rate (%)	6.2	4.3	8.6
% with tertiary education	23.60	30.8	24.3
Population ('000s)	1,312	4,313	82,218

Sources: Cambridge Econometrics, Eurostat, Statistisches Bundesamt, Bayrisches Landesamt fuer Statistik. *Note: Munich Metro is approximated by Oberbayern NUTS2 area

Table 2
Metros' share of national ICT, biotech and cleantech patenting, 2007 (%)

	Munich	Stuttgart	Rhein-Main	Hamburg
ICT	18.5	12.9	10.8	2.6
Biotech	20.4	2.3	19	3.7
Cleantech	15.4	12.8	7.2	6

Source: OECD.Stat. Notes:

1) Patents to EPO, by inventor region of residence.

2) Patents by priority year.

3) Spatial units are German Metropolitan Regions, proxied using best-fit Spatial Planning Regions.

4) Table gives a sample of the 11 Regions, so shares will not sum to 100 5) 'Cleantech' is defined as renewable energy, electric and hybrid vehicles, energy efficiency in buildings and lighting

Table 3
Munich metro economic performance in the early 1990s

		1991	1992	1993	1994
GVA per capita	Metro	57,444	56,179	53,545	54,290
	Germany	49,020	48,949	47,155	48,529
Employment rate	Metro	74.1	75.8	73.0	71.5
	Germany	64.0	64.3	62.8	62.0
Unemployment rate	Metro	4.8	4.5	4.7	5.0
	Germany	8.8	9.5	9.7	9.6

Sources: Cambridge Econometrics, Eurostat, Statistisches Bundesamt.

Note: Munich Metro is approximated by Oberbayern NUTS2 area

people are employed in these agencies, helping to give the metropolitan region Germany's highest number of R&D employees, with over 55,000 full time equivalent (FTE) positions in 2008 (Prognos AG 2009).

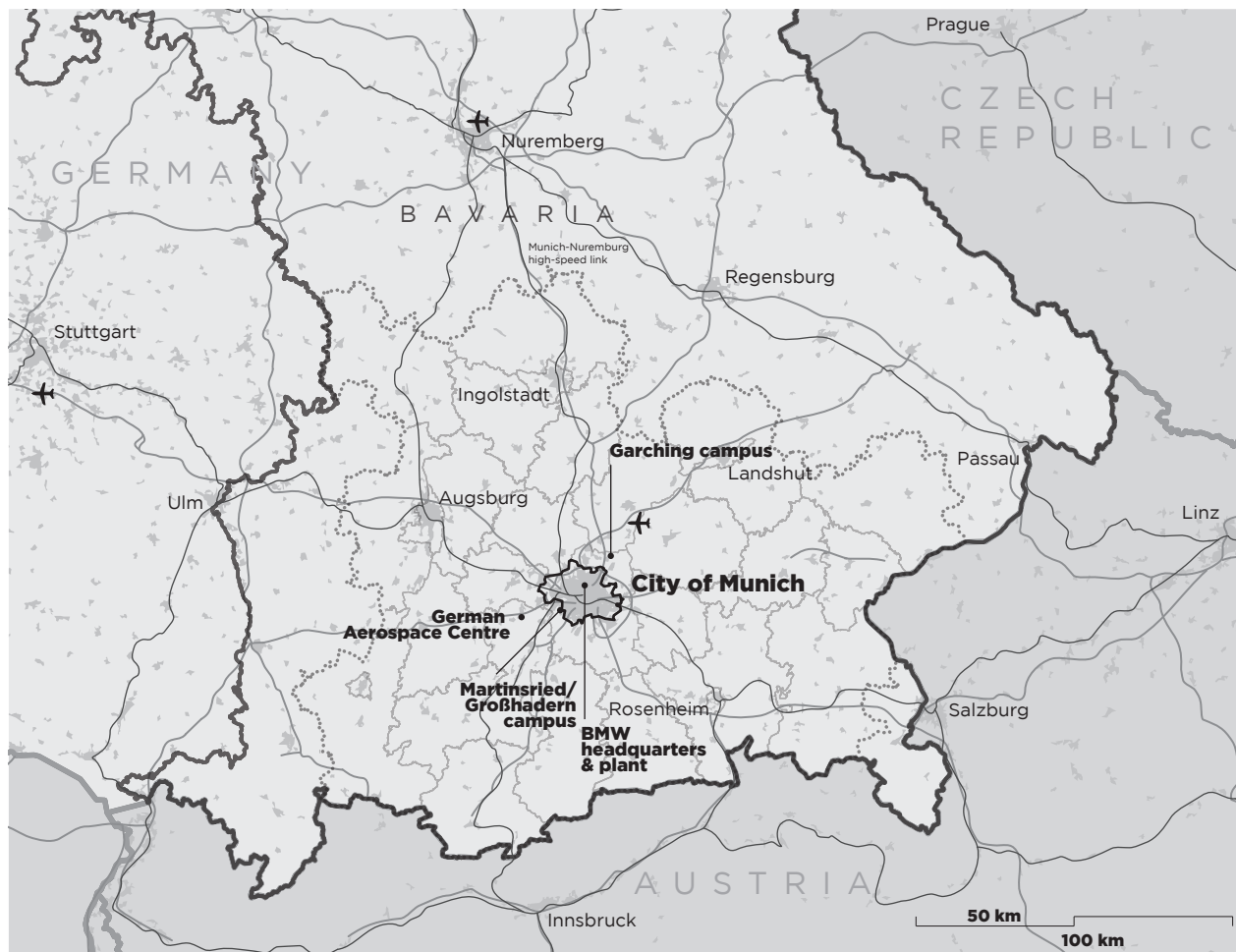
Third, the metropolitan region has a very diverse industrial structure. The 'Munich Mix' covers a range of sectors, global players, and small and medium sized enterprises (SMEs). The metropolitan region has identifiable clusters in high-tech manufacturing (automotive, space and aerospace, ICT and biotech), knowledge-intensive services (finance and insurance) and the creative sector (media, software and internet publishing).

Together, these factors help produce what we call 'institutional thickness' (Amin and Thrift 2001). We will explore this combination of strong public agencies, powerful public-private networks and collaborative relationships further in Section 3.

Munich's industrial structure also needs to be understood as the product of two bigger, related forces. First, unlike

² When we talk about 'the city' we mean the Munich urban core (the administrative city). 'The metro' or metropolitan region means the European Metropolitan Region Munich (EMM) area. Data for the EMM is not straightforward to assemble. Due to practical constraints, we generally use the Oberbayern NUTS2 area as best-fit for EMM. For patent statistics we construct a more precise best-fit using Spatial Planning Regions.

Figure 1
Bavaria Free State (Freistaat Bayern) **12,510,331 people**
Munich Metropolitan region (Metropolregion München) **5,200,000 people**
City of Munich (Kreisfreie Stadt München) **1,330,440 people**



Source: European Metropolitan Region Munich Association 2010



- regional boundary
- metropolitan boundary
- district boundary
- ✈ airport
- highways
- intercity rail

Anglo-Saxon countries, Germany has always maintained a strong element of manufacturing, and has resisted de-industrialisation and outsourcing. The results are visible on the ground in Munich and in many other German regions. Second, the country's development dynamics are centrally based on interacting knowledge-intensive services and advanced, knowledge-intensive industries, which in turn have created a service and manufacturing nexus at regional levels (Laepple 2008). Munich's particularly strong 'service-manufacturing-nexus' is an example of path-dependence, a product of the city's history and, to an extent, historical accident. We explore Munich's history in more detail below.

2.2.1 How did Munich get here?

Much like Silicon Valley, the Munich metropolitan region evolved rapidly from agrarian to high-tech economy in the decades following World War II. The city was the regional capital of Bavaria from the early 16th century. In the 19th century it industrialised less than other German cities, and remained in large part a centre of craft industries within an agrarian state until the late 1930s. Nevertheless, it was the site of some key technological developments: Munich was one of the first cities to have a train line and street lighting, for example.

Post-war restructuring laid the foundations for catching-up. The city had the good fortune to be in the American

sector, and close to Eastern Europe. It received an influx of skilled refugees, federal research agencies and large firms from Berlin and Eastern Germany:

‘A significant number of manufacturing and service sector companies such as Allianz relocated to Munich because they expected having to pay less in [war] reparations in the American Sector.’

Dr. Detlef Straeter, Fellow, Munich Institute for Social and Sustainability Research

This historical accident, which included the arrival of large technology firms like Siemens, helped Munich build technological capacity and shape, together with more established regions of advanced manufacturing, Germany’s distinctive ‘service-manufacturing-nexus’.

A number of policy factors also came into play. In the immediate post-war period, research policy was a State-level function. The Fraunhofer Gesellschaft, a key German public research agency, was founded in Bavaria with the heavy involvement of the Bavarian Ministry of Trade and was dominated by Bavarian ‘players’ in its early years – the board and senate being made up entirely of representatives from Bavarian science and industry (Schlemmer and Woller 2004, Trischler and vom Bruch 1999).

In subsequent decades, as with Silicon Valley, a great deal of Federal defence spending was directed towards the Munich metropolitan region, laying the foundations for the microelectronics industry. This was largely due to the influence of Franz Josef Strauss, who was a Federal Minister from 1953-69 and Prime Minister of Bavaria from 1978-88. From 1961-78, Strauss was also leader of the conservative CSU Party, and as such the ‘lobbyist-in-chief’ for Bavarian science and industry. He helped rebuild Munich’s universities, and secured the long-term presence of key public research institutes. At city level, 1960s Mayor Hans-Jochen Vogel developed the city’s compact urban form, and helped with a successful Olympic bid. The 1972 Games triggered significant physical development:

‘It’s clear that Munich experienced an enormous infrastructure development because of the 1972 Olympics, as on the one hand infrastructure was being improved, and on the other the city gained a lot of prestige...’

Rudolf Escheu, Head of the Department of Economic Policy, Ministry of Economic Affairs, State of Bavaria

From the early 1970s, the metro economy rapidly expanded from these foundations. Continued federal funding helped the university base to grow. Rising land costs in the urban core led to a ‘metropolitanisation’ of development; among others, the German Aerospace Centre Oberpfaffenhofen and Society for Radiology both expanded into suburban neighbourhoods. Over the years, a new urban and regional rail system (opening in 1971, in time for the Games the following year) and an expanded, relocated airport (opening in 1992, which allowed for the establishment of a new hub for Eastern Europe) have provided the infrastructure for the metropolitan region’s outward push.

2.3 The problem

By the start of the 1990s, the Munich metropolitan region was hit by a series of shocks: from the end of the Cold War, re-unification, recession and new global competition. City leaders feared that Munich’s growth era might have ended:

‘The city really had to grapple with the new economic conditions after re-unification – we all did – and that led to a very realist perception [of the city], and [seeking] the support of those perceived as reliable ...’

Prof. Christiane Thalgott, Head of Department of Urban Planning 1992-2007, City of Munich

This pessimism felt by Munich’s leaders during this time is borne out in the statistics. Table 3 shows economic output per capita heading downwards from 1991-93, with labour market indicators following shortly after.

State and city leaders had a number of specific worries. First, they feared that after re-unification, industries and organisations that had moved from Berlin post-WWII might return to the new capital. They further worried that Germany’s axis of development might shift from North-South to East-West, from Berlin to the Ruhr, bypassing Bavaria entirely.

Second, during the Cold War period Bavaria invested heavily in developing defence and aerospace industries, many of which were concentrated in and around Munich. After 1989, these industries experienced a severe drop in demand (later adjusting to take advantage of the peace dividend).

Third, and in addition, the economic downturn of 1993-94 meant a further heavy blow to the export-orientated industries at the heart of the Bavarian economy: the automotive industry, and electronic and mechanical engineering (Berger 2002). As Table 3 shows, there was a measurable increase in unemployment during these years.

Fourth, and more broadly, there were fears around globalisation. Civic leaders worried that Munich’s leading firms might offshore production or relocate entirely; at the same time, competitor firms in other countries were moving up the value chain in automotive and electronic sectors.

The Munich metropolitan region’s challenge was, therefore, to ‘stay ahead’ on innovation. But there was also an opportunity to use the innovation ecosystem to restructure the economy and secure long-term growth. State actors had been developing ideas for a smarter, greener economy for some time; as far back as 1985, the Bavarian Ministry of Economy and Transport had highlighted life sciences, information technology and green technologies, among other, as key sectors for future economic development (BaySTMWIVT 1985 in Berger 2002). The events of the early 1990s provided the necessary tipping point.

3

Intentionality to advance the next economy

3.1 Approach

How did political leaders respond to these challenges? Most obviously, they sought to sustain Munich's economic trajectory, and to secure the competitive position of the metropolitan region's existing firms:

'Both the Future Bavaria Initiative and the High-Tech Initiative should be seen as the result of reflections on what to do to avoid being left behind economically.'
Rudolf Escheu, Head of the Department of Economic Policy, Ministry of Economic Affairs, State of Bavaria

However, Munich's challenges were also opportunities to refresh the metropolitan region's economic basis, and to engage with emerging ideas and technologies. As the previous section suggests, the metropolitan region has a long history of looking forward. One of our interviewees summarised the civic leaders' approach as:

'There is a conviction that economic policy requires an explicit commitment to future technologies, even if on occasion this does not appear [politically] expedient. That is in my view the core element of the Bavarian political creed.'
Dr. Gerd Gruppe, Head of the Department of Innovation, Research and Technology, Ministry of Economic Affairs, State of Bavaria

Or as the advertising slogan of Munich region-based Audi has it, 'Vorsprung durch Technik'.

Von Streit et al (2010) characterise Bavaria's enduring economic development strategy as 'top down approaches which focus ... on innovation, knowledge and high-tech sectors'. In the early 1990s, this meant:

- Promoting innovation, and through this, long term economic growth
- Growing a new economy by pushing innovation, identify and promote 'future winners'
- Growing a greener economy – interest in promoting innovation in green goods and services, and developing markets at metropolitan region level.

3.2 Institutional framework and governance

3.2.1 Actors

Unlike many other city-regions, Munich does not have formal metro-level leadership or institutions. Rather, the powerful metro economy is co-ordinated from above (at state government level) and below (at city government level). Despite this 'institutional gap', political and business leaders have been extraordinarily successful at articulating a clear vision and programmes.

Bavaria's State government has led the process of promoting innovation and stimulating long-term growth. State governments in Germany are leading actors in economic development, controlling budgets for education, R&D, culture and media activity, among other things. In the Bavarian case, State economic development activity disproportionately affects Munich because of the spatial clustering of high-value activity in the metropolitan area.

Within this area, the city of Munich has a number of important functions – in particular, those relating to land management and planning, support for start-ups and providing business space, city marketing and branding. The city's public utilities company, the Stadtwerke Muenchen (SWM) has also played a critical role in developing green

infrastructure, and in stimulating demand for innovation in green goods and services (see Section 4).

The Federal government and the EU play important indirect roles. Both provide direct funding to individual scientists and research institutions. The national government also provides critical investment in kind, through the wider public education system. And both national government and European agencies help shape markets, through regulation (which shapes industrial norms and encourages upgrading) and fiscal policy. Germany's feed-in tariffs system, which we explore further below, has significantly helped grow green industries both in Munich and across the country.

3.2.2 Moving forward

Metropolitan region leaders put their vision into practice by exploiting Munich's 'institutional thickness'. This term, coined by economic geographers Ash Amin and Nigel Thrift, refers to the 'ensemble of local social and cultural conditions conducive to economic growth' (Amin and Thrift 2001). The key elements are a) strong institutions b) high levels of interaction c) sense of common purpose and d) co-ordinating activity. Munich has all of these elements in place, and in addition can profit from Bavaria's overall interconnectedness of interests. As one of our interviewees put it:

'One of the important aspects that keeps playing a role in Bavaria is the close link between business, politics, finance and other service providers, be that lawyers or others. Some tend to call it sleaze, which doesn't hit the nail. One can also look at it as a good thing in terms of effective and active networking.'

Enno Spillner, Chief Financial Officer, Pharmaceutical Company 4SC

As Dieter Laepple points out, 'institutional thickness' can be extremely helpful to a metro's economic development, in the right circumstances. In other German regions, the Rhein-Ruhr region for example, 'institutional thickness' has been obstructed innovation.

So what has made the difference in Munich? Key ingredients include:

- Political stability – the conservative CSU party has led Bavaria for many decades. Munich has been dominated by the centre-left SPD (which provided all but one of the city's Mayors since 1948). For the past two decades Munich has had a continuous Red-Green coalition, the longest in any large German city. This means that:

'... both are rather stable systems. On the one hand the red-green [coalition] in the City of Munich and on the other hand the Conservatives at the State level. This way one naturally knows one another for a long time.'

Bernhard Eller, Economist, Department of Labour and Economic Development, City of Munich

State and city can and do act differently – for example, Munich kept its utilities in public ownership, while Bavaria sold off its share holdings. However, as this quote makes clear, stability leads to certainty. And the ideological divide between what some described as a more 'neo-liberal, technology-oriented' state government and a 'social-democratic, public-service-oriented' city government often translates into a positive process of learning and correction.

- ‘Geeks in government’ – both Munich and the Bavarian state have strong interventionist traditions, and an equally strong focus on technology-led development. Munich has benefited from a cadre of technically-educated personnel in public agencies, especially in Bavarian State Ministries. This ‘forward orientation’ has helped metropolitan region leaders avoid complacency, and encouraged economic change. One department head put it dramatically:

‘We have 50 true believers here, with the capacity to make informed judgements. There are chemists and biologists and all sorts ... they are convinced of their cause. They are convinced that technological progress is a decisive element of business competitiveness.’

Dr. Gerd Gruppe, Head of the Department of Innovation, Research and Technology, Ministry of Economic Affairs, State of Bavaria

- Critical mass – as Section 2 illustrates, Munich has a rich mix of high-value economic activity, high-quality universities and a network of public research intermediaries, focused on both blue-skies and applied research.
- Connected elites – more broadly, there are multiple connections between heads of the business, university and public research communities. Business world representatives sit on University Councils, which set universities’ strategic direction, and repeatedly use their influence to promote Munich’s wider standing. Several national public research institutes have been headed by Bavarian academics. And numerous wealthy entrepreneurs have provided financial support for educational institutions.

Combined, these four factors have helped build a powerful policymaking machine. We can identify four key characteristics:

- Strong and stable public institutions, with competent administrators and good public services
- Productive public-private relationships, promoting formal and informal ideas exchange and collaboration
- A commitment to technology, making long term public investments, even when this is politically unpopular
- Common purpose and flexibility – the ability to set out and stand by overall strategies, and to fine-tune initiatives quickly when conditions change.

As is normal with multilayer governance systems, co-ordination of these systems in Munich is not perfect. Our interviewees had strikingly divergent views on the success of day to day operations. A more optimistic view was that:

‘Collaboration is excellent on the technical level and on the political level there is the attempt to make it work somehow. And that pretty much always works.’

Prof. Christiane Thalgot, Head of Department of Urban Planning 1992-2007, City of Munich

Others pointed out that differences in political outlook, different aims and interests, and the lack of specific co-ordinating mechanisms have all limited Munich’s governance capacity in the past. Some suggested, as mentioned above, that friction between state and city layers of government might lead to ‘creative learning’ at the metropolitan region level.

3.3 Interventions

State, metropolitan region and other actors developed a series of overlapping interventions. There were three main

‘policy events’, all led by the State of Bavaria:

- The Future Bavaria Initiative (‘Offensive Zukunft Bayern’), 1994-1999
- The High-Tech Initiative, 1999-2006
- The Cluster Initiative, from 2006.

Since the 2007 financial crisis, Federal support has also become increasingly important.

Bavaria’s innovation strategy was delivered in a highly distinctive way. The region’s institutional thickness helps us understand how this was done: public and private actors had a strong, shared vision, and this gave them the confidence to roll out a series of flexible initiatives, retiring anything that did not perform:

‘It really worked according to the principle of trial and error. There were no role models, one simply tried something and then saw if it worked. If it didn’t work, then we simply suspended it.’

Dr. Gerd Gruppe, Head of the Department of Innovation, Research and Technology, Ministry of Economic Affairs, State of Bavaria

Or as another interviewee set out:

‘We rarely pick a single measure. In the area of innovation politics we are looking at a specific succession of programmes or projects, in order to reassess and reschedule as required. The Future Bavaria Initiative and High-Tech Initiative were very similar [in this respect].’

Rudolf Escheu, Head of the Department of Economic Policy, Ministry of Economic Affairs, State of Bavaria

3.3.1 The future Bavaria initiative (1994-99)

The ‘Offensive Zukunft Bayern’ (OZB) was launched in 1994 by newly-elected Bavarian Prime Minister Edmund Stoiber. The overall aim was to maintain Bavaria’s innovation advantage, both by supporting existing activities and through developing new high-value activity. The Initiative combined highly interventionist industrial policies with a high degree of market activity, in the form of privatisation and liberalisation:

‘We can see here the attempt, more than in other German States, to advance the economy and to invest in the future – even selling some of the family silver in the process.’

Enno Spillner, Chief Financial Officer, Pharmaceutical Company 4SC

The Initiative had a distinctive financing mechanism – the sale of government-owned shares in a range of enterprises, netting around €2.9bn. At the time, no other German State had this kind of investment budget at their disposal. The majority of this was spent on technology and innovation infrastructure (Berger 2002). Given Munich’s dominant role within Bavaria, the metropolitan region benefited significantly through these state-wide programmes.

There were three sets of overlapping, Bavaria-wide activities, organised into a massive 82 individual projects. These covered:

- Investment in physical and ‘knowledge’ infrastructure: upgrading of university facilities, construction of eight new polytechnic college, installation of supercomputers and new broadband infrastructure, plus €25m on R&D. In addition, all 25 University locations in Bavaria were connected with each other in 1996 via a broadband science network. High-speed broadband connecting Munich and Berlin was also predating a country-wide network. The Leibniz Computer Centre of

the Bavarian Science Academy and the Munich Universities received about €30m to upgrade its facilities and set up a high-capacity computer. Nearly €250m was also invested in University facilities at Garching (see Example 1).

- **Knowledge transfer and ‘public venture capital’:** a set of new institutions was established, in particular Bayern Innovativ and Bayern Kapital. Bayern Innovativ was established in 1995 with €50m from OZB funds. It is the main communication platform for all state sponsored high-tech initiatives, and is jointly operated by public, private and intermediary research agencies. It aims to promote technology transfer, both for researchers and businesses, especially SMEs. It runs a series of collaborative projects, as well as 10 professional networks. It also collaborates with the 1990-founded Bavarian Research Foundation. Bayern Kapital was set up with State support of €75m. An innovative public finance instrument in the German context at the time, it was copied shortly after by several other German States. A 100% subsidiary of LfA Foerderbank Bayern, the Bavarian State Bank, it provides venture capital for start-ups, especially in the risky high-tech sectors. It thus aims to bridge the development stage between the traditionally academic basic research and products close to market-entry stage that are able to attract private venture capital.

- **High-tech firm formation:** the Bavarian Technology Development Programme aims to support innovative and risky technologies to prototype stage. It works through a mix of subsidies and low-interest loans.

- **Fostering the internationalisation of the Bavarian economy.** Three agencies were set up to coordinate a range of relevant activities – the International Technology Forum Bavaria was founded in 1995 to foster exchange between science and industry, Bayern International focuses on supporting SMEs as they increase their exports or expand internationally, and Invest in Bavaria promotes Bavaria as a location for foreign investment. To this end it built up a network of 22 Bavarian foreign representatives around the world and facilitates international trade-fair participation for SMEs.

3.3.2 The High-tech initiative (1999-2006)

The High-Tech Initiative (HTI) began as the third phase of the OZB. Being almost exclusively focused on technology development, it was increasingly seen as a distinctive economic development policy of its own. It concentrated its support on various key technologies, including among others life sciences, ICT, environmental technology and mechatronics. While focussing on high-tech sectors it can be seen as a continuation of policies aiming to avoid substantial structural shocks (Berger, 2002). It was designed by the Bavarian State Chancellery and implemented through the State Ministry for Economic Affairs, Infrastructure, Transport and Technology.

The HTI was also funded through the sale of government-owned shares, this time raising €1.35bn, and built on four “pillars” alongside a complementary infrastructure programme (Table 4).

The overall programme aims were to further develop technology fields and help firms to build an international presence. Around half the total funds (€663.6m) were spent on accelerating the development of spatial clusters – in particular, a high-tech manufacturing centre in the suburb of

Garching, north-east of Munich near the technical university, which had already benefited from the Future Bavaria Initiative. Two biotech-orientated centres were also funded in the suburbs of Freising and Martinsried.

Two ‘pillars’ were of particular importance and received most funding. Pillar 1 aimed to foster globally-recognized high-tech centres in new scientific fields. All together €663.6m were spent, of which €358.4m went into Life Sciences, €129m on ICT, €114m into new materials, €24.4m in green technology, and €38m on nanotech. Projects supported in the area of Munich include:

- **New university buildings:** provision of new buildings enabled relocation of university departments (mechanical engineering, IT and mathematics) of the Technical University out of the city centre to Garching, to the north of the city (Example 1), and the creation of a biotechnology cluster in Martinsried in the south-west of Munich (Example 2). In Martinsried, Bavaria has financed the new construction of the Chemistry and Pharmacy departments of the University of Munich (LMU).

- **Start up centres:** The Bavarian State has financed three start-up centres in the Munich region. They offer a variety of forms of start-up support as well as technology transfer points, which encourage the intensive networking of science and industry. They assist in the search for suitable co-operation partners, make contacts with holders of expertise, give patenting and financing advice, and engage in active knowledge transfer. One of them is GATE (Garchinger Technologie und Transfer Zentrum), a centre for start-ups established in 2002, situated in Garching, in north-east Munich. Located near Munich Technical University, it offers young high-tech enterprises the right conditions to successfully start a new business, especially in ICT.

- **Promotion of innovative networks:** Another field of activity is that of policy initiatives aimed at improving co-operation between firms and universities, and making more of the regional knowledge base. One example is the €55m ‘Software Initiative’, which supported research, development and training in information and communication technologies. The initiative also aimed to stimulate high-growth start-ups in the software industry, making Bavaria a top location for dynamic young businesses in the information and communications sectors.

Table 4
Pillars of the high-tech initiative

Programme elements	€m
Pillar 1: expansion of world-class high-tech centres	663.6
Pillar 2: ‘technology concepts’ for all regions	179.0
Pillar 3: state-wide programme of start-up promotion and technological infrastructure	267.4
Pillar 4: internationalisation of high-tech industries	65.4
Additional Infrastructure programme	175.4
Total	1,350.8

Source: Bavarian State Chancellery, 2006.

Pillar 3, with a budget of €267.4m, aimed to promote start-ups and technological infrastructure as well as qualification. Supported projects included:

- The Bavarian Support Scheme for Facilitating Start-Up Transition ('Förderprogramm zum leichteren Übergang in eine Gründerexistenz', or FLUGGE). It aims to increase the numbers of spin-offs from universities, and it supports, for example, the Technology Transfer Centre at the University of Munich.
- The Munich Business Plan Competition (Münchener Business Plan Wettbewerb (MBPW), modelled after an original scheme at MIT, which awards prizes to exceptional business plans and has been held since 1995. The awards have already helped many technology-oriented firms to become successful. This programme is also supported by the City of Munich. Prize funds have helped found and finance around 480 new enterprises in the last ten years.

According to a recent study on biotechnology policy in Bavaria and Baden-Wuerttemberg (Liecke, 2009) the biggest (positive) impact on the financing and founding of new (biotech) enterprises came from Bayern Kapital and the BioM Biotech Cluster Development Group. Other relevant tools had been the business plan competition, the start-up centres and to a lesser extent the Bavarian Research Foundation. However, unions as well as some business representatives have criticised the exclusive focus on high-tech in technology transfer, arguing for the inclusion of basic technologies to meet the needs of local firms (Berger, 2002).

3.3.3 The Cluster initiative (2006-)

The Bavarian State Government initiated its cluster campaign in 2006. The focus of the programme is very broad and only partially aligned with the academic understanding of clusters: 19 clusters have been identified, among them biotechnology, energy and environmental technologies and three types of clusters: production-orientated, high-tech and cross-sector (Gutgesell and Maier 2007). The programme works by setting up so-called 'cluster platforms': management teams that support state-wide networking and collaboration between firms, researchers and venture capital. The management teams also work to promote specific spatial clusters around Munich, such as Garching and Martinsried.

As this description suggests, the Cluster Initiative is both smaller than and differently configured from the previous two initiatives. As von Streit et al point out (2010), 'in several respects, the technology policy of Bavaria has reached a turning point [with the cluster initiative].' In part this reflects a genuine desire to shift the focus onto helping maturing clusters develop further; it also reflects the reality that funds from share sales have been exhausted, necessitating a shift towards lower-key project support, dialogue and mobilising private resources (ibid).

3.3.4 Federal support

As noted above, Federal funding plays important indirect roles for Munich, not least through direct support for R&D. That role has become more important in recent years, both because of Bavaria's funding crunch and following the 2007 financial crisis.

In 2006, the Federal Government launched Germany's

first national innovation strategy. The 'High-Tech Strategy' provided €14.6bn of first tranche funding between 2006-2009, aimed at funding high-technology R&D, forging research-industry links, supporting SMEs and cluster development.

The metropolitan region has already received significant funding boosts. Munich's biotech cluster has been awarded €100m from 2006-2011, with Munich's two best universities – Ludwig Maximilians University and Technical University Munich – receiving €110m each of R&D funding.

More broadly, the federal government's series of feed-in tariff laws have helped to promote demand for green energy, which has significantly benefited cleantech firms in Munich and other metropolitan regions. The Renewable Energy Law (EEG) was introduced in 2000, and allows homeowners and businesses to sell back renewable energy to the national grid at a fixed price legally guaranteed of 20 years. This provides a powerful incentive to install solar panels, wind turbines and other forms of green energy. Green energy firms in Munich have benefited both from the EEG and its recent amendments, and from complementary measures implemented at city level:

'The Renewable Energy Law was a giant step ... and has had impacts on all levels. We as a municipality, however, have also developed a range of programmes. As an example, our Energy Promotion Programmes are generating a ten to fifteenfold return of what we put in.'

Hep Monatzeder, Deputy Mayor, City of Munich

Surveys of green industry firms in both Munich and internationally suggest these 'policy push' factors are a critical catalyst for innovation and product development (Triebswetter and Wackenbauer 2008, Chapple and Lester 2009).

4

The success story

'I believe it is really this mix of tradition and progress which makes us successful.'

Prof. Christiane Thalgot, Head of Department of Urban Planning 1992-2007, City of Munich

4.1 Economic success at city level

The Munich strategy seems to have paid off. Civic leaders' 'active state' approach has enhanced the metropolitan region's capacity for innovation, and successfully strengthened the innovation ecosystem. Partially as a result, overall economic performance has also improved (table 5).

Figures 2 and 3 develop these in more detail. Figure 2 shows metro-level productivity since 1980; there is a clear upward spike in the early 1990s and an accelerating-away from the German average. Figure 3 shows an increasing metro-national gap in employment rates from the mid-1990s, although the trend is not as pronounced as the shift in productivity. More efficient businesses need not be so labour-intensive.

Behind the figures, shifts in the innovation system also suggest successful technological upgrading. Table 6 shows Munich metropolitan region's shares of national patenting, compared to some other leading metropolitan regions.

We can see Munich losing patent share during the 1980s, then reversing this from 1990 onwards, overtaking Stuttgart and Rhein-Main metropolitan regions by the 2000s. All regions lost patent share from 2000-2005, but Munich turned this around by 2007.

Figures 4, 5 and 6 break down Munich's innovation performance across the target sectors of the innovation strategy. There is a very strong performance in ICT and cleantech patents, and good performance in biotech patenting. Munich's historic strengths in electronic engineering help its firms stay ahead on ICT patents; biotech shares grow strongly from the early 2000s, and total patenting also rises; Munich firms develop a substantial advantage in cleantech activity from this period too.

Innovative activity is also reflected in entrepreneurship, as new ideas are spun out into new firms. Figure 7 gives some recent data for start-ups. It shows clearly that at city level, Munich's 'start-up rate' has been above the Bavarian and national average for some years now.

Figures 8 and 9 explore two other dimensions to the innovation story. Figure 8 looks at R&D spending, expressed here as a share of GDP. R&D is an important 'innovation input'. Munich metropolitan region's R&D share is much higher than the state or national average, but has stayed stable since the mid-1990s. Since 'innovation outputs' (e.g. patenting) improved during the same period, this suggests public programmes may have helped to improve the innovation system's performance in the metropolitan region.

Figure 9 explores another critical input: human capital. Munich's share of high-skilled science and technology workers is also higher than regional or national comparators, and the disparity has grown since 2002. However, Munich has been more seriously affected by the recent downturn than Bavaria or Germany regarding its technology workforce.

4.2 Economic success in the next urban economy

What are the broader success factors behind Munich's continued high performance?

The international evidence suggests that the development of high-tech regions is at least partly a matter of opportunities, luck and time (Bresnahan and Gambardella 2004). Like Silicon Valley, the Munich metropolitan region has gradually evolved into a high-tech centre, an innovation-building process lasting several decades.

Our evidence suggests two types of success factors for Munich:

- *Hard factors* – economic diversity and strong firms, plus investments in infrastructure and human capital;
- *Soft factors* – an effective 'active state' and the right kind of institutional thickness, especially at State and metropolitan region level.

These factors are summed up in an interview comment:

'I see it as an ongoing contradiction. On the one hand we're promoting a free market economy with a social touch. But under the surface, as it were, we're pursuing a massively interventionist industrial and structural policy agenda.'

Dr. Detlef Straeter, Fellow, Munich Institute for Social and Sustainability Research

We now explore each of these success factors in more detail.

4.2.1 Economic diversity and high value firms

The 'Munich mix' is at the heart of the metropolitan region's continuing success. Economic diversity is important for a number of reasons. As Jane Jacobs explains, it provides cities with long-term economic resilience (Jacobs 1970). Economically diverse urban cores also act as 'nursery cities', promoting ideas flow and allowing new ideas to emerge out of the old (Duranton and Puga 2001). Munich's broad industrial mix, with deep clusters across several sectors, is an excellent example of these dynamics in action – most recently, in the development of green industries in the metropolitan region:

'Innovation, I believe, was an expressed goal. Green Economy, I believe, was more of a by-product.'

Dr. Detlef Straeter, Fellow, Munich Institute for Social and Sustainability Research

'[Green industries] probably came about due to the traditional strengths of the Bavarian Economy. Green technologies did not develop out of thin air, but most likely out of the strong mechanical engineering base.'

Rudolf Escheu, Head of the Department of Economic Policy, Ministry of Economic Affairs, State of Bavaria

Munich's large firms play important roles in the innovation process. Many are world-class with significant in-house research and development facilities; they are also embedded in the metropolitan region's spatial clusters, and evidence shows they have an important 'halo effect' on local SMEs – via supply chain relationships and wider collaboration (Sternberg and Arndt 2001, Sternberg and Tamasy 1999). Inter-firm collaboration within the metropolitan region has been important in the development of both knowledge-intensive business services (Koch and Stahlecker 2006) and biotech (Kaiser 2003, Zeller 2001).

By retaining advanced manufacturing, Munich has also been able to retain a large share of relatively well-paid jobs, and provided employment for lower-skilled workers. This helps both economic resilience and social cohesion.

4.2.2 Critical public investments

State and metropolitan region leaders have supported Munich's firms by investing in the assets that matter most to supporting innovation, strong firms and long term economic growth – human capital and strategic infrastructure.

First, Munich has fed its innovation system from a large pool of skilled labour. In part this comes from excellent higher education institutions (discussed in Section 2). Munich also has a strong public school system – 40% of students qualify for university entry, almost double the Bavarian average.

More broadly, the availability of a skilled workforce stems from German cultural emphasis on vocational education, exemplified in Munich's training programmes. Academic and vocational education are organised as a 'dual system', provided jointly by the state, the city and by private enterprises offering practical training:

'Many [firms] did try and relocate to cheaper production locations, but BMW for instance came back when they couldn't find the technical know-how.'

Prof. Christiane Thalgot, retired Head of the Municipal Planning Department of the City of Munich

This strong education system – Munich is the only German municipality that runs its own schools³ – thus creates a number of feedback loops, helping attract and retain talented workers and their families – and the firms they work in.

Second, investment in physical infrastructure has been important in supporting economic activity. Connectivity is critical within the metropolitan region, which consists not just of Munich and its periphery, but several other second tier cities within 60-80km. As such, metropolitan region leaders have not only needed to connect Munich to its hinterland, but also to connect all firms in the metropolitan region to international markets, and to support the metropolitan region's gradual densification of the outwards from the core.

A number of investments have been key: the 1971 urban rail system, upgraded rail lines linking Munich via Augsburg and Ingolstadt to Germany's high-speed rail network, a series of high capacity motorways, and most notably, Munich's new airport.

4.2.3 Strong and agile institutions

As explained in Section 3, State and metropolitan region leaders have exploited Bavaria's historic 'institutional thickness' to move the metropolitan region forward. At the same time, they have carved out distinctive 'active state' roles.

'When you're a three-man business, you've just started out, you don't have any bookkeeping yet, you have no purchasing department, you have nothing. Then you call your colleague over at a nearby institute or company and say hey, we need a bit of nitrogen. Says he, sure, just come over.'

Enno Spillner, Chief Financial Officer, Pharmaceutical Company 4SC

By 'institutional thickness' in this context we mean four things: 1) close networks between private and public sectors, 2) strong and stable public institutions, 3) political leaders committed to investing in technology and innovative capacity and 4) the clear sense of common purpose and desire for innovation that results from all this. For example, the City of Munich (led by a red-green coalition) and the State of Bavaria (run by the conservative CSU and the liberal party) have governments of different political complexions, but have focused on common interests that cross party lines. This enabled state agencies to bring key people together, bonding them through shared economic development activities. And as the quote above suggests, co-operation extends from the highest-level strategy through to the business of everyday life.

Table 5
Key performance measures for Munich metro*, 1991-2008

		1991	1995	2000	2005	2008
GVA per worker	Munich metro	32,078	55,043	58,976	61,944	64,625
	Germany	30,436	48,191	47,421	49,823	51,522
Employment rate	Munich metro	74.1	71.3	81.6	81.5	83.9
	Germany	64.0	62.1	70.0	70.4	74.0
% unemployed	Munich metro	4.8	5.0	3.0	5.8	3.3
	Germany	8.8	9.4	8.0	11.1	7.5
Population ('000s)	Munich metro	3,801	3,959	4,034	4,211	4,313
	Germany	79,753	81,539	82,163	82,501	82,218

Source: Cambridge Econometrics, Eurostat. *Note: Munich Metro is approximated by Oberbayern NUTS2 area

Table 6
Metro shares of national patenting, 1980-2007

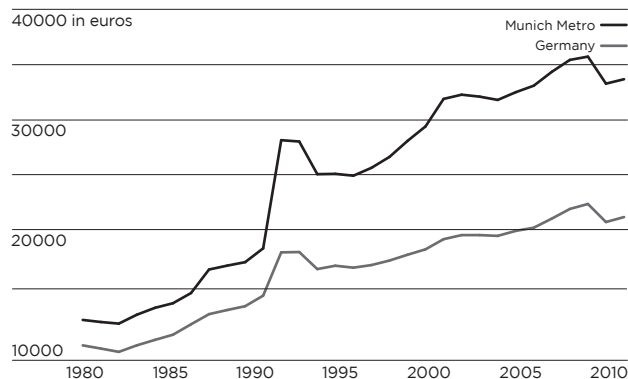
	Munich	Stuttgart	Rhein-Main	Hamburg
1980	11.60	7.42	20.21	2.52
1985	11.52	9.11	17.27	2.86
1990	10.90	12.20	17.25	2.76
1995	12.32	12.44	17.53	3.25
2000	13.92	13.68	13.69	3.30
2005	12.04	13.54	13.39	3.60
2007	12.82	13.17	12.88	3.25

Source: OECD.Stat.

Notes: 1) Patents to EPO, by inventor region of residence. 2) Patents by priority year. 3) Spatial units are German Metropolitan Regions, proxied using best-fit Spatial Planning Regions. 4) Table gives a sample of the 11 Regions, so shares will not sum to 100

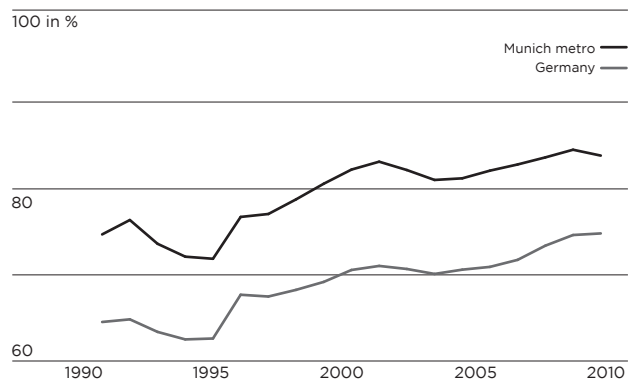
Figures 2 and 3
Metro productivity and employment rates, 1980-2010

Figure 2
GVA per worker 1980-2010



Source: Cambridge Econometrics, Eurostat
 Note: Munich Metro is approximated by Oberbayern NUTS2 area

Figure 3
Employment rate 1991-2009



Source: Cambridge Econometrics, Eurostat
 Note: Munich Metro is approximated by Oberbayern NUTS2 area

The Bavarian sense of common purpose includes a strong emphasis on the 'active state'. As Dieter Laepple suggests, at different times government has been happy to take on 'problem-solving' functions (for example, the Bavarian State government bought company shares in the 1970s to prevent job losses), as well as 'proactive' and 'enabling' functions (such as developing the Future Bavaria vision, and selling off shares to fund it).

The 'active state' also expresses itself through the technological orientation of public officials, especially the 'geeks in government' at city and state level. More broadly, it includes strategic state actors like Stadtwerke Muenchen (SWM), the city's integrated public utilities company and the seventh largest energy company in Germany (see Example 3). SWM's ownership structure allows it to consider very long term time horizons – and so it is able to both make long term, future-facing investments, and to actively shape demand in emerging energy sectors, such as low-carbon and renewable sources.

Another important tool in the city's box is ownership and control of land. The city has an activist planning regime, aiming to be 'compact, urban and green', in the words of Munich's planning department. The cheap purchase of

ex-military sites in the early 1990s, part of the peace dividend, provided it with an important strategic land portfolio during the implementation of the innovation initiatives discussed above.

As the city government recognizes the value of maintaining a mix of uses, including small craft and manufacturing businesses which are regarded as the basis for advanced manufacturing, it seeks to provide spaces for such uses to avoid a monofunctional city centre. To this end it devised a strategic land management tool in 2000, the so-called 'industrial and commercial land development programme'. It is based on two main approaches: by specifying a range of commercial land typologies in the preparatory land use plan to help preserve existing uses, and by developing inner city land for commercial use as replacement for losses incurred. This strategy extends to areas for 'new economy' uses: IT, media, biotech etc., and may involve mixing zones for traditional and 'new' industry to allow for synergies between the two. One such example is the 'Messestadt Riem' ('trade fair city Riem') where two commercial zones were developed, one for traditional commercial, one for 'new economy' uses. Overall, developing a long-term strategic urban planning vision for industrial and commercial uses provides an important source of information for businesses' location strategies.

4.2.4 Wider issues

A number of other 'soft factors' have also helped retain skilled people and businesses in the metropolitan area, even if the evidence suggests they have not actively driven forward economic development. The very high quality of life in the city of Munich – public space and cultural life in particular – and the city's surroundings are obvious pulls:

'The natural beauty of Lake Starnberg and Mount Zugspitze right on your doorstep naturally makes it very attractive to live here and to stay here.'

Dr. Johann Niggel, Executive Director, Invest in Bavaria, Ministry of Economic Affairs, State of Bavaria

Conversely, the metro's economic success has raised the local cost of living, particularly for housing. The city's population has been rising continuously since the year 2000, raising competition for space. The suburbanisation of key firms and business clusters during the past decade is partly a response to these ongoing challenges.

'Those that came here, that were poor, that had potential but were not so visible at first glance, were very much always taken care of here. What I mean is that Munich has a very stable social basis.'

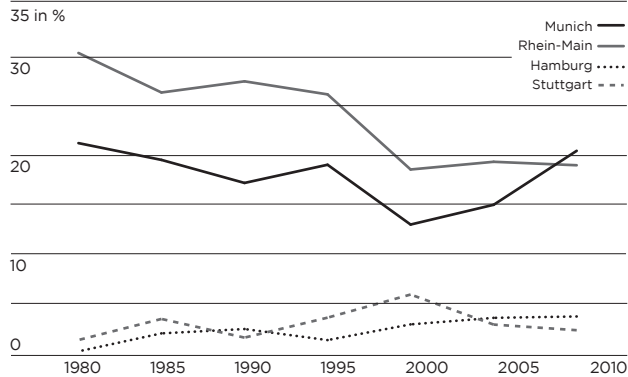
Prof. Christiane Thalgott, Head of Department of Urban Planning 1992-2007, City of Munich

Finally, a number of interviewees mentioned the importance of social cohesion and inclusion in Munich, a kind of 'Munich mindset' that informs a range of public policies (including public education, social housing and social care programmes). This progressive attitude reflects and reinforces the city's long history of left-of-centre politics; more broadly, it reflects Munich's historical development as a 'Millionendorf', a city with a village outlook, and until relatively recently, an artisanal centre in a rural region.

3 Hamburg and Berlin have their own schools as part of their status as Federal States

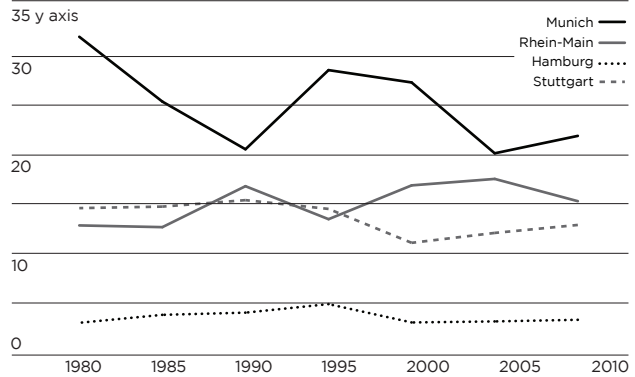
Figures 4-7 Innovation performance: patenting and start-ups

Figure 4
Metro's share of German biotech patents 1980-2007



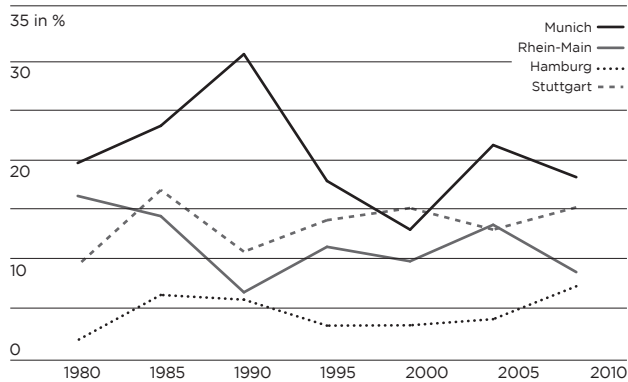
Source: Statistisches Bundesamt, OECD.Stat.
Notes: 1) Patents to EPO, by inventor region of residence. 2) Patents by priority year.
3) Spatial units are German Metropolitan Regions, proxied using best-fit Spatial Planning Regions. 4) Sample of metros, so shares will not sum to 100

Figure 5
Metro's share of German ICT patents 1980-2007



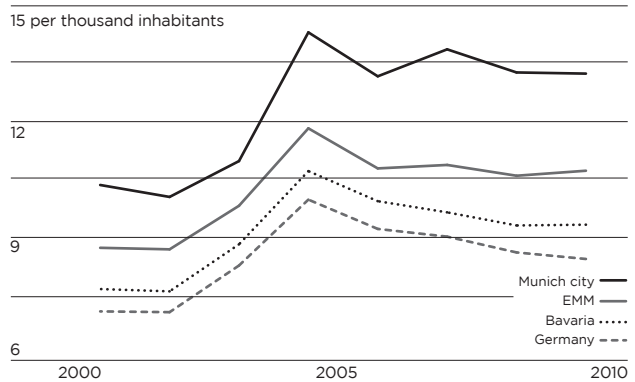
Source: Statistisches Bundesamt, OECD.Stat.
Notes: 1) Patents to EPO, by inventor region of residence. 2) Patents by priority year.
3) Spatial units are German Metropolitan Regions, proxied using best-fit Spatial Planning Regions. 4) Sample of metros, so shares will not sum to 100

Figure 6
Metro's share of German cleantech patents 1980-2007



Source: Statistisches Bundesamt, OECD.Stat.
Notes: 1) Patents to EPO, by inventor region of residence. 2) Patents by priority year.
3) Spatial units are German Metropolitan Regions, proxied using best-fit Spatial Planning Regions. 4) Sample of metros, so shares will not sum to 100 5) 'Cleantech' is defined as renewable energy, electric and hybrid vehicles, energy efficiency in buildings and lighting

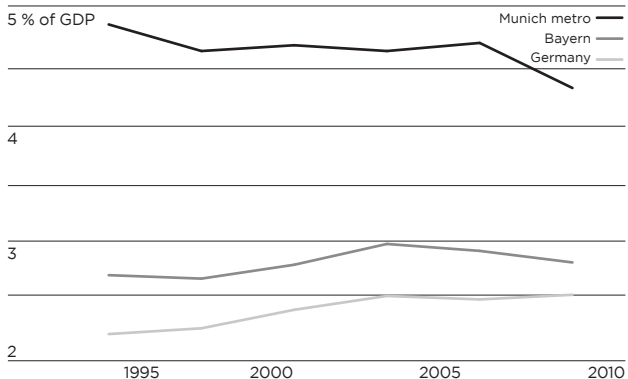
Figure 7
Start-ups per thousand inhabitants 2001-2008



Source: Statistisches Bundesamt, OECD.Stat.
Notes: 1) Patents to EPO, by inventor region of residence. 2) Patents by priority year.
3) Spatial units are German Metropolitan Regions, proxied using best-fit Spatial Planning Regions. 4) Sample of metros, so shares will not sum to 100

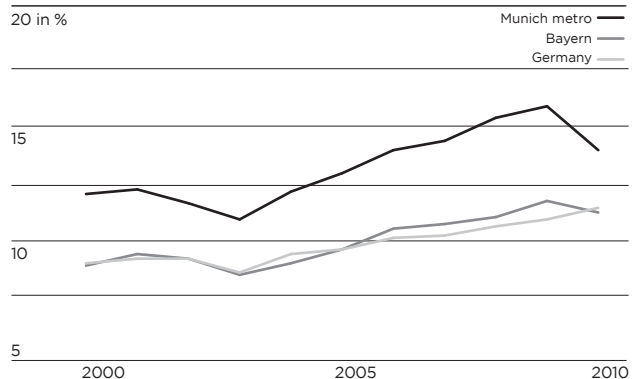
Figures 8-9 Innovation inputs: R&D and science and technology workforce

Figure 8
Research & Development spending 1995-2007



Source: Eurostat.
Notes: 1) GERD measures total public and private sector R&D spend.
2) GERD is expressed as a share of GDP.

Figure 9
% Skilled science & technology workers 1999-2009



Source: Eurostat.
Note: Eurostat defines 'core HRST' as workers who a) are educated to degree level or above, and b) are employed in a science and technology occupation as Professionals' or 'Technicians and associate professionals'

Example 1 Campus Garching

5,000 scientists
10,000 students

Garching is a small town of about 15,000 inhabitants to the north-east of Munich, a few kilometers from Munich Airport. It houses one of the most prominent universities and research campuses in Germany, home to the country's first nuclear reactor, the headquarters of the European Southern Observatory (ESO), Munich Technical University's (TUM) faculties of Physics, Chemistry, Electrical Engineering and Information Technology, amongst others, as well as a range of high profile research institutions such as the Max Planck Institute for Plasma Physics and the Leibniz Computer Centre. As well as extensive public research, private business-led research is conducted here, with General Electric's only European research centre based in Garching.

History of Cluster Development

In 1957 Germany's first nuclear research reactor was opened in Garching. This is commonly perceived as the catalyst of Garching's perceived status as a desirable science and research location. It laid the foundation for the internationally recognized neutron research conducted in the

town under the guidance of TUM scientists. This tradition continues with the highly contested opening of FRM-II in 2004, a new research reactor and one of the world's most powerful neutron accelerators, supported by €225m from the Future Bavaria Initiative. This research is applied, amongst others, to the field of medical technology and helps secure Garching's position in the international science community by attracting high-profile researchers from around the world. According to Dr. Gerd Gruppe, Head of the Department of Innovation, Research and Technology at the Bavarian Ministry of Economic Affairs, realising this project despite significant political resistance at the federal level required 'unity amongst politicians and administration (...), you need people that are convinced of what they are doing.'

In the late 1990s the University relocated its key science faculties to Garching and opened a state-of-the-art mechanical engineering faculty here. As part of the State of Bavaria's High-Tech Initiative, the Garching Technology and Entrepreneur Centre (GATE) was opened on Campus in 2003. It aims

to provide support for young high-tech companies, particularly in the ICT sector, and to strengthen the 'Science Cluster' Garching. Stakeholders from Munich and Garching public administration, Bavarian State Banks as well as the engine manufacturer TUM are shareholders in this venture. Garching was further strengthened by the opening of the Leibniz Computer Centre, which operates a national supercomputer funded by HTI and is open to research for all German universities. In 2006 the underground line was extended to the Campus, providing a direct connection to the centre of Munich in less than half an hour.

Drivers of Cluster Development
Undoubtedly, the development of the Science Cluster Garching is the result of a combination of State and Federal policies, the location of Max Planck Institutes being determined at the Federal level whereas higher education issues are dealt with by the Regional government. At the same time, the City of Munich contributed to the attractiveness of the location by connecting it to its fast and reliable public transport system, operated by its Municipal

Example 2 Campus Martinsried/ Grosshadern

Over 190 firms
13,000 employees

Munich's biotechnology sector is concentrated in Martinsried, a neighbouring rural community where more than 190 biotechnology companies and several high profile research institutes are located (BioM AG 2007). High-profile organisations include the Max Planck Institutes for Biochemistry and Neurobiology as well as the Gene Centre of Ludwig Maximilians University Munich (LMU) in adjacent Grosshadern. The LMU has also recently relocated its faculties of Chemistry, Pharmacy and Biology to Martinsried, establishing a life-sciences campus with about 6,000 scientists from various departments. Currently the cluster has Europe's second-highest concentration of Biotech companies, exceeded only by London.

History of Cluster Development

The establishment of the Max Planck Institute of Biochemistry (1973) and the LMU Gene Centre (1984) formed the basis for the development of the Biotechnology Cluster Martinsried. The campus was first established in the 1970s when the Max Planck Society, in search of a location for its new Institute of Biochemistry, chose Martinsried due to the availability of space in the vicinity of Munich and of the new Clinical Centre of the LMU. More recent German Federal and Bavarian State policy to

promote the commercialisation of scientific research led to significant funding to improve physical as well as networking infrastructure. The Federal Government's BioRegion Competition is regarded as a milestone in German technology policy in its approach to encourage regional collaboration of various stakeholders. Initiated in 1995, it was designed to support regions with the greatest existing potential and density of research institutions. Interdisciplinary teams from universities and other research institutes, regional government, private enterprise and venture capital firms were encouraged to develop business plans for their region. Out of 17 entries the Biotech Region Munich/Martinsried was chosen as one of three winners and awarded €12.5m in funding. Possibly the greater effect of this competition has been strengthened collaboration between key players in the region. Two major players have since become the foundation of new developments in Martinsried. First, the Innovation and Start-up Centre Martinsried (IZB) which was established in 1995 and provides state-of-the-art office and laboratory facilities to biotech start-ups on campus, thus facilitating knowledge transfer and networking between budding

entrepreneurs and the research institutes. Its main shareholder is the Bavarian Ministry of Finance. Second, the central agent promoting the Munich Biotech Cluster and acting as a broker between start-ups and venture capitalists is BioMAG. Founded in 1997, again in the context of the BioRegion Initiative, it raises seed capital for start-ups, advises on public grants, business planning, patenting and licensing issues and promotes networking activities. The OZB of the Bavarian State provided significant funding.

The Role of Venture Capital

The commercial success of the Biotech sector, more than of most others, depends in no small part on the availability of venture capital. While changes in Federal legislation in the 1990s and the growth of the venture capital market in Munich due to the region's wider economic prosperity provided great impetus to the growth of the Biotech sector in the late 1990s, the availability of seed capital has dried up significantly in the last years. Tighter public budgets make it increasingly harder for the Bavarian State to fill in where the private market fails. This may be one of the greatest challenges the Biotech Cluster Martinsried will have to face in the future.

Example 3 Stadtwerke Muenchen

7,500 employees
4.9bn annual turnover

Stadtwerke Muenchen (SWM) is Munich's utility company and Germany's seventh largest energy company in turnover terms. Its portfolio includes the city's gas, electricity and water supply, the operation of district heating systems as well as public transport and public swimming pools. It recently expanded into the internet and communications sector.

Company Structure

Unlike most other cities in Germany, Munich did not privatise its utility company, instead opting to keep it in public ownership while running it as a private for profit enterprise, in the process transforming it from a loss making public enterprise to a profitable firm with double the previous sales volume. The City now benefits both financially and from SWM's critical role in delivering strategic policy objectives. Financial benefits amount to approximately €400 million annually, made up in equal shares of SWM's dividends, local trade tax, a commission fee as well as the operation of the city's public transport and swimming pools. SWM's broader contribution lies in pursuing strategic goals set by its board, chaired by the Mayor of

Munich and staffed by city officials. As Dr Florian Bieberbach, CFO of SWM puts it, 'The city's backing makes it possible for us to invest massively in future infrastructure today with much longer payback periods than most private companies could sustain.' To further shield against inefficiencies external supervision by technical experts will be introduced.

Fibre Optic Initiative

The so-called Fibre Optic Initiative demonstrates the strategic possibilities of a municipal utilities company. SWM is investing more than €200 million to set up high-speed internet connection to every household within the denser urban core - some 60 to 70% of households. This will provide individuals and SMEs with an infrastructure usually available to major companies only, of particular advantage to the media sector. As one of the few cities able to implement such a policy Munich gains a real competitive edge.

Renewable

Energy Supply/ Internationalisation
SWM's move into renewable energies is being driven wholly by

political targets to produce the equivalent amount of Munich's energy consumption using renewable sources by 2025. The side-effect of this policy is the internationalisation of the company. Committed to producing energy where it is most efficient it has set up subsidiaries in various countries to exploit local sources of renewable energy such as off-shore wind farms in the Irish Sea (UK) and North Sea (Germany), on-shore wind parks in Germany and solar-thermal energy in Andalusia (Spain). By 2025 SWM will have invested some €9 billion in renewables. Furthermore, the company is moving into gas exploration in the Norwegian, Danish and British North Sea, providing the income necessary for Munich's own supply thus guarding against the financial risk associated with Gazprom's factual monopoly in Europe. SWM continues to innovate in its own field of expertise such as district heating and combined heat and power generation. Overall, SWM demonstrates an impressive level of innovation as a company moving into new sectors and countries, based on a sound appraisal of its own strengths and weaknesses.

5

The financial crisis and future perspectives

The recent recession has hit Munich's tradable sectors, with both BMW and Audi hit by higher oil prices and lower orders, although demand from Asia has picked up since 2008. In finance, Munich's Hypo Real Estate could only be rescued by €14.0bn state guarantees, and failed the European Central Bank's recent 'stress-testing' exercise (Reuters 2010). Bayerische Landesbank, a publicly owned bank, was also severely impacted by the downturn, and its misfortunes are now considerably straining the State's budget. However, insurance firms Allianz and Munich Re have weathered the crisis successfully.

Looking forward, city leaders are focused on two main economic development fields. The first is 'e-mobility' – a cluster of activities including low-carbon and electric vehicles, electric car grids and the next generation of high-speed rail. The second is 'future infrastructure' – the city plans to have 100% renewable electricity supply by 2025, and the SWM is developing an ultra-fast fibre optic network in anticipation of future commercial and household demand.

'The economic benefit for Munich will come short-term but for us as a company the fibreglass infrastructure as well as the investments in renewable energy won't pay back before 15 years time or longer. Infrastructure is a business that requires long-term investors. Our advantage is that we as a city-owned company can think very long term, unlike most private companies who are driven by short-term objectives. Our experience has shown, however, that very long-term investments can be highly profitable - not only for the Munich Metro but also for us as a company.'

Dr. Florian Bieberbach, Chief Financial Officer, Stadtwerke Muenchen (Munich Public Utility Company)

Regional co-ordination is also improving. The Munich metropolitan region was only formally established in 2001, and in the years to come should help improve strategic co-ordination across the wider metropolitan region, as it moves into the next phase of its economic evolution.

6 Conclusion

The Munich metropolitan region was chosen as a case study for LSE Cities' 'Next Urban Economy Series' based on a range of criteria related to regional economic success and sound economic policy to advance innovation, internationalisation and the green economy. Our detailed analysis of Munich entirely supports this choice as it not only confirmed the region's strong overall economic performance but the crucial role of an active state and city government in shaping related developments.

The 'Munich Story' is particularly strong on innovation and it features the region's strength in advancing its edge even at times when it was challenged by external shocks. But the more recent success also needs to be put in context of a longer-term trajectory of Munich's economy, which in itself is the result of a particular history and historical accidents, path dependence, the continuous sizing of opportunities and strong political leadership. Together, these have led to several factors that underpin Munich's innovation system:

- High human capital, with an above-average share of graduates;
- a critical mass of public research activity – not only in universities, but in numerous public research institutes; and
- a diverse industrial structure – the 'Munich Mix' which covers a range of sectors, global players, and small and medium sized enterprises.

Munich's economic success and capacity to innovate has further been linked to a particularly strong 'service-manufacturing-nexus' – a key characteristic of Germany's economy which is centrally based on interacting knowledge-intensive services and advanced, knowledge-intensive industries.

Our analysis further focused on the region's innovation strategy, which was put in place over the last 20 years mainly by the Bavarian State government. Exploiting strong public institutions and public-private networks, the various initiatives have certainly had an effect. Munich has strengthened its presence in science and advanced manufacturing – while diversifying into new activities, notably biotech and increasingly, 'cleantech' activities such as green energy and low carbon vehicles. And while direct causality between desired outcomes and policy is always difficult to pin down, all interviewees agreed that in this case policy has played a strong role.

Besides the overall context outlined above, there were other critical factors that facilitated effective government intervention. These factors helped produce what we call 'institutional thickness', which in addition to a critical mass with a rich mix of high-value economic activity, high-quality universities and a network of public research intermediaries include:

- Political stability at both the state and city government level;
- strong interventionist traditions and a cadre of technically-educated personnel in public agencies; and
- connected elites with multiple connections between heads of the business, university and public research communities.

Combined, these factors have helped build a powerful policymaking machine. We identified four key characteristics:

- Strong and stable public institutions, with competent administrators and good public services;

- productive public-private relationships promoting formal and informal idea exchange and collaboration;
- a commitment to technology – making long-term public investments, even when this is politically unpopular; and
- common purpose and flexibility – the ability to set out and stand by overall strategies, and to fine-tune initiatives quickly when conditions change.

Unlike many other city-regions, Munich does not have formal metro-level leadership or institutions. Despite this 'institutional gap', political and business leaders have been extraordinarily successful at articulating a clear vision and programmes. Behind this, Germany's 'active state' approach has allowed Federal, State and city public agencies to make and shape new markets, especially in the green economy.

Certainly, the broader success factors behind Munich's continued high performance go beyond specific economic development programmes. These include the above mentioned economic diversity and strong firms, but also investments in infrastructure and human capital. It is the region's continuous commitment to its education system, which includes inclusive schooling and vocational training as well as competitive higher education, an efficient urban transport system, its international airport and intercity rail as well as land-management that allow the Munich Mix to flourish. But it is also on these broader issues that state and city government ultimately have a common agenda.

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List of interviewees

- Florian Bieberbach**, Chief Financial Officer, Stadtwerke Munich (Munich Public Utility Company)
- Bernhard Eller**, Economist, Department of Labour and Economic Development, City of Munich
- Rudolf Escheu**, Head of the Department of Economic Policy, Ministry of Economic Affairs, State of Bavaria
- Dr. Gerd Gruppe**, Head of the Department of Innovation, Research and Technology, Ministry of Economic Affairs, State of Bavaria
- Dr. Mathias Lamparter**, Cluster Manager, Bavarian Biotech Cluster
- Hep Monatzeder**, Munich Deputy Mayor, City of Munich
- Johann Niggel**, Executive Director, Invest in Bavaria, Bavarian Ministry of Economic Affairs, Infrastructure, Transport and Technology
- Enno Spillner**, Chief Financial Officer, Pharmaceutical Company 4SC
- Dr. Detlef Straeter**, Fellow, Munich Institute for Social and Sustainability Research
- Markus Strangmueller**, Head of Internal Stakeholder Engagement, Corporate Sustainability, Siemens AG
- Prof. Christiane Thalgot**, Head of Department of Urban Planning 1992-2007, City of Munich