Funding TECHNOLOGY

Germany: better by design?

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With a Foreword by Dr Hermann Hauser CBE, Founder Director, Amadeus Capital Partners Limited

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Abstract

"British and American commentators have been administering the last rites over the European economic and social model ever since British and US unemployment began to fall in the early 1990s, while Europe's stayed stubbornly high, falling only towards the end of the decade. European 'stakeholder capitalism' is being gradually dismantled, runs the argument […] while over-expensive, featherbedding welfare states are being scaled back."

Will Hutton, *The World We're In*[1]

"In the last decade or two, both the social democratic and the libertarian versions of market economics have been challenged by a school of 'new institutionalists', of whom the most prominent member is the Nobel prize winner Douglass North. They pay attention to history and institutions: to questions such as why China has been more successful in moving towards a market economy than Russia."

Sir Samuel Brittan[2]

Traduttore traditore. Translators are wary of *faux amis* or deceptive cognates ("*ich bekomme*" = I receive), and any anglophone interpreter of knowledge transfer in Germany must beware of misleading similarities. After all, many of the same institutions exist, in name at least, and appear to fulfil the same function as their counterparts in America or Britain: incubators, science parks, patent laws, venture funds and (until recently) a "junior" stock exchange. Both English-speaking countries benefited from the ill-wind of history through substantial immigration of leading German scientists 70 years ago. Germans pay us the compliment of treating our language as their own; many have studied in the UK and the US. Our universities share a common inheritance, as in the nineteenth century American colleges were founded, and English ones reformed, along German lines.

But such surface similarities do not take account of subtle differences provided by context and the institutional framework, the cumulative effect of which is to make direct comparisons suspect. For instance, Germany may have achieved its 1995 goal of surpassing the UK in terms of biotech start-ups, but the follow-through is proving much more difficult than expected. Also, whatever the current reality of the mass education system in Germany, much of the self-understanding of universities is still predicated on a Humboldtian view of their mission, however attenuated. Relevant professional journals in Germany are peppered with anglicisms ("angels", "incubators", "limited partner") but these terms can have subtly different implications in the German environment than they might have in either of the Cambridges.

These asymmetries do not operate in one direction only: Germany also benefits from a range of institutions for the advancement and commercialisation of science (such as the Fraunhofer Gesellschaft and the Max Planck Institutes) largely absent in the Anglo-American model. Analysis of the German market is rewarding for highlighting both similarities and differences, for some elements of each model are nevertheless comparable and German experience may serve a minatory purpose for the UK: German business spending as a proportion of GDP (c.1.9%) dedicated to research (UK: c.1.4%); or the seriousness with which education and training are considered.

But differences may be based on fact or misunderstanding: just as in the 1970s and 1980s a myth was rampant in the UK that German banks regularly provided equity finance to small firms, so in recent years a new myth has been gaining ground to the effect that Germany has solved its high-tech problem and is accordingly a role-model for other countries.

1 Hutton (2002) p237

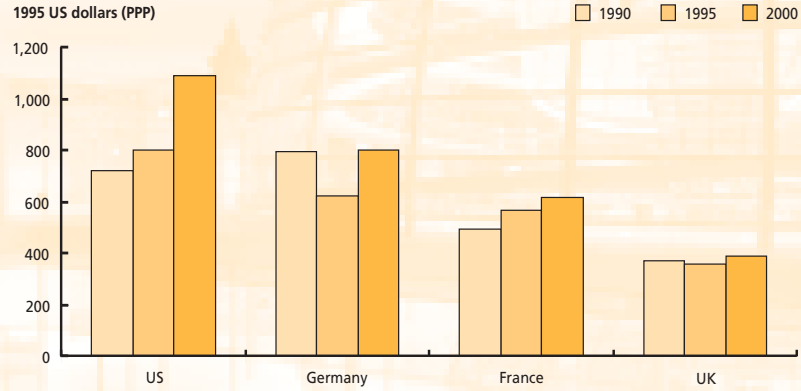
2 Samuel Brittan, "How economics came to rival religious faith", *Financial Times,* 15 August 2002, p11

Germany has a long and successful tradition of scientific research, including 84 Nobel Prize winners. It also has a strong, sometimes pre-eminent, position in industries reliant on the successful application of advanced engineering and technological development, for instance in the automotive sector. Learning – both technical and academic – runs deep in German society, with some 355 institutes of higher education for a population of 82 million, and a long-established apprenticeship system. Exports account for 29% of gross domestic product (UK: 19%); Germany is the second largest exporter in the world and represents 23% of aggregate EU GDP.

Since the mid-1990s, commercial exploitation of the scientific research base has become increasingly prominent on the agenda of German businesses and policy makers. The shift of resources to a more obviously knowledge-based economy came at the same time as the long integration of the Federal Republic of Germany and the former German Democratic Republic. Since the beginning of this change (*die Wende*) with the removal of travel restrictions in East Germany on 9 November 1990, prolonged restructuring of the economy in the *Neue Länder* of the East has required net annual transfers from West to East of more than €60bn in most years since reunification. These transfers should be seen in the context of the wide range of labour market regulations, limited availability of risk capital and numerous government SME support schemes. Can an economy with stagnant growth and an ageing population continue to resist major regulatory adjustment?

Several other unique features of the German market are also under considerable pressure. For instance, the *Mittelstand*, the respected body of (often) "hidden industrial champions", over the past decade has had to confront a deterioration of its collective relationship with banks, succession problems and a growing need for outside investment. Germany supports few internationally recognised business schools or MBA programmes to assist in supplying external management to supplement that brought on within the Mittelstand itself.

Business R&D per worker



Source: OECD

The most controversial aspect of the German model for a British or American commentator is government intervention, such as the Bayern Offensive launched by the *Land* of Bavaria in 1994. From a policy perspective, the extent to which government intervention corrects market weakness or creates market distortion is unclear. The answer may depend in part on how soon the public and private sectors come to a dynamic accommodation. Follow-on risk capital is in short supply and in many areas brutal consolidation of unviable investment portfolios will be required. Innovation since the *Wirtschaftswunder* has tended to be incremental; Germany's social market approach is not obviously receptive to radical change at either the commercial or the political level.

Is Germany now better at technology transfer than it was in the 1980s, or better than its competitors, as a result of a decade of federal and regional government policy and investment? Analysis of numerous initiatives to promote a knowledge economy shows both the impact and the weakness of targeted intervention at the micro level (matched funding for venture investors or entrepreneurship courses at university) where macro issues such as taxation and labour markets are not also tackled. Policy must work within its cultural context and cannot create or design a significantly improved model of innovation through additional incentives without also enabling appropriate adaptation of existing traditions and institutions.

Foreword

"The United States has not yet understood that a purely national economic strategy is an anachronism in today's interdependent world economy. Just as in the areas of foreign policy and security strategy the United States cannot prevail in any corner of the world and certainly not against the Soviet Union without the cooperation of its partners, it must also cooperate with its partners for its own economic welfare."

Helmut Schmidt, *Men and Powers* (1987), p274

"I used to think the DDR was the most bureaucratic country in the world […] I reckoned without the Federal Republic."

Gregor Gysi, former leader of the PDS (the erstwhile East German Communist party), quoted in the *Financial Times*, 31 January 2003, p9

"[…] the whole German educational method – from universal state primary schools to the treatment of science as an essential academic discipline – was to be the envy and inspiration of British schools and universities […] As the nineteenth century drew to its close, the British love of all things German would widen from the intellectual to the middle classes."

A N Wilson, *The Victorians*[3]

Since the mid-1990s, Germany in general and Munich in particular have been increasingly "on the map" of locations rich in technology from an investment point of view. Long-standing virtues – high-quality education and training, superlative engineering, good infrastructure, efficient transport, strong exports – were joined by a wealth of factors favouring the exploitation of Germany's nascent knowledge economy. I witnessed at first hand the growth of business incubation, the emergence of a varied venture capital sector and a range of government measures to support innovation and entrepreneurship.

It was therefore no surprise to find that numbers of science-based start-ups were beginning to outstrip those in the UK. Germany proved notably effective at creating favourable "noise" about its success, and for a while many elements of this new industrial revolution were self-reinforcing. Germany even took to the equity capital markets with the rapid, if brief, growth of the Neuer Markt. But now worldwide conditions for technology investment – quoted or unquoted – have conspired with domestic conditions to call into question the achievements in the innovation sector made by Germany over the past six or seven years.

This report maps the swiftly changing territory of knowledge transfer and investment in what remains a research-rich location at the heart of one of the most economically important regions of the world. The authors identify the reasons for the current downturn as well as describing the circumstances and policies that led to Germany's earlier rapid rise. One of the most important lessons from Germany at this difficult juncture is the fact that the German phenomenon is still so young and should only be judged accordingly – Silicon Valley has been a key centre for 20 years or more, three or four times as long as Munich or Mannheim. Policy-makers and entrepreneurs alike are aware of the difficulties, and much consideration and enthusiasm are being dedicated to ensure that Germany can benefit from the next upturn in technology markets.

Dr Hermann Hauser CBE
Founder Director,
Amadeus Capital Partners Limited
Cambridge, April 2003

3 Wilson (2002) p350

Preface

"Germany Shuts Down High-Tech Stocks."

AP News Service, headline 26 September 2002, referring to the German Stock Exchange's decision to close the Neuer Markt with effect from January 2003. The Neuer Markt had lost 96% of its value since the March 2000 peak.

"Internationalisation is not resisted and is not equated here with globalisation, in contrast with France. But we go first to Austria, then to eastern Switzerland or northern Italy, then we find friends in France and Britain, and then we go maybe to Singapore. Those who went international early often burnt their fingers – they set up in California and failed…"

Leading Munich investor, August 2002

"One of the chief things to impress George Lewes about Germany – and not merely about Prussia – was the advanced state of scientific education. At Munich in 1854, he had worked in the laboratories where 'extensive apparatus and no end of frogs' were put at his disposal. Those very few professional scientists in England would envy the salaries paid to German scientists."

A N Wilson, *The Victorians*[4]

This report is based on a series of some 40 interviews conducted between August 2002 and January 2003 in a range of research-intensive locations across Germany with a cross-section of individuals active in the commercialisation of Germany's science base. As with previous reports in the Funding Technology series (the US and Israel), *Germany: better by design?* is a portrait rather than a snapshot, attempting to put the current technology transfer position in to a broad historical and economic context. We have once again sought to synthesise the competing voices we heard while recognising divergent and incompatible trends. The interviews complement the extensive literature already available on German educational and research policy and on economic performance, especially post-reunification.

Why study Germany? Two separate sets of circumstances combine to make Germany a rich source of material in researching international best practice and policy implications for the UK in the application of technology. First, the German model sharply polarises anglophone commentators between those who believe that 50 years of "social market" policies have led directly to unprecedented peace and prosperity (and by implication will continue to do so), and those who consider that Germany's slowness to implement structural reforms will inevitably lead to economic contraction and even social unrest.

Secondly, the sphere of technology and innovation provides a specific case study of both the impact and the limitations of government policy as opposed to strictly market solutions: in 1995, German policy-makers adopted a target of overtaking the UK as the leading European country for biotech start-ups; this target was reached in 2001 (320 start-ups against 250 for the UK), but many of our interviewees considered that starting up was less challenging than moving on to growth and development.

We are grateful to the numerous German researchers, investors, entrepreneurs, advisers and policy-makers who gave up valuable time to put across the complexities of a system which is directly comparable with the UK model only in part. The fall from grace of the Neuer Markt may have slowed the overall pace of technology commercialisation in Germany, but the depth of its research base combined with the realism of many in the younger generation about Germany's

4 Ibid. p350

Preface

need to adapt nevertheless led many of our interviewees to believe that the market conditions prevalent since around 2001 represent only a temporary set-back. The Neue Länder may yet prove to be one source of strength not yet fully appreciated outside the former East Germany itself.

The research behind this report was undertaken thanks to generous support from The Gatsby Charitable Foundation. We are also grateful to the numerous UK experts who have assisted our enquiry and provided research materials. All remaining errors are the authors' own.

Finally, although all the authors are actively involved in the technology finance sector in the UK, the opinions expressed in this report are those of the authors alone and do not necessarily reflect those of the organisations for which they work or those that have provided support, guidance and advice in its preparation.

Cambridge and London
Gründonnerstag
17 April 2003

Economic and Regional Context

"Under the Weimar Republic Konrad Adenauer also played a significant role in the Prussian Staatsrat, which succeeded the Herrenhaus in its functions. Adenauer never relished the prospect of travelling to Berlin. There is a story that as soon as the sleeper crossed the Elbe, he would pull down the blind and turn his head to the wall. 'Hier beginnt Asien!' he said."

Giles MacDonogh, *Prussia – The Perversion of an Idea*[5]

"Similarly, the German writer Günter Grass, who was born in pre-war Danzig but who has close links with post-war Gdansk, has written of his own learning curve. And he stresses the emotional complications of remembering. When he returned to his native city in 1958, for the first time since the war, an aunt who had stayed behind whispered in his ear: 'Ech waiss, Ginterchen, em Wästen is bässer, aber em Osten is scheener.' (Which approximates to: 'I know Günter, it's better in the West, but it's more beautiful in the East.'*)."*

Norman Davies & Roger Moorhouse, *Microcosm – Portrait of a Central European City*[6]

"Investing in biotech in Brandenburg is like placing a bowl of water in the desert."

Young Munich professional, August 2002

INTRODUCTION

1.1 In the 55 years since the Marshall Plan and the currency reform introduced by Ludwig Erhard (20 June 1948),[7] Germany again became an economic power, with the third largest economy in the world after the US and Japan and one of the highest incomes per head. More recently, numerous factors have caused German economic performance to lag behind those of its immediate competitors: the costs associated with reunification since 1991, inflexible labour markets, an ageing population and high taxes, which together may be considered the downside of the social market approach.

1.2 At the same time, Germany has invested heavily in research and development in both the public and private sectors. The thinking behind recent policy initiatives, such as the legal changes to "professorial privilege" (see Chapter 4) is predicated on an intensification of the application of science and technology to help reverse Germany's relative decline. Innovation policy interacts with a defining feature of modern Germany – regionalism. Each Land of the Federal Republic has considerable autonomy over educational and development issues. Some *Länder*, notably Bavaria, have implemented policies to accelerate innovation and entrepreneurship. It is not yet clear whether such investment will have the desired outcome in building sustainable, profitable, world-leading business.

ECONOMIC WEIGHT

1.3 Without warning, the heavily devalued Reichsmark was abolished in Erhard's cornerstone economic reform. Initially, 10 old units were replaced by one new Deutschmark; the rate was later reduced to 15 to one. Almost worthless savings were replaced by modest

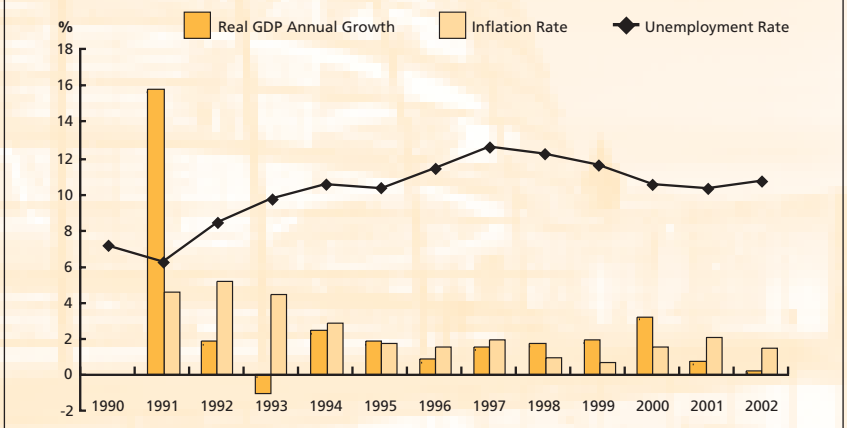
5 MacDonogh (1994) p307. MacDonogh comments: "He borrowed the line from Metternich, who applied it – a little more realistically – to the Landstrasse to the east of Vienna's old city wall"

6 Davies & Moorhouse (2002) pxvii

7 Erhard (1897-1977) had been professor of economics at Munich. He eventually succeeded Adenauer as Chancellor, 1963-66

1 Economic and Regional Context

Economic Performance 1990-2002



Source: HSBC Business Economics; Bundesbank/ECB; Datastream

sums with stable value and real purchasing power,[8] leading to a swift contraction of both hoarding and the black market. Wage and price controls, together with food rationing, were abolished. After an initial swift rise in inflation, prices stabilised. Soon inflation was below that in France or Britain, and from a platform of stability, the physical rebuilding of (West) Germany began. With only occasional hiccoughs, the next four decades were those of the Wirtschaftswunder, or economic miracle.

1.4 Two other major factors of Germany's economic success came together in Erhard's insistence on strong competition rather than a return to "cartels and other restrictive practices"[9] and the openness to foreign trade provided by the creation of the European Economic Community in 1958, though EEC policy caused friction between Adenauer (who welcomed its political dimension) and Erhard (who was concerned that the European Coal and Steel Community would lead to a recreation of pre-war cartels):

"However, although the creation of the Common Market had a distorting effect on the pattern of trade – most notoriously in the field of agriculture – it had the offsetting advantage for West Germany of opening up the two most protected European markets, France and Italy."[10]

1.5 The relative wealth of the new Germany can be readily appreciated from table A. Its overall impact by the time of reunification (which was the catalyst for considerable change in the robustness of the enlarged German economy and in Germany's self-confidence and self-understanding) can be summarised as follows:

"Manufacturing output is 60% greater than in Britain (for a comparable population) and the standard of living 20% higher. The economy has gained added confidence from a stable currency […] And exports in recent years have amounted to as much as 27% of GNP, for German companies have been assiduous in exploiting foreigners' appetites for their finely made products […]"[11]

REGIONAL vs WORLD POWER

1.6 Despite a long period of unprecedented peace and prosperity, resulting in Germany being the third-largest economy in the world, and the most populous in Europe, its international political presence has been muted. This was early on recognised at the highest levels in Germany itself. The legendary Hermann Joseph Abs[12] memorably described the country in the post-war years as "the world's greatest powerlessness."[13] Counterbalancing the lack of centralised power – internal or external – of the federal government in Bonn, regional identity (only partly subsumed beneath a "German" or "national" umbrella after unification in 1871) made a positive return with the renewed importance of the constituent federal states (Land, plural Länder).

8 John Ardagh, *Germany and the Germans* (1995), p21-22

9 Sir Geoffrey Owen, *From Empire to Europe* (2000), p37

10 ibid. p38

11 Ardagh, op cit, p104

12 Dr Abs (1901-94), director of Deutsche Bank, was appointed President of the Bank Deutsche Länder to oversee the allocation of Marshall aid. With some 40 directorships, he was such an influential figure that German corporate law was amended to limit the number of board seats any individual could hold

13 Cited in Werner Meyer-Larsen, *Germany Inc.* (2000) p14. This strand persists in public policy even today: "Joschka Fischer, German foreign minister, yesterday admitted that Germany remains a less powerful player than France on the international stage […] Mr Fischer said: 'It would be entirely wrong to place us in the same rank with France and Britain on foreign and security policy.' It would be 'an illusion' to think that Berlin and Paris were equal, since Germany's 'broken history' meant Berlin was 'in a different situation' to France." *Financial Times,* 22 January 2003, p8

Following reunification in 1990, the five Länder of the East (Brandenburg, Mecklenburg-Vorpommern, Saxony, Saxony-Anhalt, Thuringia) were reconstituted alongside the 11 in the West (Baden-Württemberg, Bavaria, Berlin, Bremen, Hamburg, Hessen, Lower-Saxony, North-Rhine-Westfalia, Rhineland-Palatinate, Saarland, Schleswig-Holstein). See Annex A.

1.7 The political strengths of the Länder are woven into the *Grundgesetz* (basic law or constitution) of the Federal Republic, which is based on the twin themes of the separation of powers and federalism. Each Land has its own constitution, a directly elected parliament, its own government and administrative agencies, and independent courts. Land parliaments have responsibility for education and public order. The implementation of federal law is devolved to Land level (or lower). Although the constitution could be changed with a two-thirds majority in both national houses of parliament, the federal structure cannot be so altered. The Länder nominate the members of the upper house of the federal parliament (the Bundesrat).

1.8 The political and cultural influence of an individual Land has direct implications for innovation policy and its relative success. In the first instance, the quality of education at *Gymnasium* (high school) level was said by a number of our interviewees to vary considerably from Land to Land, with the more rigorous southern states often seen as producing better results.[13a] Secondly, investment at Land level has enabled some federal states to pull ahead in terms of start-ups, incubation and entrepreneurship programmes. The most notable instance is Bavaria, which has reinvested the proceeds of utilities privatisations (*Bayernwerk*) in the early 1990s into a range of technology-oriented programmes under the Bayern Offensive umbrella.

TECHNOLOGY AND PUBLIC POLICY

1.9 Despite enduring professional pride in Germany's many internationally successful major corporations, such as Siemens, Daimler-Chrysler, Thyssen-Krupp, BMW, Volkswagen and the successors to the discredited IG Farben (Bayer, Aventis and BASF[14]), over the past quarter century considerable debate has

TABLE A – Germany: Economic Data

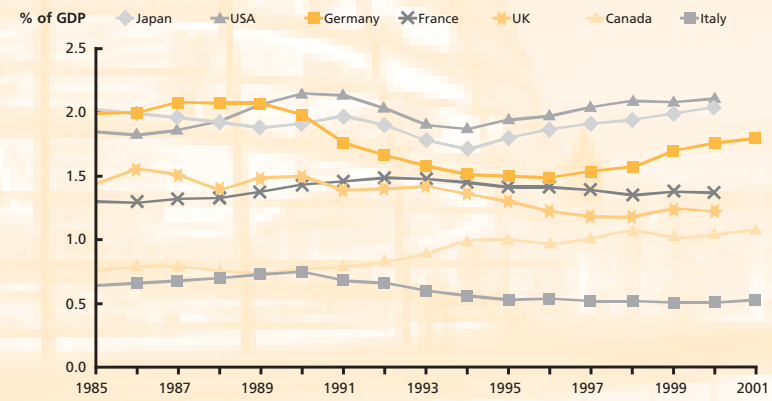
	1998	1999	2000	2001
GDP per head ($ at PPP)	23,702	24,660	25,952	26,680
GDP (% real change pa)	1.96	2.05	2.86	0.57
Government consumption (% of GDP)	19.15	19.15	19.08	19
Budget balance (% of GDP)	-2.2	-1.55	1.18	-2.73
Consumer prices (% change pa; av)	0.91	0.58	1.94	2.48
Public debt (% of GDP)	63.21	60.88	60.81	60.26
Labour costs per hour ($)	26.76	26.18	22.99	23.04
Recorded unemployment (%)	10.9	10.3	9.3	9.6
Current-account balance/GDP	-0.31	-0.85	-1	0.21
Foreign-exchange reserves ($bn)	74	61	56	51

Source: Country data

13a The German school system is three-tiered. After primary school (four years), pupils go on to one of three types of secondary school (based on ability, ultimately at the parents' discretion but on the recommendation of primary school teachers): *Hauptschule*, for another five years, usually leading to jobs that do not require further education or training, sometimes leading to an apprenticeship; *Realschule*, for another six years, generally leading to an apprenticeship or *Berufsschule; Gymnasium,* for another nine years, leading to university or an apprenticeship

14 Badische Anilin und Soda Fabrik. IG Farben or Interessen Gemeinschaft Farbenindustrie (Community of Interests of the Dye Industry) began as a trade association but around 1925 developed into a more formal conglomerate of the leading firms from the late nineteenth century, embracing (in addition to the three firms already listed) Cassella, Kalle and Agfa (Aktiengesellschaft für Anilinfabrikanten). Synthetic dyes originated in 1856 with the work at the Royal College of Chemistry in London by Sir William Henry Perkin, producing aniline dyes from coal tar. At the time, he was seeking to derive synthetic quinine. His work was also influential for the origins of the pharmaceutical industry. Although Perkin opened a factory at Greenford to exploit his discovery, he sold his business to devote himself to research

Business Expenditure on R&D



Source: OECD main science and technology indicators

taken place at the policy level on whether its competitive advantage is becoming technologically obsolete. Consider the following from as early as 1983:

"The technological base that underpinned Germany's economic miracle is quietly becoming obsolete […] Germany today is a nation that cannot make the change from mechanical engineering to bioengineering. It cannot make the leap from precision-engineering the machines of yesterday with their thousands of moving parts and motors to the throwaway electronic devices of today and tomorrow."[15]

1.10 By the late 1990s, many of the constraints governing the entrepreneurial exploitation of Germany's undoubtedly strong research base appeared to be being surmounted through a combination of policy initiatives and market forces, with the growth of seed capital, the launch of the Neuer Markt (or junior stock exchange), as well as numerous state-sponsored programmes to encourage business start-ups in technology sectors and provide equity guarantees. Six years after the launch of the Neuer Markt, however, the key question is whether the recent burst of technology entrepreneurship is simply an exotic historical aberration (and given the scale of the Neuer Markt's fall from grace, one likely to engender a long-term reaction away from equity markets and business innovation) or will form the basis for an enduring move in German industry towards new technology sectors.

MITI vs MIT?

1.11 A recurring feature of the science/industry interface in post-war Germany has been the repeated attempts by government to counter market weaknesses through state intervention. To take one early foray by government by way of example, as Lehrer put it:

"By the 1970s, the Federal Research Ministry even proclaimed that technology policy is structural policy. By *Strukturpolitik* was meant a kind of industrial macro-management, an attempt by central government to steer the national economy toward sunrise sectors and compensate for declining industries (agriculture, steel, shipbuilding). To assist in structural adjustment, 13 large-scale federal research centres were ultimately established in areas ranging from atomic energy and data processing to molecular biology and plasma physics […] Their contribution to industrial innovation was and remains virtually nil. Instead of helping to overcome structural inertia in the German economy, the national research centres added to it. In the 1990s, they continued to consume more than half of institutional R&D support funds dispensed by the Federal Research Ministry […]"[16]

1.12 Beneath the surface, two irreconcilable economic models for development in the high-tech sector were involved – central planning and the free market, or Japan and the US. If at the outset the top-down approach of the Japanese Ministry of International Trade & Industry (MITI) found favour in Germany, by the end of the 1990s the more entrepreneurial achievements of Silicon Valley or the Massachusetts Institute or Technology (MIT) and Route 128 around Boston were highly influential:

"The high-tech policy model […] in the early 1990s was clearly Japan. Indeed, the first German Delphi survey was conducted using a direct translation of the Japanese survey instrument. Some critics went further and advocated the creation of MITI-like agencies

15 B Nussbaum, *The World after Oil: the Shifting Axis of Power and Wealth* (New York: Simon and Schuster, 1983), pp82-84. Cited in Mark Lehrer, "Has Germany Finally Fixed its High-Tech Problem? The Recent Boom in German Technology-Based Entrepreneurship", *California Management Review,* Vol 42, No. 4, p89

16 Lehrer (2000) p94

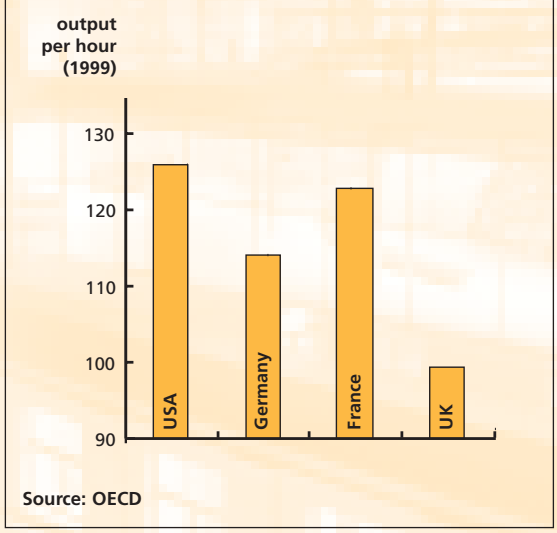
TABLE B – Hours Worked per Employee and Relative Size of the Labour Force			
	US	FRANCE	GERMANY
Average annual hours worked	1960	1630	1580
Labour force/working age population	77%	67%	70%

Source: OECD (latest available)

in Bonn (and Brussels) to coordinate the selection of future technologies for targeted development. Yet within the space of only four to five years, the perspective changed completely. In the light of the Japanese financial crisis and the American high-tech boom, the Japanese model was quickly forgotten (perhaps too quickly) and by the mid-1990s the American pattern of high-tech entrepreneurship became the model to emulate."[17]

1.13 Given both the legal framework and industrial practice, it is difficult to see Germany easily making a clear transition from consensual planning to the free market. The "social market", like federalism, is written into Germany's Grundgesetz.

Productivity



Source: OECD

ECONOMIC REFORM

1.14 Built into Germany's economy are a number of advantages, for instance a consistently favourable trade balance, high levels of productivity (a goal which has eluded Britain for a generation or more) and sustained investment by the business sector in research and development. Investment at the firm level is critical in innovation sectors as it ensures that individual businesses are able to benefit from external or consortium research – their absorptive capacity:

"The extent and the efficiency of knowledge and technology transfer depend not only on the research results and willingness of public institutions to transfer them, but also to a great degree on the ability of the enterprises to integrate external knowledge. This problem, which is discussed in expert circles under the concept of absorptive capacity, is often all too closely linked to the extent of own research and development in the enterprises, ie to technological competence."[18]

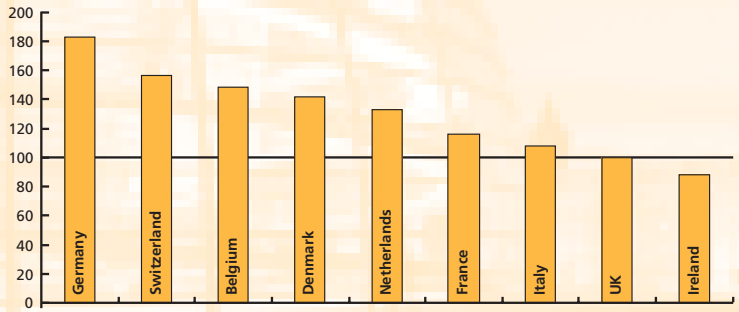
1.15 However, on a number of other levels, Germany has ceased to be in the vanguard in terms of international competition. For instance, productivity is offset by the average number of hours worked per employee and by the low proportion of the labour force vis-à-vis the population of working age. (Late entry into the workforce by graduates is an enduring feature of the German model. Early retirement in much of continental Europe is a form of disguised unemployment, and productivity figures are consequently flattered by including only the most highly trained workers in their prime.) Hiring is restricted by the difficulties of subsequently firing, and the cost of employing a worker in Germany, taking account of non-wage or social costs, is nearly twice the equivalent in Britain or Ireland.

1.16 Introducing "Agenda 2010" in a major address to the German parliament on 14 March 2003, Chancellor Gerhard Schröder proposed a number of measures to counter the country's structural inefficiencies, though

17 ibid. p95

18 Schmoch, Licht & Reinhard (2000), who recognise technology management (eg project steering and incentive structures) as a potential bottleneck in the acquisition of external knowledge in German SMEs

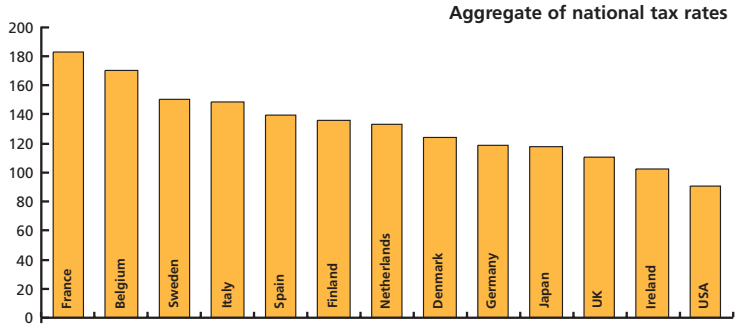
Flexible and Competitive Labour Markets (International Labour Costs)



Source: US Dept of Labor (UK=100)

his stated preference was to "fortify the European social model against the storms of globalisation" rather than to move more radically to a liberal market approach. Proposals announced include: limiting unemployment benefit to 12 months for workers under 55 (18 months for older workers); a reduction in employment protection for those working for small firms; a simplification of the tax code for SMEs and regulations affecting the handicraft sector; and allowing deviation by companies, in agreement with their employees, from industry-wide wage agreements. This is a substantial package of reforms for which to legislate and which, even if implemented as proposed (many trade unions are bitterly opposed), will need time to take effect. Legislation is also currently being enacted to implement the recommendations of the commission headed by Volkswagen Personnel Director Peter Hartz, which reported in August 2002 *inter alia* in favour of the "Ich-AG" project to bring workers out of the grey economy by improving the terms for low-paid self-employment.

Competitive Tax Framework Tax Misery Index 2001 – All Taxes Combined



Source: Invest UK

GRADUAL OR RAPID REFORMS?

1.17 If there is considerable agreement that Germany must reform much of its welfare practice and deregulate its labour market, there is less consensus on whether changes are likely to be brought about gradually or only as a result of severe economic necessity. In this, our interviewees mirrored the debate among economists.

1.18 On the one hand, the "gradualists" take the view that Germany has proved notably adaptable over the past 50 years, and circumstances favour a smooth transition to a more flexible market with fewer social benefits and safety nets. One of our interviewees, a technically qualified venture investor with many years of experience in the US put it this way:

"This is a generational issue. The current generation has been strongly influenced by those who grew up in the immediate post-war era of the Wirtschaftswunder. Their style is consensual, conservative and affects both business and politics. The last of this generation will have left power at the September (2002) election. Students leaving university today know that they cannot expect to work for one firm all their lives, and therefore must be responsible for their own careers and pensions. Above all they do not trust the state to provide a pension."

1.19 Similar observations at both firm and society level come through in the academic debate on Germany's ability to change. Reviewing the twin issues of the need for companies to adapt scientific advances to their own processes and technologies while at the same time incorporating radical innovation in newly emerging technologies, Harding and Soskice conclude:

"In addressing both these problems, the German system generally and technology policy in particular appears remarkably suitable for sustaining the country's traditional strengths in producing hi-tech and high value-added incremental innovations and adapting itself, albeit relatively slowly, to exogenous paradigm shifts. The inherent dynamism of the system is such that it can successfully

incorporate both markets and new innovations. What is remarkable about the German system is its capacity to anticipate and pre-empt changes and to adapt appropriately when the need arises. We see no reason to doubt that this trend will continue."[19]

1.20 On the other hand, another interviewee (with a similar background in technology ventures and with similar international experience) took the opposite view:

"There are relatively few spin-offs. It is difficult to foster entrepreneurial activities, people play safe […] the social security net is still strong over here. And the tax on successful start-ups is more than 50%."

1.21 He took the view (in August 2002) that some drastic bad news would be required to shake German society into taking painful decisions on social benefits and employment protection. The city of Munich had just declared itself bankrupt "but this is just gesture politics''. Such views are also confirmed by economists:

"Perhaps Germany needs a declinist debate. British declinists […] were at their most vociferous just before Britain started to tackle its structural problems under Margaret Thatcher […] The Germans, still with a much higher level of per capita income than Britain's, will need to be terrified if they are to confront the economic challenges ahead."[20]

1.22 Although Germany is in breach of the Euro stability criteria, it is unlikely that intervention by European regulatory authorities will be decisive, given that a number of other countries (France, Portugal, Italy) are also in or near breach, and the relevance of the stability criteria themselves has recently been challenged by the President of the European Commission, who called them "stupid".[21]

STRENGTHS AND WEAKNESSES OF REGIONALISM

1.23 Given the political and financial investment in regionalism, notably through the creation of Regional Development Agencies since 1999, it is sobering for the UK to consider the extent to which long-standing devolution may have indirectly held back the growth of successful technology-based industries in Germany, though it should be stressed that a number of other factors, including regional "brand" recognition and physical and cultural proximity to the US and world markets play a role here as well. One of our interviewees, now responsible for regional life-sciences initiatives but formerly an employee of a major pharmaceutical company, with extensive experience of the US market, put it this way:

"The clear number one in Europe is the Golden Triangle.[22] US corporations find it easier to go to Ireland or the UK and stay with one language and legal system. In pharmaceuticals there are also important concentrations around Copenhagen/southern Sweden, also Basle-Freiburg-Strasbourg, but Germany is fragmented. Munich is in first place, followed by Berlin/Brandenburg, then Frankfurt-Heidelberg-Mannheim (though even they are hampered by being in different Länder), then North Rhine Westphalia, covering Cologne, Düsseldorf and Aachen. How you benchmark (a cluster) depends on different measures, from turnover to number of employees. Either way, US biotech commercialisation is 20 years ahead. There are 25,000 people working in the quoted biotech sector in the Bay Area, 250 in Berlin, with perhaps 3,200 in the unquoted Mittelstand sector [...]

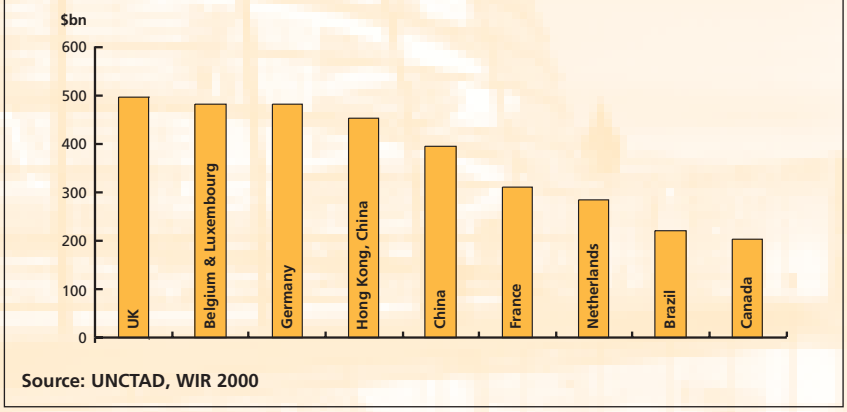
19 Rebecca Harding and David Soskice, 'The End of the Innovation Economy?' in Harding and Paterson (eds) 2000, p99-100

20 John Plender, *Financial Times,* 18 October 2002, p21. See further, for instance, *The Collapse of British Power,* Correlli Barnett, Alan Sutton Publishing, Gloucester, 1972; *English Culture and the Decline of the Industrial Spirit 1850-1980,* Martin Wiener, Penguin edition, London 1981; *Capitalism, Culture and Decline in Britain 1750-1990,* WD Rubinstein, Routledge, London 1993

21 "Jacques Delors […] regarded it as 'serious' that the Commission had been sidelined when France and Germany agreed a deal last October on the future of EU farm policy. Others have railed against [Romano Prodi's] 'gaffes', such as his description of the EU's stability pact as 'stupid'. *Financial Times,* 3 April 2003, p6. The Euro was introduced on 1 January 1999. From that date the DM became a denomination of the Euro and the rate was irrevocably fixed at EUR 1 = DM 1.95583. Euro notes and coins were launched throughout the eurozone on 1 January 2002. Simply put, the "stability and growth pact" provides that constituent members of the Euro should not incur deficits of more than 3% of gross domestic product. The European Central Bank also targets an inflation rate not exceeding 2%

22 of Cambridge, London and Oxford

Top Ten Global Recipients of Overseas Direct Investment 2001 (Excluding US)



Source: UNCTAD, WIR 2000

"A marketing lacuna operates at two levels. At the cluster level, people do not think to promote Berlin as an entity – by contrast, US investors know of Munich and Heidelberg. When money is short, people save on marketing, and they only had small budgets to promote the region as a cluster in the first place. Secondly, at the company level, there is little spend on marketing or business development. This is a mistake – GSK must have heard of you at least when you approach them with a proposal. You simply can't say we'll build a product then sell ourselves."

1.24 This observation at regional level is borne out by a national study:

"[...] the national innovation system in Germany is in fact influenced by several regional innovation systems which are quite different in nature, and which subdivide a supposedly homogeneous country into many subsystems of innovation – each having specific impacts on regional economic development but, at the same time, each being influenced by the national innovation system itself […] The regional level plays a role in the explanation of innovation processes (stemming from the cooperation between public research and business in the economy) that should not be neglected in a nation with a relatively balanced spatial structure like Germany […] In states like Bavaria and Baden-Württemberg positive effects for the regions' economies were undoubtedly triggered by the interaction between state and federal policy. Fundamentally, the problem remains that the national level does not consider the regional effects of its measures sufficiently, and coordination between federal, state and community programmes is minimal."[23]

"GERMANY, INC"

1.25 Just as at the small firm level a number of more "American" features such as venture capital have begun to appear on the German commercial landscape over the past decade, so a number of commentators see a similar shift at the level of established corporations, household names such as DaimlerChrysler, Volkswagen, Allianz, Lufthansa and Deutsche Bank. Especially since several leading companies have made major acquisitions in the US:

"Now Deutschland AG is turning into Germany, Inc. It is no longer aiming at the old, firmly established home base, but at the United States."[24]

1.26 The problem for such corporations, especially those like DaimlerChrysler or Deutsche Bank that are listed on the New York Stock Exchange and are subject to international accounting conventions, is that they are now competing with American and other international firms for capital and other resources. The older, more clubby and less transparent style of German capitalism, with numerous cross shareholdings and directors common to banks and their customers, will be less and less relevant in a world where many leading German public companies embrace "shareholder value". It is difficult to see how the social market as traditionally understood can survive a commitment to enhancing shareholder returns.[25]

23 R Sternberg (2000). "University-Industry Relationships in Germany and their Regional Consequences" in *Regional Innovation, Knowledge and Global Change,* edited by Zoltan. J. Acs, Pinter

24 Werner Meyer-Larsen (2000) *Germany, Inc. – the New German Juggernaut and its Challenge to World Business,* p32

25 "The number of companies listed on the stock market has increased very slightly as has listing on foreign markets, and the proportion of shares owned by foreign institutional investors increased from 4% in 1990 to 13% in 1998." Lane (2003) p13. Listings may not be relevant for the foreseeable future: NASDAQ Deutschland had attracted no entrants at its launch on 21 March 2003, despite some 250 companies on the Neuer Markt not having found alternative listings following the NM's 2002 year end closure

1.27 Limited corporate reorganisation was envisaged as a matter of public policy. Because many cross-shareholdings, particularly those owned by banks, dated back to enforced corporate reorganisations in the 1930s or 1950s, subsequent capital appreciation would have led to punitive taxes on gains in the event of realisation. Capital gains tax breaks became effective in 2001 to encourage corporate reorganisation, *inter alia*. However, subsequent events have overshadowed policy:

"Commerzbank's unrealised gains of €180m at the end of last year have become unrealised losses of some €1.9bn. HVB's equity gains of €4.2bn are estimated to have shrunk to €180m."[26]

SUMMARY: INSTITUTIONAL FRAMEWORK

1.28 So numerous are the differences between the German model and the circumstances of knowledge commercialisation in the US or the UK that it is tempting to fall back on "culture" as a broad explanation for their cause. However, a more tangible answer may be provided through the German practice of establishing formal institutions to deal with many issues (the Fraunhofer Gesellschaft for technology transfer, BioRegio competitions for the allocation of challenge funding, PUSH or EXIST schemes to encourage start-ups end entrepreneurship, and so forth[27]). Through institutions, formal and informal, one generation's values and best practice are passed over to the next, creating a framework for the future. An economy's success is rooted in its ability both to learn from and adapt its institutions over time:

"Collective learning – a term used by Hayek – consists of those experiences that have passed the slow test of time and are embodied in our language, institutions, technology, and ways of doing things […] It is culture that provides the key to path dependence – a term used to describe the powerful influence of the past on the present and future. […] Learning then is an incremental process filtered by the culture of a society that determines the perceived payoffs, but there is no guarantee that the cumulative past experience of societies will necessarily equip them to solve new problems. Societies that get stuck embody belief systems and institutions that fail to confront and solve new social problems."[28]

1.29 Germany's post-war institutions served it remarkably well by international standards – in terms of wealth creation, domestic stability and foreign relations – until the combined effects of the greatly under-estimated costs of reunification, significantly increased competition through globalisation and the impact of an ageing population coalesced in the late 1990s to require material redesign of the social market settlement. The social market in its broadest sense implies a preference for consensual – and therefore usually gradual – change. Germany's many structural institutions, including its basic law (designed to ensure the fragmentation of power), its co-representation of workers and management, its large public sector, collective bargaining, powerful unions and regional regulations all make swift and radical change a near impossibility. Precedents do exist for radical restructuring with short-term adverse consequences for long term gain (the creation of the Zollverein in 1834 or the introduction of Erhard's new currency in 1948), but as one of our interlocutors in Munich in January 2003 put it:

"Yes, unemployment is high at over 10%. But if you are one of the 90% in a job, life's still very good. Look around you in any German city – in the West at least – and every second car is a Mercedes or a BMW. It is difficult to change when the present is so comfortable."

Especially so when foreign commentators have been expecting Germany to land in dire straits for two decades and such an outcome has not (yet) come to pass.

26 *Financial Times,* 14 October 2002, p19

27 "The strong performance of SME in Germany is due to [...] at the meta level, a value system which encourages entrepreneurship and achievement [...] Many of the typical problems of collective action (eg vocational training, R&D) were solved through the creation of specific institutions a long time ago." Meyer-Stamer & Wältring (2000) p53

28 Douglass C North, *Prize Lecture in Economic Science in Memory of Alfred Nobel,* 9 December 1993. Reproduced in Alston, Eggertston & North (eds) (1996) *Empirical Studies in Institutional Change,* Cambridge University Press, Cambridge, p349

1 Economic and Regional Context

Key Dates in German History

"A Lübeck, sur la mer Baltique, nous sommes recus par Gerhardt Stoltenberg, ministre-président de Hanovre […] De la fenêtre de notre hôtel, nous apercevons les grillages du 'rideau de fer' avec, de loin en loin, de sentinelles en vigie en haut des miradors […] Quelle étrange situation me fait-il toucher du doigt: le long du rideau de fer, ce sont des Allemands qui tirent sur des Allemands!"[29]

71BC – Atovius takes control of lands west of the Rhine from the Romans
58BC – Reoccupation of territories by Julius Caesar
AD9 – Arminius (a tribal leader with Roman citizenship) defeats Roman legions at Teutoburg Forest, halting Roman advances to the Elbe
90 – Romans consolidate southern fortifications and step up promotion of Roman culture in leading commercial and administrative centres: Trier, Cologne, Mainz, Regensburg
4th Century – Hun incursions from central Asia cause Great Migration to Europe
5th Century – Germanic tribes invade southern Europe
453 – Death of Hun leader, Attila
486 – Collapse of western Roman Empire. German tribes continue Roman administrative framework
482-511 – Reign of first Merovingian king, Clovis, covering western Europe
716 – First mission of Devon-born apostle, St Boniface, to Frisia
8th Century – Carolingians succeed Merovingians
768-814 – Reign of Charlemagne (Karl der Grosse), crowned Holy Roman Emperor (Kaiser, or caesar) on Christmas Day 800 in Rome
843 – Treaty of Verdun, dividing Charlemagne's legacy among his grandsons and remoter issue
843-876 – Reign of Louis the German
911 – Death of Louis the Child without heir. East Frankish nobles elect Konrad I as king, beginning separate German Reich
919-936 – Reign of Heinrich I. "Henry the Fowler", from Saxony, establishes hegemony over French-speaking Lorraine
936-973 – Otto I consolidates Markgrafschaften (marches) as buffer on eastern border
983-1002 – Otto III fails in attempt to make Rome capital of the reconstituted Holy Roman Empire
1024 – Power passes to Franconian or Salian house
1056-1106 – Rule of Heinrich IV; conflict with papacy on right to appoint bishops leading to 20 year civil war.
12th Century – German settlements east of the Oder River
1122 – Treaty of Worms gives local bishops independence from the Reich
1125 – Heinrich V dies heirless. Lothar III elected by Kurfürsten (Prince Electors)
1138-1152 – Konrad III begins Hohenstaufen dynasty
1152-1189 – Friedrich I Barbarossa. Quarrels with Papacy
1190-1197 – Reign of Heinrich VI. Marriage alliance with Sicily. Temporary consolidation of power halted by death of Heinrich VI without heir: election of competing kings (Philip von Schwaben and Otto IV, son of Heinrich der Loewe). Disintegration of central authority
1254-1273 – "Great Interregnum", numerous concurrent claimants to throne
1273-1291 – Rudolf first Habsburg ruler in Germany, but election of rulers still controlled by seven Kurfürsten, leading to weakness of central power
13th-14th centuries – Eastern settlements by the Teutonic Knights
1338 – Declaration of Rense: papal confirmation no longer required for election of monarch
1348-1350 – Plague destroys a quarter of German population
1356 – Signing of the Golden Bull, establishes clear rules for election of Kaiser
Late 14th Century – Establishment of universities in Reich territory
1378-1417 – Great Schism or period of the two popes (Rome and Avignon) dilutes papal influence in German affairs
1415 – Jan Hus burnt at stake for heresy in Prague
1493-1519 – Consolidation of Habsburg rule under Maximilian I; Habsburg hegemony lasts until Napoleonic invasion and legal reforms in 1806
1517 – Martin Luther publishes the "95 theses" attacking the selling of indulgences
1518 – Luther breaks from church of Rome and takes refuge at Wartburg in Thuringia, where he prepares first German translation of the Bible
1519-1556 – Reign of Karl V; Luther invited to Reichstag
1524-1525 – Bauernkrieg or Peasants' War; Luther supports nobility
1555 – Peace of Augsburg grants each Prince the right to decide the faith of his principality
1576 – Accession of Rudolf II. Counter-Reformation gains momentum
1618-1648 – Thirty Years War, concluded by Peace of Westphalia. Fragmentation of Holy Roman Empire
1683 – Turks repelled after siege of Vienna
1689 – Birth of J S Bach (died 1750)
1756-63 – Seven Years' War. Brandenburg-Prussia annexes Silesia
1806 – Rhine Confederation formed under aegis of Napoleon, consolidation of many minor principalities
1813 – Defeat of Napoleon at Leipzig
1815 – Congress of Vienna. Germany becomes confederation of 35 states
1837 – Railway constructed between Dresden and Leipzig
1871 – German Empire declared at Versailles following defeat of Napoleon III at Sedan
1888 – Friedrich Wilhelm Kaiser for just 99 days. Accession of Wilhelm II
1890 – "The Pilot Dropped" – Bismarck ceases to be German Chancellor
1914 – Archduke Franz-Ferdinand of Austria-Hungary assassinated in Sarajevo. War declared
1917 – US enters World War against Germany
1918 – Armistice signed
1919 – Treaty of Versailles. Germany adopts federal republican constitution at Weimar
1920 – Right-wing Kapp Putsch, occupation of Berlin ministries
1923 – Hyper-inflation leads to introduction of *Rentenmark.* Munich Putsch. Reoccupation of Ruhr by France
1925 – Death of President Paul Ebert. Field Marshal Paul von Hindenburg becomes president. Under Locarno Pact, Germany recognises western borders with France and Belgium
24 October 1929 – Wall Street crash. Start of Great Depression
January 1933 – Hindenburg nominates Hitler as Chancellor; Nazis win 43% of vote in March election
10 May 1933 – Burning of "un-German books"
1935 – Promulgation of Nuremberg Laws
1938 – Opening of Volkswagen factory and Anschluss with Austria. Under Munich Agreement, Czechoslovakia left open to German occupation
9 November 1938 – *Kristallnacht.*
August 1939 – Hitler-Stalin Non-aggression Pact
3 September 1939 – Declaration of war by Britain and France
June 1941 – Invasion of USSR
January 1942 – Wannsee Conference
20 July 1944 – Failed plot against Hitler led by Graf Claus Schenk von Stauffenberg
8 May 1945 – Unconditional surrender. Partition of Germany
1948 – Marshall Plan for economic regeneration. Currency reform in Allied zones introduced by Ludwig Erhard. Blockade of Berlin
1949 – Konrad Adenauer elected Chancellor. East Germany (DDR) adopts own constitution
17 June 1953 – Soviet troops quell popular uprising in DDR
1955 – West Germany joins NATO
1958 – Treaty of Rome. West Germany founder-member of European Economic Community
12 August 1961 – Construction of the Berlin Wall
1971 – Erich Honecker replaces Walter Ulbricht as leader of SED in East Germany
December 1972 – Signing of Basic Treaty between the two Germanies, each recognising the other's practical sovereignty but not full independence
1987 – Honecker received in Bonn by Kohl administration with full state honours
9 November 1989 – DDR Polibüro spokesman announced approval of direct travel to the West; fall of Berlin Wall
March 1990 – Free elections held in East Germany, won by the CDU. Revival of old Länder, institution of common currency and economic union
August 1990 – Unification Treaty
2 December 1990 – General election in unified Germany
1998 – Election of SPD/Green Alliance
1999 – Berlin restored as capital

29 "At Lubeck on the Baltic coast we were received by Gerhardt Stoltenberg, prime minister of Hanover. From the window of our hotel we can see the wire fencing of the iron curtain with, in the distance, sentinels keeping watch in look-out towers. What a strange situation he makes me touch with my fingertips: along the iron curtain, it is Germans shooting at Germans!" Valéry Giscard d'Estaing, *Le Pouvoir et la Vie, Cie12,* Paris 1988, p157

Venture Capital, Angels and Corporate Venturing

"How do Germans consider improvisation? Well, on the whole people would prefer you to say, 'that was well planned.' Preparation is valued more than improvisation."

Senior life sciences manager, speaking in Berlin, January 2003

"There aren't enough foreign investors in Germany. €40bn has been invested by Germans out of the country and inward venture capital is only €1bn. This has a lot to do with tax and employment laws."

Leading member of Munich life sciences sector, October 2002

INTRODUCTION

2.1 Germany has traditionally been a nation built on proprietorial self-reliance interlaced with a strong sense of the need for collectivism. These tendencies have stood in the way of adopting the Anglo-American model of competitive enterprise based on open and transparent capital markets.

2.2 Even today, with widespread acceptance of the need to open up markets, end cartels and promote competition in the interests of consumers, there is a hankering after the "German way" where a wider collective good is pursued through close (and often secretive) co-operation between management and workers, or suppliers and customers, or banks and borrowers. Grafting an effective venture capital industry onto a financial system like this has not been easy.

2.3 Nonetheless, by 2001, Germany had the second-largest European venture capital industry, after that of the UK, and Munich had developed an international reputation as one of Europe's most successful clusters of venture capital backed technology businesses.

VENTURE CAPITAL

2.4 Germany has developed its venture capital industry largely in the period since reunification. At its peak in 2001, the German Venture Capital Association[30] had 215 members. The number of active venture capital investors has declined during the past two years; nonetheless this compares with 160 full members of the BVCA in the UK and 178 full members of AFIC in France, the country with next largest venture capital sector. The German industry invested €4.4bn in 2001, compared with €9.3bn invested by the UK industry.[31]

2.5 The German venture capital industry reflects the regionalism of the country's wider economic and political structures. The largest concentrations of venture capital investors are in Munich and Berlin, with smaller clusters in Frankfurt, Stuttgart and the Cologne/Bonn/Dusseldorf conurbation. These clusters are characterised by the presence of large industrial corporations, which are sources of spin-out, joint-venture, customer and supplier opportunities (such as Siemens in Berlin and Munich, BMW in Munich and Bayer in the Cologne, Bonn and Düsseldorf area); concentrations of technology

30 Bundesverband Deutscher Kapitalbeteiligungsgesellschaften – http://www.bvk-ev.de

31 Data from BVCA and BVK

research institutions and those regional governments, such as that of Bavaria, which have been proactive in promoting new, technology-based businesses.

2.6 The direct role of national and regional government in the venture capital industry has been less significant than in Israel, for example. Nonetheless, the Max Planck and Fraunhofer Institutes have been incentivised to commercialise technology through the creation of new companies and the federal government has provided funding to set up dedicated commercialisation arms for these and other research bodies. Much new technology-based business formation over the past five years has been the result of spin-out activity by federal research institutions, and most have involved some venture financing using federal funds.

2.7 However, the greatest impact of government, both federal and regional, on venture capital has been indirect. Federal policies to encourage the formation of new businesses – such as the availability of soft loans – has been a significant incentive to venture capital investment, because of the way it skews the financial returns of an investee company in favour of commercial investors. Regional government has had material influence over regional banks and savings institutions, actively encouraging them to form venture capital units in the late 1990s. Among significant early-stage venture capital investors in the Munich bioscience cluster in the five years up to 2002 were the captive venture capital firms of the regional banks of the former East Germany.[32]

2.8 The impact of this government involvement in venture capital has been mixed. It has certainly been catalytic in increasing the number of technology business start-ups[33] in the past five years relative to earlier periods. It has also contributed to a wider realisation in the country at large that equity, including private equity and venture capital, has a significant role to play in the development of high-growth, but often capital-hungry, technology businesses.

2.9 However, both federal and regional government policy has contributed to a distortion of the venture capital market in Germany through the creation of a large number of early-stage venture capital funds which, in turn, have encouraged a plethora of start-up technology businesses. Even if all these businesses were outstanding propositions – with excellent technology, strong market potential and competent management – there are simply too few larger funds to finance them all through the later stages of development. This has created a legacy of maturing technology businesses unable to raise the follow-on venture capital (typically in the range €1m to €10m) necessary to get their product or service to market or, in the case of biotechnology businesses, undertake the clinical or other trials necessary to allow successful transfer of their technology to large pharmaceutical companies.

2.10 Germany's venture capital industry is less international than that of some other European countries – such as the UK and, especially, Israel. Nonetheless, the level of international venture capital activity has been increasing. An example of the new, international investors drawn to Munich is MyQube, a fund raised from large Italian businesses including Benetton and Telecom Italia, which has a reputation for accelerating

tbg – Venture Capital for Technology Innovation Companies

The Technologie-Betailigungs-Gesellschaft mbH is part of the Deutsche Ausgleichsbank, based in Bonn. It runs one of the federal government's most extensive venture funding programmes. It sets out its mission and rationale as follows:[34]

"tbg supports technology companies during all business development stages – from the idea to the IPO. Young high tech start-ups often face two main hurdles: a lack of capital and necessary collateral and a lack of management experience. Given the high financing costs of high-tech start-ups venture capital is a more suitable financing instrument. tbg co-invests in young high tech companies by way of a silent participation. Together with a lead investor tbg ensures an adequate capital base. The lead investor is frequently a venture capital firm; but it also can be a holding company or a private investor. As well as providing at least the same amount of capital as tbg, the lead investor also assists with the necessary managerial experience. This increases the probability of success and at the same time spreads the liability among several investors."

32 Information supplied in interviews, October 2002

33 Hence the 2001 *sorpasso* by Germany of the UK for biotech start-ups. Several of our interviewees were critical of the complexity of established venture capital matched funding schemes. A new programme launched in June 2001 (BTU Frühphase) was designed to promote investment readiness

34 www.dta.de

BioM

BioM is an unusual hybrid of network and early-stage venture investors. It was set up in 1997 with the avowed aim of enabling Munich to develop a biotechnology cluster similar to those that had developed around Cambridge and Oxford. It has been successful in backing 29 businesses, utilising the considerable intellectual property created in Bavaria's universities, or through spin-outs from existing life sciences businesses and has been a major factor in promoting Munich's (and Germany's) reputation as a hothouse for the creation of bioscience businesses. It counts 115 early-stage life science businesses in the Munich cluster as at mid-2002.[35]

BioM has offices in the new campus adjoining the Max Planck Biochemistry Institute in the Munich suburb of Martinsried and is currently run by Professor Horst Domdey. Horst Domdey has had an international research career, including periods at UC San Diego and Caltech and as an associate professor at the Ludwig Maximilians University, and was the founder of SWITCH Biotech AG. He is disarmingly frank about both the opportunities and challenges that BioM faces. It enjoys a plethora of sources of excellent technology: 10 universities and other higher education colleges[36] and five Max Planck Institutes[37] specialising in the life sciences are based in the greater Munich area.

However, success has brought its challenges. In the heat of the technology boom, from the mid-1990s until some time in late 2001, demand for equity in BioM's "baby bios" far outstripped supply. The investor pool included both domestic and foreign venture capital funds, with a significant slug of capital coming from the newly established venture capital arms of the regional and savings banks.

By 2002, the reality of global technology recession had started to bite in Munich. BioM found that the supply of capital to its fledgling portfolio had all but dried up. Only the very best of its portfolio companies were able to find capital from larger, established biotechnology investors as the new VC funds disappeared from the market-place as quickly as they had arrived.

As Prof Domdey points out, timing is everything and BioM has been unlucky in facing a capital famine for its portfolio companies at the stage where many of them have the greatest need for investment to push their technology forward. He sees consolidation as a necessary part of the way forward for the biotechnology cluster:

"We must now concentrate on building corporate co-operations and preparing the ground for prospective fusions [sic, ie mergers]. This will enable us to stay internationally competitive. We do not need a larger number of companies but instead the emphasis should be on stronger ones."[38]

During our meeting, Prof Domdey referred to an analysis of the European life sciences venture capital market prepared by Dunhaw Capital, which shows that pent-up demand for further rounds of investment on the part of investee companies successful in raising capital in recent years amounts to some $2.5bn. In the first quarter of 2003, only 14 publicly announced financings, totalling $114.3m, took place.[39]

the development of its investee companies through exploiting its extensive international network of well-placed contacts (including Jim Clarke, the founder of Silicon Graphics, Netscape and Healtheon).

2.11 Since 2001, however, inward international investment has significantly dried up although German venture capital investors have continued to invest elsewhere in Europe, especially in the UK and Scandinavia.

Polytechnos is the lead investor in Plastic Logic, one of the clutch of semiconducting polymer spin-outs from the Cavendish Laboratory in Cambridge, and Siemens has an extensive corporate venture capital portfolio across much of Europe.

CORPORATE VENTURING

2.12 With the notable exceptions of Siemens, Bertelsmann and DaimlerChrysler, large

35 BioM press release, 16 July 2002

36 http://www.forum.ecp.fr/uni/uni/d_tum.html

37 http://www.mpg.de/english/institut/

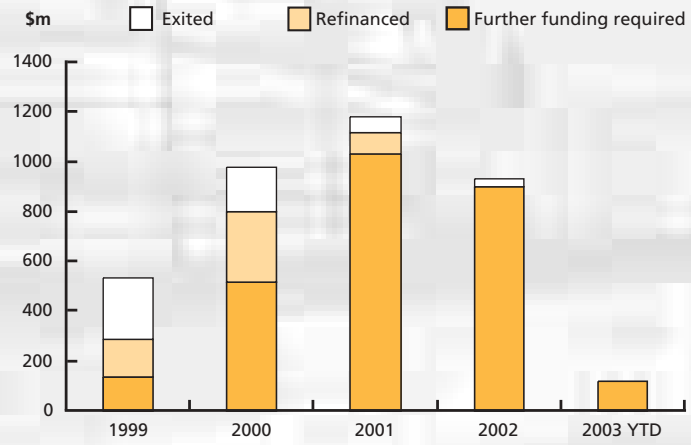
38 BioM press release, 16 July 2002

39 We are grateful to David Hawkins, Managing Director, Dunhaw Capital Limited, for permission to reproduce the chart concerned

2 Venture Capital, Angels and Corporate Venturing

European Demand for Venture Financing Continues to Grow

	1999	2000	2001	2002	2003 YTD
Exited/ Refinanced v Further funding required	$398m v $134m	$460m v $516m	$183m v $999m	$27m v $903m	- v $118m



Source: Dunhaw Capital

German companies have not been significantly active in corporate venturing.

2.13 Siemens is one of the most active corporate venturers outside the US. Its corporate venturing activity bears comparison with the leading US corporate investors such as Intel, Cisco and Johnson & Johnson.

2.14 Siemens' investment activity operates on several levels. It invests strategically – to promote industries and markets which are important to the corporation as a whole: in sectors such as semiconductors, switching and carrier technology and new materials. It also has a range of tactical investment activities, operating within its business units, whose aim is to support the development of technologies and businesses which enhance the performance of the business units themselves. See box below.

BUSINESS ANGELS

2.15 The recent federal government publication *Innovation Policy – More Dynamic for Competitive Jobs*[40] noted that:

"Three years ago the term 'business angel' was almost unknown in Germany. There was an informal market, but it was largely invisible. Today Germany has an almost national supply with around 40 business angels networks that can provide financial investors and know-how for new firms regionally, nationally or on the internet. Nevertheless, this market is still only at the start of its development, and it is still clearly under-sized compared with the United States."[41]

Corporate Venture Funding – Siemens Venture Capital

Siemens has had a series of funds for some time – these have now been consolidated under the Siemens Venture Capital (SVC) umbrella. Infineon Ventures is totally separate but has a working relationship with SVC.

Some 60% is invested in the US. "We are a corporate fund but have the same goal in returning capital as other VCs. We were lucky with our first deals four years ago (eg Virata) and lucky to sell early enough." Each director typically looks after five investees. SVC has in the past worked closely with only one or two specialised investment banks for exits. The team looks at 2000-3000 plans per year but rarely invests in unsolicited plans. One out of 70 deals was the result of a cold call. SVC's sweet spot is US$500k – $5m.

There is a plurality of accelerators within Siemens, including SMAC. SVC's relative success in comparison to other corporate VCs may stem from the policy of recruiting internally so that investment directors start with a good understanding of the Siemens situation. However all established corporations must realise that spin-offs will be rare, people play safe and are subject to internal constraints: they do not wish to lose key individuals or promising technologies.

Siemens has undertaken fund of fund investments for 20 years but it was previously described as corporate finance, not VC. The fund of funds invested in TVM, for instance.

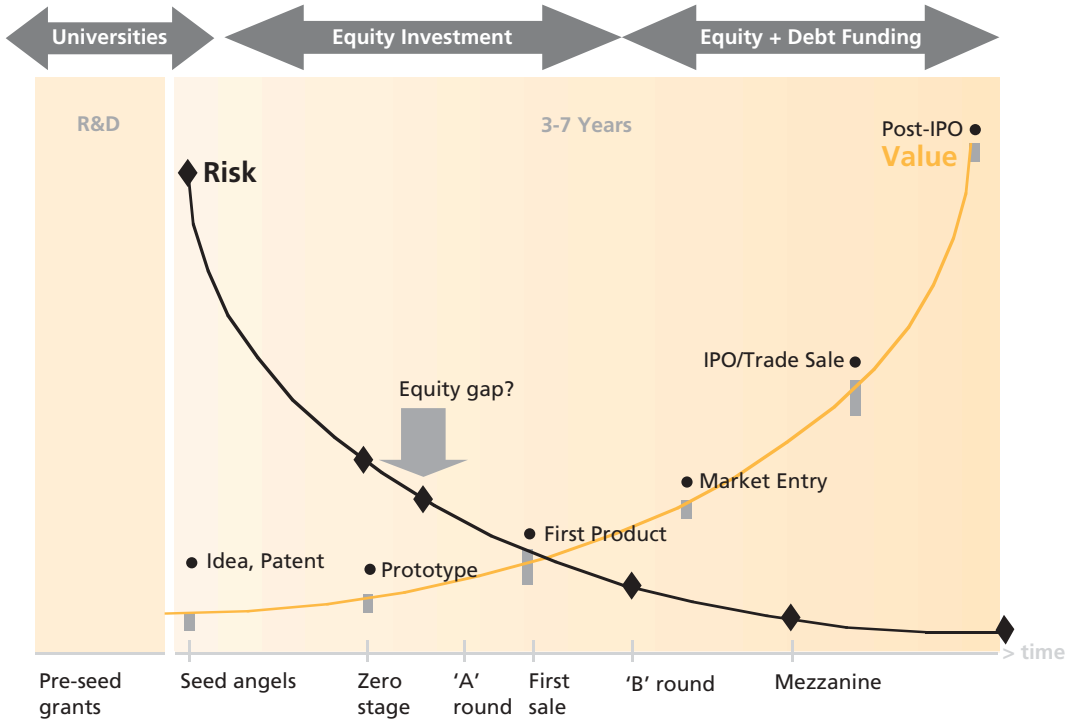
The fund has no external investors. Heads of division decide on deals in conjunction with SVC and take full P&L responsibility on their divisional bottom line. SVC has a carried interest on standard terms.

"It helps that the capital comes from the business entity. There is no real conflict at the exit stage. Capital is costed at around 12%." Siemens operates a total shareholder return system.

40 Federal Ministry of Economics and Technology jointly with the Federal Ministry of Education and Research, Berlin, April 2002

41 op cit p24

Stages of Investment



Source: Adapted from Siemens Venture Capital

2.16 Deutsche Bank also established its own national business angel network to link young entrepreneurs and experienced managers. We did meet a limited number of early-stage firms with business angel funding, but activity (even in this hard to measure sector) appears still limited. The leading angel in one Munich firm interviewed was obviously highly influenced by his experience in the US in terms of his management style and aspirations for the business, but we did not find sufficient national activity to identify emerging patterns.

2.17 Given that angels must be successful entrepreneurs and need to be present in force to make a material impact, the relative youth of Germany's current focus on the knowledge economy militates against the existence of a powerful, active cadre of experienced, well-funded angels. The position may change as the tech sector comes out of its current slowdown.

SUMMARY

2.18 An equity culture is a relatively recent addition to the bank-dominated German finance market. Venture capital has grown swiftly in recent years, propelling Germany into the top three countries in terms of activity in Europe. But timing has been difficult. Exits through the stock market dried up around two years ago and many firms are unable to raise second or subsequent round finance. A shake-up of investment portfolios is required and, though this goes against many cultural preferences, seems inevitable as well-informed practitioners realise that consolidation will be the only way to make part of the market at least viable. None of this should be surprising given both the severity of the world market downturn and the fact that Germany has only dedicated material resources to the knowledge economy for some six or seven years.

Munich Network/Munich Business Angel Network

Munich is generally agreed to be the leading technology commercialisation cluster in Germany. How did this come about in what used to be, only 50 years ago, a mid-sized provincial city with more connections in the fashion than the science world? We discussed the background with members of the Munich Network, who also explained what the Network itself seeks to achieve.

Pre-war, neither Munich nor Bavaria was a technology region. The post-war move of Siemens from Berlin was the catalyst, leading to the emergence of a virtually complete supply-chain network. Franz-Joseph Strauss was the driver behind the creation of a technology economy in 1970s. This was followed more recently by Edmund Stoiber reinvesting US$7bn (received from selling off shares in state enterprises) in biotechnology initiatives, research labs and other entrepreneurial activities. A cadre of new companies started to emerge but most businesses are still in the established Mittelstand. The late 1990s saw the first "bio-wave" plus a new IT wave. Munich was the most active region by number of VCs and number of investments, and the industry is in effect headquartered in Munich.

The Munich Network outlines its mission as follows: "With specific programmes Munich Network supports foundation, expansion and sustainable success of technology-based high growth businesses. Therefore Munich Network brings together the regional innovators and is generating substantial connections into the worldwide strongest high-tech areas"; and its vision is: "Becoming one of the most successful entrepreneurship networks worldwide."[42]

The Munich Network organises an annual Business Plan Competition: "We have about the same number of teams entering in 2002 as in 1998-99. People are more realistic today, but some still talk the dot com lingo. Business plans are better thought through now from the commercialisation angle, though."

How successful has Munich been as a technology cluster? "The US still has a much better platform – VCs, angels, CFOs, advisors – but we only have a five-year history versus a 50-year history in Silicon Valley." Corporate Venturing/Corporate VC has slowed significantly as many corporations have balance sheet problems. In the later 1990s some did build funds or make direct investments but this proved to be risky in a bear market. "A further worrying roll-back is the retreat to incremental innovation – how can a VC make money out of that?"

"In 1998/99 the most prominent advisors to arrive were the consultants, there are still some around but they have significantly reduced expectations. They came originally because they always need new technologies to implement and in the 1990s created their own investment funds and put their own management resources behind ventures in the hope of a rapid payoff through IPO, but now most consultancies have moved away from taking equity, as many were badly burned and need to generate cash."

The VC model follows the US example: funds are structured with carried interests and adapted to German tax legislation. "The difference with the US is the time lag of a year or more. VCs in the US are purging bad companies from their portfolio, focusing on keeping good companies alive, often accepting down-round valuations; this has happened less in Germany." There was a big surge in the AG format, which used to be reserved for large corporations: this format was designed to enable investees to be quoted on the Neuer Markt. "The major problem [of the NM] was immaturity; overall regulation was carried out by private law not legislation: for instance, owners would not respect a lock-up period post flotation. The NM latterly had no momentum and was too small. It was too slow to admit that it had problems and to implement change."

"With the banks, there is a big difference between the 1960s and the 1990s. Post-War, the banks helped build the Mittelstand but it is difficult to build high growth firms with bank loans; growth companies require VC or public funds. Banks play less and less of a role, they are under pressure to drive up profits and some commercial banks would not now take on small companies because of the risk. […] The Mittelstand traditionally has high gearing, making debt inappropriate for growth in high risk markets. Basel 2 will make loans more difficult."

Munich is like the rest of Germany in displaying limited tolerance of business failures: "To be associated with a business going under still represents a broken career. Though we have made it a bit better in the entrepreneurship community, the press and politicians show that a negative attitude is not out of the market yet. Both major political parties propose a new law to force the CEOs of failed companies to pay back five times their annual salary." As for entrepreneurship, "the pendulum has swung back again from seeing this as an exciting career possibility." But major companies have also let many people go. "When you leave university it is difficult to get a job and stay in it."

42 www.munichnetwork.com

The Banking System

"The Grossbanken had closer ties to their industrial clients, through supervisory board membership and in other ways, than the British commercial banks, but the difference can be overdrawn […] It is not uncommon for bankers to provide advice and support which went well beyond the provision of short-term credit. A notable example was Edward Holden, head of the Midland Bank, who worked closely with several large manufacturing companies."

Sir Geoffrey Owen[43]

"The skill and experience of the clearing banker in Britain, unlike West Germany for example, does not extend to taking sizeable equity stakes in industry."

Lord Boardman[44]

"I think banks don't play any role in start-ups. A generation ago we had so few new companies as banks wouldn't finance start-ups […] What the banks are doing with the Mittelstand is not right. The banks are over-reacting and cutting back on lending. They are not well perceived in Germany at the moment."

Young German professional, August 2002

INTRODUCTION

3.1 To say that "Germany has a large number of financial institutions"[45] pushes understatement to its limits. However, the past decade has seen further consolidation in the German banking sector and more is likely to follow. The structure of the market is complex, with considerable indirect government intervention. Much admired and even more misunderstood in Britain up to the late 1990s, German banks today are no longer generally seen as a principal source of strength for industry. The fundamental issue, however, may be the slowness of a thriving equity culture to emerge alongside specialist debt-oriented institutions.

STRUCTURE OF THE BANKING MARKET

3.2 Germany has some 2,900 banks, operating 43,000 branches. This great density of both banks and branches (the four major banks accounting for nearly 90% of the business market in Britain between them maintain closer to 9,000 branches[46]) represents a significant reduction in numbers of independent banking organisations over the past 10 years; at the beginning of the 1990s, some 4000 banks operated in Germany.[47] The structure of the market helps to explain both the huge number of banks and the slow consolidation. A simplified taxonomy of German banks reveals three main types, with a number of sub-species. The most

43 Owen (1999) p395 – see pp404-5 for the Mittelstand. Sir Edward Holden was managing director of Midland Bank from 1898 to 1908, and Chairman from 1908 until his death in 1919. See further A R Holmes & Edwin Green (1986) *Midland – 150 Years of Banking Business,* Batsford, London, p133: "Holden himself dealt with applications for services which would have been beyond the scope of country banks; at the turn of the century this remarkable graduate of Manchester and Birmingham banking was being consulted by a railway company exporting to Japan, an American cereal food producer setting up a British factory, and a London piano manufacturer with most of his business in New York and Hamburg"

44 *Financing New Technology,* Institute of Bankers Cambridge Seminar, 1984, p73

45 Meyer-Stamer & Wältring (2000) p32

46 "In 1995, in the UK there was, on average, one branch per 1,580 inhabitants, compared to one branch per 1,203 inhabitants in Germany." Lane & Quack (2001) p10

47 Economist Intelligence Unit, *Country Finance, Germany,* March 2002, p7

3 The Banking System

TABLE C – The Three Main Types of Banking Institutions in Germany		
PUBLIC SECTOR	COMMERCIAL	SPECIAL FUNCTION
Sparkassen	Deutsche, Dresdner, Commerz, HVB	Kreditanstalt für Wiederaufbau
Landesbanken	Volksbanken, Raiffeisenkassen	Deutsche Ausgleichsbank
Bürgschaftsbanken	Deutsche Genossenschafts-Zentralbank	Mittelstand Bank
(Mortgage Banks)	Mortgage banks	Industrie Kredit Bank

important category is composed of savings, guarantee and other public sector banks. The other two main types are the commercial banks and banks with special functions (for which also the public sector is a critical influence).

3.3 **Public sector savings banks and credit co-operatives** account for almost half the market in terms of numbers of branches, of which there were some 19,100 as at 2000, spread across 600 different institutions.[48] *Sparkassen* are established under public law as institutions of their city or Land. Crucially, (local) government representatives form part of their management and government does not invest equity but has a responsibility to bail out Sparkassen in financial difficulties. The Sparkassen finance themselves through savings and retained earnings. They were established in the nineteenth century to offer poorer people access to interest-bearing accounts and to improve the savings and investment ratio at regional level; they had a duty to provide savings accounts to anyone on demand.[49]

3.4 In the early twentieth century, the Sparkassen became business banks, providing long-term investment for smaller enterprises and were funded mainly by the personal savings accounts of depositors. They also act as intermediaries for government SME schemes run by the banks with special functions, such as the KfW. Their role is not straightforward and has become an increasing source of criticism:

"The Sparkassen are, together with the *Volksbanken*, the main source of credit for SME […] But a common criticism is that they have a strong preference for financing firms which have a long track record, whereas they tend to rate fast-growing new firms as too risky […] government representatives by all means try to avert financial problems, since a bail-out would put an additional burden on already strained public finances."[50]

3.5 The individual Sparkassen early on became linked to each other at Land level through what were originally regional "clearing house" banks, but which have since become full business banks – the *Landesbank-Girozentrale*. Several of the **12 Landesbanks** (LBs) have branched out overseas and/or into investment banking, for instance:

- Westdeutsche Landesbank, or WestLB;[51]
- Landesbank Baden-Württemberg, one of Germany's largest since the merger in January 1999 of its three constituent predecessors;
- Bayerische Landesbank Girozentrale (BayernLB); and
- Landesbank Hessen-Thüringen (Helaba).

3.6 Each Land of the former West Germany owns a stake its regional Landesbank (which in turn acts as banker to the Land), with the Sparkassen (for which the Landesbank acts as liquidity manager) collectively owning the remainder. Some of the New Federal States now use the services of the Landesbanken of Länder in the West: Hessen's covers Thuringia, WestLB covers Brandenburg;

48 Meyer-Stamer & Wätring (2000) p32. Seperate legal status for each of the Sparkassen and the credit co-operatives accounts for much of the "headline" number of German banks

49 Edwards & Fischer (1994) pp103-4

50 Meyer-Stamer & Wältring (2000) p33

51 On 13 March 2003, WestLB announced significant restructuring of its investment banking operations. It hired McKinsey to look at options for its UK operations, including a complete withdrawal from London

NordLB covers Mecklenburg-Vorpommern and Saxony-Anhalt. Saxony, by contrast, created SachsenLB.[52]

3.7 The relationship of the LBs with government and its effect on the rest of the banking industry is also controversial. As government-backed institutions, they are able to borrow on the capital markets at favourable rates with low capital bases. The EU is eroding their anti-competitive advantages. Unlimited state guarantees are being phased out between 2001 and 2005, but these guarantees will continue to cover liabilities incurred before 19 July 2005 and maturing before 2016. Between them, Sparkassen and Landesbanken account for 45% of the German market;[53] their ability to price commercial lending at fine rates thanks to their low cost of borrowing influences the profitability of the entire commercial banking sector.

3.8 One specific example of the complex and not necessarily beneficial consequences of Land involvement in the banking sector is Bankgesellschaft Berlin, the holding company for Landesbank Berlin, Berliner Hypothekenbank, Berliner Bank and two Sparkassen. Real estate lending in questionable circumstances led to substantial losses, as a result of which the Land government in Berlin lost power in June 2001. However, Bankgesellschaft Berlin continues in business, with the benefit of statutory Land guarantees, though it would be insolvent if in the private sector. The strain on Berlin's public finances has wider consequences, such as its ability to fund higher education.

3.9 **Credit guarantee banks** (*Bürgschaftsbanken*) began in the 1950s as vehicles for implementing state support programmes for SMEs, a public-private initiative sponsored by the Chambers of Commerce to address perceived market failures affecting SMEs without sufficient collateral to support conventional bank lending (and latterly leasing and equity-related funding as well), both at start-up and subsequent stages. Guarantees between 50% and 80% are provided for periods of some 10 years and for sums of around €300,000. Any trading surpluses are always treated as retained earnings and no dividends are paid. As with the public sector banks, the influence of government is also present:

"[…] the government helps the Bürgschaftsbanken in three important areas: (1) As non-profit organisations they do not have to pay corporate income tax, (2) the guarantees of the Bürgschaftsbanken are counter-guaranteed by the federal and Land government (which back a maximum share of 39% and 26% respectively of the amount of the guarantee; in the "new Länder" this amounts to 48% from the federal and 32% from the Land government), (3) long-term loans are financed by the federal government, taken from the so-called ERP fund at low interest rates."[54]

3.10 **Volksbanken and Raiffeisenkassen** are both credit co-operatives[55] undertaking similar work to the Sparkassen. Their services since 1974 have also been available to non-depositor members. They do not have government backing and were originally established as self-help organisations for craftsmen and smallholders. These 1,800 local credit unions account for 20% of the market. They are served nationally for liquidity and clearing purposes by DZ Bank, the **Deutsche Genossenschafts-Zentralbank**, created out of the merger of Deutsche Genossenschaftsbank and GZ-Bank in September 2001; it is one of the largest banks in Germany.

3.11 **Grossbanken** or universal banks do not conform to a single definition, but as the name implies, they are likely to provide a wide range of commercial and investment banking services, "but on a narrower

52 Economist Intelligence Unit (2002) p11

53 Ibid.

54 Meyer-Stamer & Wältring (2000) pp34-35. The ERP is the European Recovery Programme, or long-term continuation of the Marshall Plan

55 "In the past the Raiffeisenbank concentrated on agricultural sectors in the countryside, and the Volksbanken on manufactured sectors in the cities. In 1972 these two banks merged." Meyer-Stamer & Wältring (2000), note 18. Their different functions may owe much to the circumstances of their foundation. The Raiffeisen banks were named after Friedrich Wilhelm Raiffeisen (1818-1888), who established the first "self-help bank of bread and food" for working people in Weyerbusch in Westerwald following the "winter of hunger" of 1846-7. See www.raiffeisen.de

TABLE D – Universal Banks' 2002 Debt and Operating Costs				
	Deutsche Bank	HVB Group	Commerzbank	Dresdner Bank
Increase in debt	€1.7bn (66%)	€2.7bn (35%)	€1.3bn (40%)	€1bn (100%)
Decrease in operating income	€2.3bn (16%)	€10bn (7%)	€6.2bn (14%)	€4.7bn (30%)

Source: company websites; *The Times,* London, 29 October 2002

definition [of universal bank] must include the ability to influence non-banks through equity holdings, including proxy holdings."[56]

3.12 From the late nineteenth to the late twentieth century, the universal banks were seen (and saw themselves) as designers and builders of Germany's economic landscape, which was not left to market forces.[57] The commercial performance of the universal banks in recent years has undermined their status as discreet arbiters of German industry. A subtle shift in the self-understanding of German banks, away from acting as "insider capitalists" and towards concentrating on their core function as providers of financial services and market stability is occurring:

"In my view, the biggest contribution Deutsche can make to Germany is to be as big and as profitable as possible. In the end only a strong bank can be a reliable partner for business."[58]

3.13 As a result, Germany may be experiencing a transition in its approach to corporate governance, with the likely convergence to the "liberal market" model of external controls replacing "the stakeholder approach which focuses on the entire network of formal and informal relations which determines how control is exercised within corporations and how the risks and returns are distributed between the various stakeholders."[59] Some commentators consider what might at first sight appear to be a technical issue of legal accountability in the context of wider social issues:

"Occurrence of convergence to liberal market capitalism is not merely of theoretical interest. It will have far reaching practical consequences, to the detriment of employees and organised labour, as well as increasing the level of social inequality in German society."[60]

3.14 If the universal banks are now seen as cautious, unlikely funders of the knowledge economy or ground-breaking ventures, this was not always the case. Commenting on the late nineteenth century, when Deutsche Bank was set up and run by the contrasting characters of Georg von Siemens and Hermann Wallich ("Where Siemens often acted rashly, Wallich tended to be hesitant and cautious"), Meyer-Larsen noted:

"All these ventures were risky and progressive. Never again would Deutsche Bank do as large a part of its business with venture capital as it did then. But if it wants to remain in first place in the finance business, it will have to pick up where it left off during that period […] The United States has never had a system such as Deutsche Bank's; that would have smothered its economy."[61]

3.15 Rising bad debts and some high-profile corporate insolvencies (such as Philipp Holzmann AG,[62] where banks proved reluctant to continue with politically inspired bail-outs) led to an increasingly fractious relationship with the Mittelstand. During

56 Midland Bank (1994) p43

57 Meyer-Larsen (2000) pp80-81

58 Josef Ackermann, Chief Executive of Deutsche Bank, quoted in *Financial Times,* 17 March 2003, p7

59 Lane (2003) p4. A hybrid middle path of corporate governance is seen as unlikely: p16

60 ibid. p25. Lane does not regard convergence as inevitable, though the antidote may cause as much tribulation as the disease: "The only chance for a halting or reversal of the convergence process lies in a strong delegitimation of the Anglo-American system of corporate governance. This might come about through the occurrence of deep world economic recession and the inability of the US economy to find a way out of it."

61 Meyer-Larsen (2000) pp94-5, 103

62 Other harbingers of the transformation of the relationship of the banks with German industry include the ability of Vodafone to acquire Mannesmann in a contested takeover and the impending sale of Kirch Media to US broadcast interests

2002, 38,000 firms ceased to trade in Germany, and 42,000 business closures are expected in 2003.[63] Margins are eroded through competition with the various state-subsidised banks. For 2002, HVB reported losses of €858m and to conserve cash did not pay a final dividend. And despite taking a profit on the sale of its stake in Credit Lyonnais, Commerzbank reported a pre-tax loss of €372m.

3.16 Even those broadly appreciative of the merits of the German "insider" industry model accept that it was not best suited to dealing with the vicissitudes of technology funding.[64] However, despite the general shift away from the unquoted company sector by the universal banks, there is some evidence of a willingness to deal with the particular problems of innovative industries through specialist market teams. Deutsche Bank, for instance, established in 1998 a team of eight industry specialists (Microtechnology Innovation Team) within the corporate and investment bank to cover areas such as nanotechnology and materials science, acting as a "translator" within the bank. Issues covered include market implications of new technology and risk evaluation. Some of our interviewees around Munich also referred to the benefits of industry expertise being built up within one or two commercial banks (eg HVB) simply by virtue of the concentration of new technology SMEs in the Munich cluster.

3.17 **Mortgage Banks** Although mortgage banks may be either public or private institutions, the largest such banks are now controlled by the universal banks and managed under regulations restricting their activities to long-term mortgage loans or loans to municipalities and other public authorities. Owner-occupation in Germany at 42% is the lowest in the Europe (average 63%, with Spain the highest at 82% and Britain at 69%). This figure has not increased since 1980 (European average increase 7%), although low home ownership ratios might in principle favour labour mobility across the federal republic, it is also possible that lack of private collateral for entrepreneurs is another limiting factor in sourcing external funding for SMEs, though debt as a percentage of household income (71%) is about the same as in the US (72%).[65]

3.18 **Banks with special functions** Banks with either public or private sector control and a specific remit to work in defined areas such as reconstruction or the Mittelstand are a notable feature of the German banking market. Three in particular are relevant for technology and entrepreneurship:

- **The Kreditanstalt für Wiederaufbau** (KfW) "was founded in 1948 (before the Federal Republic) to transfer Marshall Plan funding. Until the mid-1950s KfW lending was very low, at its inception it was almost the only source of industry finance […] Later on the brief expanded to cover *Mittelstandspolitik,* regional policy and environmental policy."[66]
- **The Deutsche Ausgleichsbank** (DtA) "is involved in state economic promotion. In contrast to the KfW, the main focus of the DtA is on new businesses."[67] Some of the activities of the KfW and the DtA relating to the mid-market are being combined in a new *Mittelstandsbank*; see below. "Through its subsidiaries, DtA mobilises venture capital for young high-tech and low-tech companies."[68]
- **The IKB Deutsche Industriebank** (IKB) "was founded by entrepreneurs for entrepreneurs in 1924, and pioneered the development of long-term corporate loans in Germany."[69] It is owned partly by a foundation (11%), Allianz AG (20%), other insurance companies (25%) and private or institutional investors (44%). Despite a history built on long-term lending, IKB does now also have a

63 *The Times,* 26 February 2003, p28

64 cf Lane (2003) p22: "Although diversified quality production has served the German economy well it has never delivered above average returns of the magnitude which, for example, has induced venture capitalists to take a long-term perspective in high technology sectors"

65 *The Times,* 26 February 2003, p4

66 Midland Bank (1994) p36. In late April 2003, the four main universal banks and DZ Bank joined the KfW to create a joint venture to securitise and sell significant amounts of their loan portfolios. Contrary to earlier rumours that the new entity would be a repository for non-performing loans, the assets being pooled will include securities with credit ratings up to AAA

67 ibid. p45

68 www.dta.de

69 www.ikb.de

venture capital subsidiary, IKB Venture Capital GmbH. This move in an "Anglo-Saxon" direction mirrors a structural adjustment towards the German approach in the UK. The IKB was sometimes seen in the UK in the early 1990s as a possible model for stimulating long-term lending, but it appears that macro-economic circumstances and a better understanding of financing needs by and for SME customers have produced the same effect a decade on. Total UK bank lending to the sector was back up at 1992 levels by 2002 (£40bn), but with term lending now accounting for 70%, against approximate parity with overdrafts in 1992. Moreover, UK SMEs are now also more reliant on their own capital resources, with aggregate deposits exceeding loans since 1997.[70]

3.19 **Mittelstandsbank.** The Federal Ministry of Finance and the Federal Ministry of Economics and Labour announced in December 2002 a merger of KfW and DtA Mittelstand activities as "part of the federal government's offensive to support company start-ups and SMEs"[71] with effect from 1 January 2003, though legal completion of the merger is not expected before 31 August 2003. The intention is to offer clearer, more transparent, effective and cost-efficient financing by having one port of call and centre of expertise, and enabling all the schemes of the KfW and the DtA to be jointly available from the one bank.

DO BANKS INVEST?

3.20 Some myths are enduring. Almost ten years ago, one of the current authors was engaged in an investigation into the belief, current in the UK, that the Grossbanken are regular equity investors in the established private company sector in Germany. The banks did not invest then and now are even less likely to provide debt funding:

"It is evident that, contrary to popular belief in the UK, German banks do not generally take equity stakes in their customers. In the years immediately after the war, the Grossbanken were obliged to convert many outstanding loans to industry into equity stakes. These stakes have been maintained and other stakes have been added as a result of subsequent restructurings, and the equity stakes as a whole are now managed on a professional portfolio basis. However, it is not the banks' practice to take equity stakes as a matter of course in successful companies.

"It is possible that the common UK belief that German banks 'regularly take equity stakes in Mittelstand companies' may derive from a misinterpretation of the following related factors:

(a) the Grossbanken own a few (but well publicised) holdings in high profile public companies such as Daimler-Benz;

(b) the Grossbanken indirectly hold sizeable equity stakes in quoted companies through the proxy votes attached to shares deposited with them by individual shareholders;

(c) German banks do generally provide longer term debt facilities than their UK counterparts;

(d) the Mittelstand is generally more extensive and successful than its counterpart in the UK; and

(e) it is also generally considered that German banks are better at 'relationship banking', possibly involving board representation.

"These factors taken together may have led many foreign commentators to believe that the long-term nature of the support for the Mittelstand involves equity investment, whereas detailed evidence suggests that there is little tangible support for this view."[72]

3.21 It is also questionable what value banks can bring to Mittelstand companies over an above mainstream debt finance:

"Bank stakes in German industry are

70 *Quarterly Report on Small Business Statistics,* Bank of England, January 2003, p25

71 See www.mittelstandsbank.de. For the rationale behind the Mittelstandsbank, cf: "At the meso level it is important to note that there is no specialised SME support institution. Instead there is a highly differentiated system of organisations and policies which creates favourable conditions for private business in general and SME in particular," Meyer-Stamer & Wältring (2000) p6

72 *The Mittelstand: the German Model and the UK,* Midland Bank plc, September 1994, p12

supposed to foster a sense of longer term investment, strategic thinking and national prosperity. But there appears rather to be a trend towards mutually dependent failure. A Mannheim University study recently found that companies with the highest level of bank influence are the most indebted. They pay relatively higher interest rates and have relatively low internal financing ratios. Bank-influenced decisions were often neither business-friendly nor economically efficient."[73]

LACK OF RISK CAPITAL

3.22 Dealing with technology firms has long been difficult for mainstream banks because innovation-based companies present acute uncertainties on at least three levels: the technology itself; the management of the business; and the scope of the market. Risk, unlike uncertainty, can in theory at least be quantified and is amenable to actuarial or portfolio analysis. And risk can be reflected in a financing premium (such as a margin over cost of funds), though beyond a given point such lending may represent adverse selection, as is seen with junk bonds – pricing for failure can become self-fulfilling.

3.23 Banks in Germany have long met the demand for conventional commercial borrowing requirements. Germany has also seen a material supply of government schemes to satisfy demand at the other end of the spectrum – uncertainty – to cover research and development phases including proof of concept and market testing (though a high level of grants and soft loans may also generate "moral hazard" if only limited evaluation or accountability apply). However, the mid-stage of risk, between the low risk suitable for bank debt and the uncertainty funded by grants, often financed in the US through equity or "risk capital", is still largely absent in Germany and its development may have been impeded by an over-dependence on bank debt for the past generation, with lending on fine margins from government-backed banks "crowding out" the market for equity as well as forcing down commercial banking margins.

Performance of the DAX Index

Source: Handlesblatt.com

3.24 In the opinion of many of our interviewees in the financial sector, the problem of risk capital may be compounded by the implementation of Basel 2, the new capital accord from the Bank for International Settlements due to be implemented in 2004. The area of concern most frequently cited to us was operational risk, "the risk of direct or indirect loss resulting from inadequate or failed internal processes, people and systems, or from external events"[74]; operational risk may have a material impact on the capital adequacy of many banks as constituting "approximately 20% of the overall capital requirements under the new framework."[75] At the time of writing, the introduction of Basel 2 is still surrounded in controversy, not least as only a limited number of international US banks were expected to implement it.

SUMMARY

3.25 Germany remains a bank-dominated economy, despite an upsurge of interest in equity (both quoted and unquoted) in the 1990s. Innovation cannot be funded through conventional bank lending and the record of government programmes to address market weakness has been mixed. It is also far from clear that the presence of a great number of banks has increased the real level of choice for SME customers or led to greater innovation within the banking industry itself. Further consolidation is inevitable as banks concentrate on profitability and financial

73 *The Times,* 23 January 1996

74 *The New Basel Capital Accord; an explanatory note,* Secretariat of the Basel Committee on Banking Supervision, January 2001, p10

75 ibid. p4-5

stability. The staged withdrawal of distortions to the market caused by state backing for regional banks may lead to greater realism in the SME banking sector. In the interim, young technology firms are unlikely to see banks as primary partners in their formative years.

Universities

"It was during the second half of the nineteenth century that the German universities, in accordance with the ideals enunciated by Wilhelm von Humboldt, the founder of the University of Berlin in 1809, became the homes of scholars dedicated to Wissenschaft (pure learning as opposed to utilitarian skills) and Bildung (the cultivation of the whole person) and were known around the world for their accomplishments."

Gordon A Craig[76]

"[...] the ideals of Wilhelm von Humboldt remain deeply entrenched in contemporary German universities. [...] 'von Humboldt' can be seen as a major institutional barrier to the diffusion of the 'third academic mission' within German academia."

Georg Krücken[77]

"We only began to take technology transfer seriously about two years ago."

Leading German technology transfer manager, January 2003

INTRODUCTION

4.1 There are currently 359 higher education institutions in Germany with a combined student enrolment of just under two million.[78] Higher education institutions encompass universities (including technical universities), *Fachhochschulen* (universities of applied science), colleges of higher education, and other university status institutions (see table E – Enrolment in German Higher Education Institutions). Substantually different entry quailifications apply to each.

4.2 The German higher education system is a mass rather than an elite system – it is open, (largely) free for all and has no equivalent to an "Ivy League" or "Oxbridge" group of institutions. The mechanism for allocating places tends to result in students being enrolled at higher education institutions close to their hometown.[78a]

QUALITY AND ACHIEVEMENT

4.3 The German higher education system was, for a period, perceived as a role model for other nations:

"Prestige in science and technology in Germany dates back for a century. The world's first graduate schools, and doctoral dissertations requiring original research, were German inventions. (American universities, for example, adopted the German model beginning with Yale in 1861.)"[79]

4.4 The traditional image of German science is of a system of high quality and consistent achievement. Consider, for instance, the

76 Craig (1991), p273

77 Krücken (2003), p26

78 Federal Statistical Office (2003)

78a Depending on the field of study the admissions process differs. Some courses are managed centrally by the Zentrale Vergabestelle für Studienplätze (ZVS) in Dortmund (applicants state preferred universities), and some are managed locally by individual universities, to which students apply directly. In addition, given courses may have *numerus clausus*, with minimum entry requirements consisting mainly of *Abitur* marks (2.5 year averages), sometimes amended for additional qualifications

79 Michael Porter, *The Competitive Advantage of Nations,* Macmillan, London 1990, p376

4 Universities

TABLE E – Enrolment in German Higher Education Institutions		
Type	**Description**	**% of national student enrolment[80]**
Universities	Based around the ideals of von Humboldt, German universities do not only focus on education and training, but are independent. Pure and applied research is pursued. Pure education and science demand strict academic work. Consequently, the length of studies tends to be higher than in many other countries. **Technical universities** originally restricted their teaching to technical and engineering disciplines. More recently they have developed into more comprehensive higher education institutions. **Comprehensive universities** developed when a university, a teacher training college, a Fachhochschule and, in some cases, a college of art and music were merged to form a single institution.	**70**
Fachhochschulen (universities of applied science, including colleges of public administration)	Highly practice-orientated. Tight organisation of the degree courses, teaching in small groups, examinations throughout the studies which count towards the final degree, and a choice of subjects which is orientated towards the necessities of professional practice, permit shorter average studies than are generally achieved at universities.	**27**
Colleges of higher education	Specialised higher education institutions focused on vocational training in selected disciplines (eg art, music, education, theology).	**3**

following from the website of the DFG, the self-governing organisation of scientific research in Germany:

"German research is carried out on the highest international level. So far, German scientists have received a total of 84 Nobel Prizes for their achievements in the field of natural sciences, including 32 in chemistry, 29 in physics, and 22 in medicine or physiology."[81]

4.5 However, German self-understanding received a severe jolt with the publication of the PISA report on educational standards by the OECD at the end of 2001. PISA concluded that those consistently below average included two relatively affluent economies, Germany and Italy.[82]

4.6 The German response to PISA is an indication of how seriously education is taken. After all, in the most recent findings by the European Commission the UK ranked third worst after Portugal and Luxembourg on key indicators such as percentage of 18-24 year olds "having achieved lower secondary education or less and not attending education or training"[83] yet this result excited little commentary in Britain.[84]

EVOLUTION OF GERMAN UNIVERSITIES

4.7 Understanding the German university system is complicated by the fact that although many German universities appear to illustrate features in common with the Anglo-American model, there are numerous differences in the way they function both at the strategic (eg the intended role of universities in German society) and operational levels (eg the way in which learning takes place within universities). One illustration of the marked difference between the Anglo-American and German systems is given by the types of degrees awarded by German universities (see the panel on German University Qualifications, p35).

MYTHOS HUMBOLDT

4.8 Underpinning this difference between the Anglo-American and German models is the

80 Data for 2002-2003 from Federal Statistical Office website (www.destatis.de)

81 www.forschungsportal.net/resger/main/en/university.html

82 See generally *Knowledge and Skills for Life – First Results from PISA 2000,* www.pisa.oecd.org

83 *European Report on the Quality of School Education,* European Commission, Brussels, 2001, p33

84 It is inconceivable that any German minister for education should have commented *mutatis mutandis* with respect to the Gymnasien as did the Rt Hon Charles Anthony Raven Crosland MP (educated at Highgate School and Trinity College, Oxford), Secretary of State for Education & Science 1965-7: " 'If it's the last thing I do, I'm going to destroy every [expletive deleted] grammar school in England,' he said. 'And Wales. And Northern Ireland.' 'Why not Scotland?' I asked out of pure curiosity. 'Because their schools come under the Secretary of State for Scotland.' He began to laugh at his inability to destroy their grammar schools." Susan Crosland, *Tony Crosland,* London 1982, Jonathan Cape, p148

impact of *Mythos Humboldt* – the myth that has been constructed around von Humboldt's vision of German universities:[85]

"[...] the ideals of von Humboldt remain deeply entrenched in contemporary German universities. The very essence of von Humboldt's university concept – the unity of teaching and research; social disembeddedness and autonomy; a non-utilitarian approach to higher education as opposed to purely vocational training – are still part of the commonly shared understanding of what it means to be a university."[86]

4.9 And yet observation of the university system shows this to be largely a myth:

"A myth, on the one hand, implies that the organisational reality is far away from being the embodiment of underlying ideals. On the other hand, a myth lies at the very heart of the social fabric of an organisation. It provides members with meaning through reference to a commonly shared identity. The 'von Humboldt' myth, in the case of German universities, is obviously both: far away from their organisational realities while at the same time constituting their chosen frame of reference."[87]

4.10 The evolution of German universities has passed through a series of broadly defined phases:

- **Pre-classical phase** (mid-fourteenth century to 1810) – "At the outset, [...] their function was by no means to cultivate the arts and sciences as they saw fit, but to train civil servants and – after the Reformation – to promote the religious creeds of their respective rulers. Living at the expense of the state, the universities had to serve its ends."[88]

- **Classical phase** (1810 to around 1870) – Education reformer Wilhelm von Humboldt proposed a new type of university and implemented this vision in a new university in Berlin in 1810 "in which unity of teaching and research, along with the freedom of teaching and learning, would together produce a scholarly and scientific elite equal to the challenges of the modern world."[89] Von Humboldt "insisted that universities should not have to serve the state first by training its officials, but by promoting the free development of personality through education and science."[90]

- **High-classical** (1870 to 1960s) – Towards the end of the nineteenth century it became clear that there had been a gradual "slow farewell to von Humboldt"[91] in Germany. "[...] the ideals of German university reformers [von Humboldt and others] were in deep tension with two fundamental trends – the emergence of a modern system of specialised, large scale scientific research on one hand, and the parallel growth of professional society based on a system of advanced academic qualifications on the other." This resulted in the development by Prussian officials such as Friedrich Althoff of a new concept – *Wissenschaftpolitik* or science policy – that led to "a state directed system of industrial functionalisation of higher education"[92] and this in turn led during the early part of the twentieth century to the development of institutions that now typify the modern research university.

- **Post-classical** (1960s to 1989) – Higher education expanded dramatically in the 1960s in response to demographic changes and political sentiment against elitism. The post-war "baby-boom" led to a growth of the primary and secondary sectors and this, coupled with aspirations for upward mobility and increased standard of living, pushed greater demand for tertiary education. This was strongly supported politically by a concern that a shortage of professionals would lead to "an educational catastrophe."[93] Clear political will, coupled with increasing

85 Ash (1997), pviii
86 Krücken (2003)
87 ibid.
88 Künzel (1997), p164
89 Ash (1997), px
90 Künzel (1997), p164
91 vom Bruch (1997)
92 ibid.
93 Jarausch (1997)

co-operation between universities (leading to the formation of foundations such as the German Research Council and German Academic Exchange Service[94]) and co-ordination between the individual Länder led to rapid growth "that fundamentally transformed the system from elite to mass higher education."[95]

4.11 By the end of the 1980s, it was widely recognised that the West German universities had reached a point of crisis. Mass education was a huge and growing burden on the public purse – not helped by poor demographic predictions. Symptoms of the crises that could no longer be ignored included "lack of resources to respond to growing student numbers, inadequate maintenance or expansion of buildings and equipment, overburdened senior faculty, insufficient positions for qualified young scholars, and, last but not least, a widespread sense of malaise due to the absence of a generally accepted sense of purpose."[96]

4.12 **Universities in the former DDR** (1946-1989) Three major reforms punctuated the development of the DDR's higher education system up until reunification. The first reform activities focused on immediate post-war "democratisation" and "denazification" of universities. The second reform in the 1950s focused resources on the restructuring of the six main East German universities around Soviet principles. The third reform attempted to implement a unified system of education concentrated on early and precise focus on specialisations. East German higher education thus became an unusual blend of attitudes:

"East Germany was the only state in Eastern Europe faced with a daily need to compete with the West; 'Humboldt' became a mask worn for Western eyes (hence in part the rationale for re-naming Berlin University – 'Humboldt University'). The more fiercely East German higher education competed with its West German counterpart, the less Humboldtian, and the more Eastern it became. Indeed, since they were most effectively subordinated to the agendas of a socialist state, East German universities were arguably the least Humboldtian in Eastern Europe."[97]

4.13 **Integration** (1990 to date) – Reunification of the two German republics was viewed as an opportunity to renew the higher educational system. However, commentators noted that the renewal "was and continues to be applied to the restructuring of the universities in East Germany – a restructuring carried out largely in the image of the very West German system that had been agreed to be in crisis a short time before."[98] This unresolved crisis is leading to a number of changes in the German higher education system that are discussed in the following sections.

RETHINKING GERMAN UNIVERSITIES

4.14 A series of reforming steps are being taken to address some of the perceived weaknesses in the German higher education system – and some of the ideas have been drawn from observation of the system in the US:[99]

"Interestingly, nowadays not only politicians refer to the US when talking about the future of the German university system. US universities seem to be the standard for many university administrators as well. In particular, Stanford University serves as a mythical role model – for very different parties. While German politicians seek to legitimize reforms in order to overcome historical legacies by invoking the Stanford myth, several of our interviewees in the university administration referred to the US "Ivy League" universities in general ('those

94 German Academic Exchange Service – www.daad.de; German Research Council – www.dfg.de

95 Jarausch (1997)

96 Ash (1997)

97 Connelly (1997)

98 Ash (1997)

99 Contrast this with the approach taken in the UK in the 1980s: "The bill put forward by Kenneth Baker did indeed take a big further step towards nationalising the universities [...] How could this be justified? The main explanation was a desire to achieve four mutually exclusive aims: to control public spending; to avoid alienating middle-class parents who expected somebody else to pay for the education of their progeny; to satisfy the demands of the great mass of academics and university administrators for 'parity of esteem'; and to increase access to higher education for a much larger proportion of school leavers. This combination of aims was (and is) incompatible with free competition in the sector, which would lead to greater diversity among institutions, inequality of pay, higher fees for students and greater public spending." Wolf (2002)

particularly remarkable universities') and to Stanford University in particular as being more effective in implementing von Humboldt's university concept."[100]

4.15 The impact of a mass education system has led to long-term adverse consequences for the excellence of its education and research. While a high proportion of its school-leavers will move to higher education, lacking an "Ivy League" Germany has produced relatively few international prize winners or frequently cited papers. A similar result is now becoming evident in Britain:

"1977 was the year of Britain's last Nobel Prize in Physics. United States institutions have won 30 prizes since then […] An equally depressing picture is drawn from indices of citations […] only two of the most cited physicists in the world work in Britain. The figure for molecular biology and genetics is three out of 100. In microbiology, it is six, fewer than in Harvard alone. Overall, Britain, has 80 of the 1,200 most widely cited scientists, against 700 in the United States. Moreover, Britain is still second, with Germany just behind, on 65. But there is little doubt that the already huge American lead is increasing."[101]

4.16 Changes have been made to the German higher education system in recent years to try to tweak its performance. For example, a new position of 'junior professor' has been introduced. This new position removes the need for rising young academics to undergo the lengthy post-thesis *Habilitation* process[102] before becoming "real" academics (albeit at a lower status to that of those that have undergone Habilitation). Bachelor's and Master's degrees have been introduced to provide German students with a shorter and more internationally transferable degree.

German University Qualifications[103]

The traditional certificates offered at German universities are the "Diplom" and the "Magister Artium" (Master of the Arts). Would-be teachers, attorneys, pharmacists and doctors also have to take the German Civil Service Examination. The average degree is supposed to take eight semesters to complete. But it actually takes longer in many departments, *inter alia* because the amount of work cannot be completed in the time available.

Students at Fachhochschulen (universities of applied sciences) usually graduate after six semesters, and are awarded a "Diplom (FH)".

Doctorate degrees and qualification as a university professor (Habilitation) can only be obtained at a university.

Unlike in many Anglo-Saxon countries, students at German universities usually do not receive a Bachelor's degree first and then leave the university and come back years later to study for a Master's or Doctorate degree. In Germany, students receive only one university degree and they graduate only when they have completed their entire period of higher education. So students in Germany work towards their Master's or Doctorate degree from the first day they are enrolled at the university. In some subjects, students also attain a university certificate after they have completed the general education part of their studies with an intermediate examination. But this certificate only qualifies them for the specialisation or graduate programme. It is of no value on the job market. The only exceptions are the international courses of study offered at some universities where a student can obtain a Bachelor's degree after only six semesters. This degree is usually sufficient qualification to find a job, but students who want to learn more may continue on for another four semesters and earn a Master's degree or the traditional German Diplom.

The introduction of the Bachelor's and Master's degrees a few years ago started a small revolution at Germany's universities. More than 280 Bachelor's and over 150 Master's degree programmes were offered at German schools in the 2000/2001 winter semester. These programmes gave students the opportunity to complete their education quickly, and move on into the working world.

There are two major advantages to the shorter international degree programmes: they give German students better chances on the international market, and international students are more likely to come to Germany if they know their degree will be accepted back home.

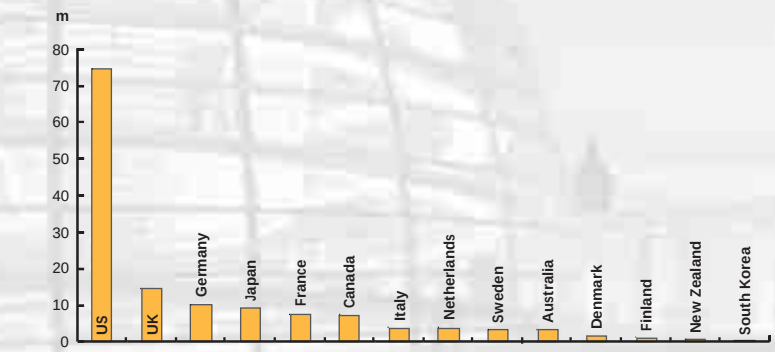
100 Krücken (2002) p13

101 Wolf (2002) p4

102 "After successful completion of their doctoral thesis and in order to receive tenure, or to become full professors, young academics are required to publish another major contribution in their research discipline, usually as a single-authored book. In contrast to Anglo-American standards, where the number and quality of journal publications is assessed for tenure decisions, the *Habilitation* is another 'monolithic' contribution." Sinkovics and Schlegelmilch (2000)

103 www.campus-germany.de

Worldwide total citations 1981-2000



Source: ISI

US-style business schools, long a notably absent feature of the German higher education landscape, are now emerging in Germany. One of the potentially most prominent is the European School for Management and Technology based in Berlin, Munich and Cologne.[104]

TOWARDS A "THIRD MISSION" FOR GERMAN UNIVERSITIES

4.17 One of the most significant changes has been the re-thinking of the role of German universities in society. Without moving away from the ideology that underpins mass higher education, the German government is taking a similar line to many nations in recent years and has been seeking to give universities a new mission – a third mission to complement teaching and research – focused around the application of new knowledge, in particular that derived from the science base.

4.18 Three examples of activities that have been undertaken by the German national and regional governments to stimulate this third mission provide a useful illustration of some of the particular challenges facing German higher education. The inspiration for these activities was drawn in part from observation of the situation in the US, in particular the implementation and knock-on effects of the Bayh-Dole Act.[105] The three examples highlighted are:

- The development of university Technology Transfer Offices
- Outsourced technology transfer service providers
- 'Professorial privilege' and the German Employees' Inventions Act

Each of these is discussed in the following sections.

TECHNOLOGY TRANSFER OFFICES

4.19 Technology transfer is not a new activity for German universities.[106] They have been engaged in such activities since the late nineteenth century. Areas of particularly active co-operation between industry and academia were found in chemistry, medicine, physics and engineering. This was somewhat at odds with the von Humboldt ideals, but as discussed earlier in section 4.10, by the late 1800s many German universities had begun to drift away from this idealised model of detached academia, although they retained significant belief in Mythos Humboldt. Two features typified technology transfer in German universities at that time:

- Empirical or industrial application was perceived as being of much lower status than theoretical advancements. Engineering was taught only in polytechnic schools of lesser standing than universities.
- Transfer activities between business and academia were not institutionalised – their stimulation and implementation rested wholly with individuals.

4.20 A significant milestone in the move towards the realisation of a third mission for German universities happened in the 1970s:

104 www.esmt.org. The value of business schools is not universally accepted: "There is little evidence that mastery of the knowledge acquired in business school enhances people's careers [...] Similarly, the impact of business school research [...] appears to be quite small, and this is even true when research produced by business school professors is compared with business research conducted by non-business school writers." Pfeffer & Fong (2002), p6

105 The US Bayh-Dole Act of 1980 assigned intellectual property rights from federally funded research grants to the universities performing the research

106 See Krücken (2003) for further information on the evolution of the third mission for German universities

"Triggered by a widespread perception that German technology transfer lagged behind that of the US, efforts were made to facilitate co-operation between different partners in technological innovation. The relatively slow flow from basic research to industrial application caused concern among policymakers. As a result, technology transfer was no longer seen merely as an informal process between individual researchers and industrialists, but rather as an organised activity needing institutional support. Technology transfer increasingly involved the university as a whole, rather than solely transfer-oriented individuals. This shift manifested itself in a variety of newly created political programmes and organisations."[107]

4.21 One of the key results of this shift in mindset was the establishment of technology transfer offices inside German universities. Following pilot activities in the 1970s at selected universities, by the mid-1990s, almost all German universities had their own technology transfer office (TTO).

4.22 TTOs within German universities have faced a number of major challenges that have resulted in a less dramatic improvement in university–industry collaboration than had been intended. These challenges have been summarised as follows:[108]

- The legal environment of German universities does not give them sufficient incentives to exploit the potential of academic–industry technology transfer.
- TTOs are not supported by all relevant key actors in the process.
- Mythos Humboldt and technology transfer do not sit well together in German universities.
- Technology transfer activities remain marginal and under-resourced in most universities.
- The status of TTOs within universities remains low and this causes problems with recruitment of skilled technology transfer professionals.

Example of Federal Programme for Technology Transfer[109]

"The Federal Government launched a technology transfer initiative in spring 2001. As part of this, it has earmarked €35 million to promote the commercialisation of university research and the establishment of a network of Patent and Commercialisation Agencies (PCAs). These offer professional services to the universities and non-university research institutes based in any one region. The Federal Research Ministry provides initial funding on the basis of commercialisation contracts between research organisations and the PCAs. The ministry has also launched an initiative to train researchers in publicly funded institutions as patent consultants and innovation managers. Additionally, grants will be allocated to universities towards the cost of patent applications and to support government-funded research institutes on legal disputes over IPR."

OUTSOURCED TECHNOLOGY TRANSFER SERVICE PROVIDERS

4.23 Realisation of the scale of the challenges facing TTOs within German universities resulted in national and regional public/private initiatives in the late 1990s and early 2000s to provide support for accelerating the performance of these offices. For example, to cope with the issue of limited financial resources to cover patenting costs, federal money was made available to fund all patenting costs at certain universities for a fixed period of time.

4.24 Funding was also made available to pump-prime the costs of bringing in external commercialisation organisations to work with TTOs and help them develop their own competences. Without such funding, many German universities would have been stuck in the cycle of having insufficient funding to support their individual TTOs, hence activity would be limited, and consequently revenues unlikely to be generated that would feed back to fund more commercialisation, and so on. One example of a commercial organisation that has been set up to provide such a services is IPAL GmbH, which provides commercialisation services to universities and Fachhochschulen in Berlin. This offers an interesting example of how universities have been able to redress the shortfall in resource and experience within their TTOs through external organisations. Such initiatives have been of particular value in helping universities in the Neue

107 Krücken (2003), p20

108 ibid.

109 Information from British Embassy, Berlin – www.britischebotschaft.de, a concise bulletin board for science policy

Patent Activity in Germany[110]		
German Patent Registrations 2001		
1	Siemens	**3,252**
2	Bosch	**3,156**
3	VW	**1,543**
etc	...	...
Total		**64,151**
vs. all academia		**2,600 or 4%**

Länder begin to develop their technology transfer activities.

PROFESSORIAL PRIVILEGE

4.25 Until very recently, one of the privileges of being an academic at a German university was that individual professors held the rights to any intellectual property (IP) they generated as part of their employment. This was the "professorial privilege" resulting from an exemption to the German Employees' Invention Act. In theory this meant that academics were free to bring the fruits of their research to market through the normal routes of patenting, licensing and forming new ventures and reap the benefits themselves. However, this did not happen on any significant scale – in 2001, only 4% of all patent registrations in Germany were from the academic community.

4.26 This poor rate of "hard" technology transfer can be explained in a number of ways. Firstly, overworked academics in a mass education-based university were extremely unlikely to have the time and resources to devote to developing and implementing the exploitation of IP on a commercial basis. Where it did happen, it would be on a very individualistic and informal level, perhaps facilitated by a private technology transfer

German Employees' Inventions Act

Legal ownership and economic benefit of inventions made by German employees are regulated by mandatory provisions of the Arbeitnehmerefindungsgesetz, or German Employees' Inventions Act (ArbEG). Since the law is mandatory, it is not subject to contractual modification by the parties to an employment contract.

- To qualify, inventions must be patentable or qualify for the Utility Model Act (Gebrauchsmustergesetz); see ArbEG, section 2.
- The law distinguishes between:

  "Service inventions" (*Diensterfindungen*) are made during the period of employment and result either from the obligatory activity of the employee in a company or public authority or are substantially based on experience and work carried out in the course of the employment.

  "Free inventions" (*freie Erfindungen*; see section 4) are all other inventions created by the employee during the period of employment.

Service inventions (SIs). If a SI is created by an employee (whether during working hours or in the employee's spare time) the employee has a strict obligation to report it, without delay and in writing to the employer, stating that the report is notification of an invention (section 5.1). This notification must provide details of the invention. Where several employees are involved, a joint report may be submitted. Within four months of receipt of the employee's report, the employer can claim his right to the SI (section 6 of the ArbEG). The employer may choose between a restricted and an unrestricted claim. With an unrestricted claim, full title to the SI is transferred to the employer with no further action on the employee's part as soon as the appropriate declaration is received (section 7.1). (A restricted claim leads to non-exclusive rights on the employer's behalf.)

Once the employer has claimed the right to the SI, the employee is entitled to claim reasonable remuneration (sections 9-12). The quantum often gives rise to dispute, and the government has promulgated *Guidelines for the Remuneration of Employees' Inventions in Private Employment.*

Free inventions (FI). The employer must still be notified of a FI in writing and without delay (section 18.1). No notice is required if the invention clearly has no application in the employer's field of operation. In some circumstances, the employee is required to offer the employer at least a non-exclusive right to use the inventions on reasonable conditions (section 19.1).

Inventions by university lecturers and assistants. Restrictions apply where inventions originate from university staff. Until 8 February 2002, such personnel were exempt from the ArbEG, but a recent reform abolished this privilege. All employees at German public universities (including chair holders) must report inventions they have made to the university. Special provisions apply to remuneration and constitutionally guaranteed freedom of research.

We are grateful to Peter W Kremer, partner, Hale and Dorr (Munich), for guidance in preparing this section

110 Bornikoel (2003)

organisation (such as the Steinbeis Stiftung) providing services to individual academics. Also, as described earlier, universities were not in a position or of a mindset willing to provide adequate resources to their technology transfer offices – partly as they were not the owners of the IP.

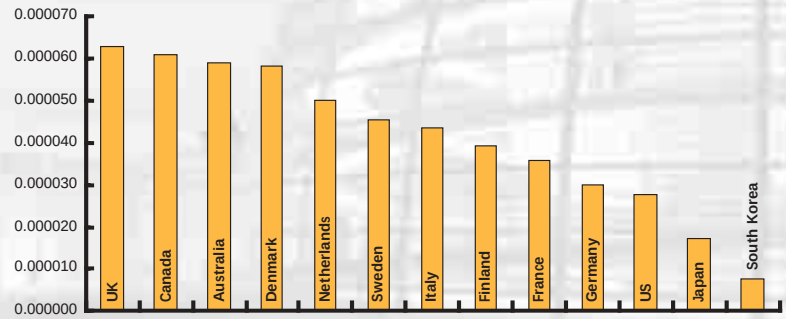
4.27 In order to help improve the flow of science and technology from universities to industry, on 7 February 2002 the "professorial privilege" exemption to the Employees' Invention Act was removed.[111] Now, inventions made by academics will be considered employment inventions and as such may be claimed by the university. This was regarded as a highly important symbolic (and practical) step in changing the way technology transfer was seen within German universities. Germany now has an academic IP ownership framework that resembles that implemented in the US as a results of the Bayh-Dole Act in 1980.

4.28 It is interesting (and perhaps significant in terms of on-going motivation) that Germany has arrived at universities owning research-generated IP from the reverse direction to that in the US. In the US Bayh-Dole Act ownership was moved from the national funding bodies to the individual universities: in Germany, it has been removed from individual academics and passed to the universities.

SUMMARY

4.29 The origins and evolution of Germany's higher education system present those analysing technology transfer with a complex picture. There is now a mass university system that in some ways is still strongly influenced by the "socially disembedded" academic ideals of von Humboldt, yet which has been actively transferring knowledge into business for over 100 years.

Number of papers per £ of Gross Expenditure on R&D for selected countries



Source: OECD and ISI

4.30 Numerous governmental and non-governmental pure and applied research institutions are increasingly overlapping with some of the research activities of universities that are most likely to have commercial potential (as described in Chapter 5 – Research Institutes and Incentives).

4.31 Attempts to resource core "third mission" functions such as Technology Transfer Offices require greater fuelling if they are to have any impact – using outsourced providers can present one solution, but may not lead to embedded changes within the universities necessary to build effective systems for spinning out new ideas and ventures.[112]

4.32 It could be argued that attaching a "third mission" to a mass higher education system already under pressure is only likely to fail, yet the effective implementation of a "third mission" may be the only way the system can be adapted to cope with its mounting challenges and make a significant contribution to the national innovation system.

111 Suchantke (2002)

112 See, for example, Di Gregorio and Shane (2003) for an analysis of the features of universities that have been successful at creating new ventures in the US

4 Universities

IPAL and Technology Transfer at Humboldt University[113]

In the 1990s, Humboldt University (HU) began to benefit from the conversion of the Adlershof site of East Germany's Academy of Science into a commercial science park and extension location for science faculties from HU.

The University was previously focused on attracting government funding rather than industrial collaboration and very little value had been generated from HU patents. However, the change in the IPR regulations for academics stimulated technology transfer and Adlershof is expected to become the main focus of this activity for HU (www.adlershof.de).

The reform of the so-called "university teacher prerogative" in the German Employees' Inventions Act, obliges professors and scientific assistants to offer their inventions to the universities employing them. The amendment aims to stimulate the process of patenting university inventions.

Technology transfer at HU was further boosted in 2001 when IPAL was established by Investitionsbank Berlin to offer universities and inventors at universities a host of services to exploit their inventions.[114] IPAL handles intellectual property (IP) asset management for HU and other institutions. These include: Freie Universität Berlin; Universitätsklinikum Benjamin Franklin; Charité; Technische Universität Berlin; Fachhochschule für Technik und Wirtschaft Berlin; and Technische Fachhochschule Berlin.

In co-operation with inventors, IPAL plans and implements each and every step, from the application for a patent, which IPAL receives via the university transfer offices, via the patent application strategy right through to the successful economic exploitation of property rights.

The mission of IPAL is that of an IP asset management firm in the broadest sense, with the clear vision of becoming the most successful German company in this, still young, segment.

One of the biggest challenges for Neuer Länder universities is the recruitment of good people to work in technology transfer. But adversity may also have its uses. Consider the drivers of tech transfer at HU: "we have a very poor situation in the Berlin area. We have big pressure to get money from industry." HU is in the top 10 universities for research and this, coupled with the Adlershof development "is the real hope for HU and for Berlin".

Most technology transfer comes from the older professors. But with the new "junior professors" it is hoped that more will come from younger faculty. The tech transfer function is to start as a central function of HU and then move out. The setting up of the current office is "not a solution but a major step forward". A McKinsey-supported business plan competition attracted 300-400 plans from Berlin and the Brandenburg area.

Steinbeis has had "almost no success in Berlin, but is trying very hard". Steinbeis is very much viewed as a Stuttgart initiative that works effectively when it is plugged into the local network – at the political, industrial and academic levels. Universities in Berlin/Brandenburg "tend to be more independent than in southern Germany".

HU received pump-priming funding from BMFT (Bundesministerium für Forschung und Technologie – now Bundesministerium für Bildung und Forschung) to cover all patenting costs for two years.

113 www.hu-berlin.de
114 www.ipal.de

Research Institutes and Incentives

"Compare Munich with California. Silicon Valley started in the 1950s and took two business cycles to establish itself. Britain started in the 80s. We in Munich have been going since 1996. The real trigger was the Neuer Markt in 1997. By 1999 many investors believed equity was a one-way bet. The baby has been thrown out with the bathwater (following the decline of the Neuer Markt). The pendulum has over-compensated."

Munich-based venture investor with US experience, August 2002

"Tax in Germany is horrible – even worse is to learn how tax works, as it changes every month."

Young German professional, August 2002

"Germany's real strength is in the depth of its technology. Institutions such as the Fraunhofer are both unique and powerful, representing a long-term partnership with industry on a contractual basis."

Experienced German venture capitalist, interviewed in August 2002

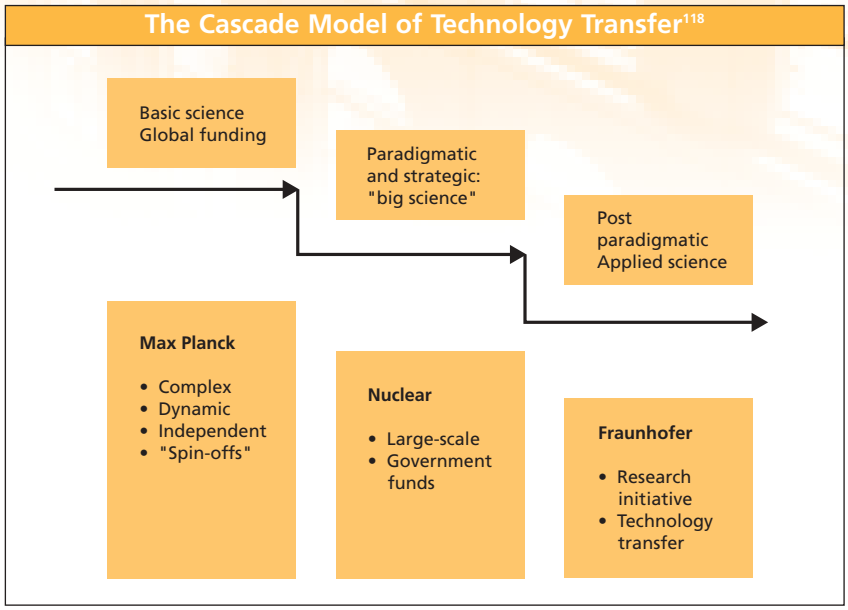
INTRODUCTION

5.1 In Germany, much research is led or supported by networks of organisations working alongside or outside universities. Some of the leading networks are analysed below.[115] Their variety has the advantage of pluralism and the risk of confusion. Much of the funding of the research institutions comes, directly or indirectly, from government. Government also intervenes in the early-stage technology area through a wealth of grants and incentives, the impact of which is only now being assessed objectively.[116]

FRAUNHOFER-GESELLSCHAFT

5.2 The Fraunhofer-Gesellschaft (FhG) network was founded in 1949 as a non-profit organisation and is, in its own words, "the leading organization for institutes of applied research in Europe".[117] Individual institutes undertake contract research on behalf of industry and government. FhG's forte is providing "rapid, economical and immediately applicable solutions to technical and organisational problems." The FhG is also active in strategic research, commissioned and funded by federal and Länder governments; it undertakes research projects focused on innovations "of major

The Cascade Model of Technology Transfer[118]



115 For a more detailed account of German research activities, see the annual report of the German Research Association (Deutsche Forschung Gesellschaft) – www.dfg.de.jahresbericht.jb2001.pdf

116 We are grateful to Dr Rebecca Harding of London Business School and the Work Foundation for assistance in the preparation of this chapter

117 www.fraunhofer.de/english/company/index.html

118 Harding & Soskice (2000) p85

public concern and in key technologies. Typical research fields include communications, energy, microelectronics, manufacturing, transport and the environment."[119]

5.3 Affiliate Fraunhofer institutes have been set up in Europe, in the US and in Asia. In Germany itself, 56 research establishments employ a staff of some 12,000, the majority of whom are qualified scientists and engineers. Current annual research income is in excess of €1bn. Research contracts account for two-thirds of the FhG's contract revenue. "One-third is contributed by the Federal and Länder governments, as a means of enabling the institutes to work on solutions to problems that are expected to attain economic and social relevance in the next five to 10 years."[120]

Biopolis Dresden – Turning the "Florence of the North" into a City of Biological Sciences

Since reunification, Dresden has been pushing itself forward as a leading centre for the development and exploitation of developments in the life sciences. It has achieved some notable traction in meeting this goal thanks to its success in attracting federal funding, coupled with clearly articulated and well resourced regional strategies to promote life sciences – linked under the banner of "BioSaxony".[121] A number of key initiatives and organisations are worth highlighting within this strategy.

Max Planck Institute of Molecular Cell Biology and Genetics:[122] Following reunification, the Max Planck Society (MPS) made a commitment to fund 20 new Max Planck Institutes (MPIs) in the former DDR. Successful lobbying by the government of Saxony resulted in a particularly innovative MPI being established at a new purpose-built facility in Dresden at the start of 2001 – the MPI for Molecular Cell Biology and Genetics (MPI-CBG). This institute is interesting for several reasons. For example, despite the problems that universities and research institutes in the Neue Länder often have in attracting international talent, the planners of MPI-CBG managed to persuade the head of the Cell Biology division of the European Molecular Biology Laboratory (Kai Simons) in Heidelberg to move to Dresden along with a significant number of his colleagues. Another interesting development for this MPI was the close integration of scientific research with commercial exploitation (see section on "Biotec" below).

Biotec[123]**:** Closely linked to the MPI-CBG is the establishment of the "Biotec" (Biotechnologisches Zentrum) by the Technical University of Dresden that provides an integrated facility for academic researchers and new biotechnology ventures. Research at this centre combines functional genomics, functional proteomics, cellular machines, biophysics, tissue engineering and bioinformatics. Reflecting the interdisciplinary nature of the centre, one of the recent initiatives has been the launching of a Master's course in Molecular Bioengineering.

BioMet:[124] BioMet is an innovation network created through Dresden's success in attracting federal funding from the InnoRegio[125] programme for the development of a high tech economy that merges biology, medicine and engineering. Formally established in spring 2001 and guided in its strategic planning by a council that includes Professor Günter Blobel (Nobel Laureate in Medicine, 1999), BioMet seeks to provide support through networking and funding to start up new life science-based ventures, to modernise existing companies and to attract national and international companies to relocate to the Dresden area.

"Biopolis Dresden" is now suffering from many of the ills common to other German regions that have sought to build biotechnology clusters (in particular, lack of follow-on funding for start-up ventures). However, the decision to build "Biopolis Dresden" around interdisciplinarity and concentration on niche-areas may be a significant differentiator. These factors, coupled with Dresden's position at the heart of an expanded Europe – a factor emphasised in the partnerships being formed by MPI-CBG with organisations such as the International Institute of Molecular and Cell Biology in Warsaw – may provide the strong foundations for one of Germany's more successful biotechnology clusters.

119 ibid. For FhG and venture capital, see www.venturecommunity.fhg.de

120 ibid. It is notable that AIRTO (the Applied Industrial Research Trading Organisations – www.airto.co.uk) in the UK is more extensive as a network than the FhG but less prominent

121 www.biosaxony.de

122 www.mpi-cbg.de

123 www.tu-dresden.de/biotec

124 www.biomet.de

125 An initiative of the Federal Ministry of Education and Research started in 1999 to develop regional innovative potential and competence in *Neue Länder.* Eligible projects and activities are to be supported with a total of €255m up to the year 2005. (www.bmbf.de)

MAX PLANCK INSTITUTES

5.4 The Max Planck Society for the Advancement of the Sciences is:

> "an independent, non-profit organisation. It was established on 26 February 1948 as the successor organisation of the Kaiser Wilhelm Society, itself founded in 1911. The Max Planck Society promotes research in its own institutes. Max Planck Institutes carry on basic research in service to the general public in the areas of natural science, social science, the arts and humanities. *In particular, the Max Planck Society takes on new and promising directions in research that universities are not able to accommodate sufficiently, if at all. The reasons for this are either due to the fact that the interdisciplinary character of such research cannot fit into the universities' organisational framework or because the costs for personnel and facilities that it demands are beyond the universities' means.* Max Planck Institutes, therefore, complement the work of the universities in important fields of research."[126]

5.5 Max Planck Institutes have only limited direct contact with companies (the patenting and licensing activity is concentrated at Garching Innovation). As a consequence of this scientific demarcation, the institutes have limited absorptive capacity, but in recent years

Patron Saints

Figures after whom some of Germany's leading scientific institutions are named:[127]

Gottfried Wilhelm Leibniz (1646-1716) was born in Leipzig and travelled to London and Paris before becoming librarian to the Duke of Brunswick at Hanover in 1676. In 1700, he persuaded Frederick I of Prussia to establish the Prussian Academy of Sciences; Leibniz became its first president. He wrote widely on optics, mechanics, statistics, logic and probability theory. Controversy surrounded whether he or Sir Isaac Newton first developed integral and differential calculus. Leibniz was left behind when in 1714 the Elector of Hanover, as King George I, moved his court to London.

Karl Wilhelm von Humboldt (1767-1835), born in Potsdam, became a diplomat and served as Prussian Minister in Rome (1801), before being appointed First Minister of Public Instruction (1808) and Minister in Vienna (1810).

Friedrich Wilhelm Heinrich Alexander, Freiherr von Humboldt (1769-1859) was born in Berlin and studied in Frankfurt, Berlin, Göttingen and Freiberg before spending five years as a naturalist in South America (the current off the west coast of which is named after him). He later worked in France and Central Asia before accepting a political appointment (1830). His *Kosmos* (1845-62) outlines a comprehensive picture of the physical structure of the universe.

Joseph von Fraunhofer (1787-1826) was a physicist born in Straubing. His work on prisms and telescopes at the institute he founded in Munich in 1807 enabled him to trace the dark lines in the sun's spectrum, since named after him. In 1823 he became a professor and member of the Munich Academy of Sciences. He pioneered using diffraction gratings to examine spectra.

Ferdinand von Steinbeis (1807-1893) was born in Ölbronn and studied natural sciences at Tübingen. In 1831, Prince Karl Egon von Fürstenberg appointed him director of Württemberg's institute of metallurgical engineering. Over the next 30 years he became a leading figure in regional industrialisation, promoting training and social welfare, including benevolent funds, medical care and the provision of mortgages. He is seen as a precursor of modern technology transfer thanks to the creation of institutions such as the "Central Office for Trades & Crafts", but in 1878 he was admonished by the chamber of deputies for opposing protective tariffs in a newly united Germany. Steinbeis was ennobled for his work at the Great Exhibition in London in 1851.

Hermann von Helmholtz (1821-94), a physiologist and physicist born in Potsdam, held chairs in physiology at Könisberg (1849), Bonn (1855) and Heidelberg (1858) before being appointed professor of physics in Berlin. Distinguished in physiology, mathematics and physics, he invented an ophthalmoscope independently of Charles Babbage and his work on vision is still taught. His statement of the law of the conservation of energy was more precise and comprehensive than previous formulations.

Max Karl Ernst Ludwig Planck (1858–1947), born in Kiel, studied in Munich and Berlin, where he was professor of theoretical physics (1889-1926). He was awarded the Nobel Prize for Physics in 1918 for introducing quantum theory following work on the law of thermodynamics and black body radiation.

126 www.mpg.de/english/ueber, emphasis added

127 See *The Cambridge Biographical Encyclopedia,* David Crystal (ed.), Cambridge University Press, Cambridge 1998; John Gribbin, *Science – a History 1543-2001,* Allen Lane/The Penguin Press, London 2002. For Steinbeis see www.steinbeis-mba.de/institut/stiftung/stiftung~e.html

5 Research Institutes and Incentives

German Research Institutes – Summary Table[128]					
	Helmholtz Centres	**Max Planck Institutes**	**Leibniz Institutes (Blue List)**	**Fraunhofer Gesellschaft**	**German Research Council**
Number of Facilities	16	80	82	56	1
Personnel	23,000	11,000	10,000	12,000	-
Research Profile	Basic research	Basic research	R&D, and service institutions without clear profile	Applied research and development	Central public funding organisation for academic research

they have shown greater willingness to work with industrial funding and with start-ups.[129]

THE LEIBNIZ ASSOCIATION

5.6 The Leibniz Association (Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz or WGL):

"is one of Germany's four non-university research organisations. It was established in 1995, but dates back to 1977, when decisions were made about research institutes to be jointly funded by the Federal and Länder Governments. Its members are occasionally referred to as Blue List Institutes, an expression taken from the fact that the first list was drawn up on blue paper. The association has [...] 34 [facilities] based in the eastern federal Länder. The WGL includes 54 institutes, which are committed to strategic basic research, seven museums with research branches, and 18 service facilities, such as specialist libraries and sample collections […] Some key future developments of the Leibniz Association will be the introduction of funding mechanisms to increase the competition between the individual institutes and to improve the exploitation of their scientific potential for the benefit of society."[130]

Bayern Offensive

One of the most high-profile and comprehensive forms of government intervention in innovation and entrepreneurship has been the Bayern Offensive, described succinctly on the British Embassy website: "In 1994, the Bavarian State Government launched the 'Offensive Zukunft Bayern' an initiative to promote new technologies in Bavaria. Under parts I and II of this programme (1994-1999), the Bavarian state invested some DM5.6bn obtained through privatisation of companies owned by the state. In 1999, the Bavarian government announced that it would invest a further DM2.6bn in the third phase of the programme starting in 2000. Most of the funding – DM2.3bn – would be devoted to the 'High-Tech Offensive'."[133] The move towards life sciences, notable in Bavaria, represented a policy departure for Germany: "[…] as a result of twentieth-century German history, there is a public (and constitutional) resistance, particularly to genetic research within Germany. Thus biotechnological and genetic research tended to be conducted by small companies abroad (especially the USA)."[134]

HELMHOLTZ

5.7 The Helmholtz Association[131] of 16 institutions exists mainly for basic research and is one of the biggest employers of qualified scientists in Germany. However, its work varies greatly in terms of the size and responsibilities of its constituent members:

"We must differentiate between research centres with a mission in basic and prophylactic research and those with more technology-oriented tasks, for which the question of knowledge and technology transfer plays an appreciable role."[132]

128 See Meyer-Stamer & Wältring (2000) p25, citing Andreas Stamm (1996), *Wirtschaftsnahes Technologiemanagement – Erfahrungen aus Deutschland und Implikationen für die fortgeschrittenen Länder Latein-amerikas,* Berlin DIE, p20

129 Schmoch, Licht & Reinhard (2000)

130 www.wgl.de/leibniz_association.htm

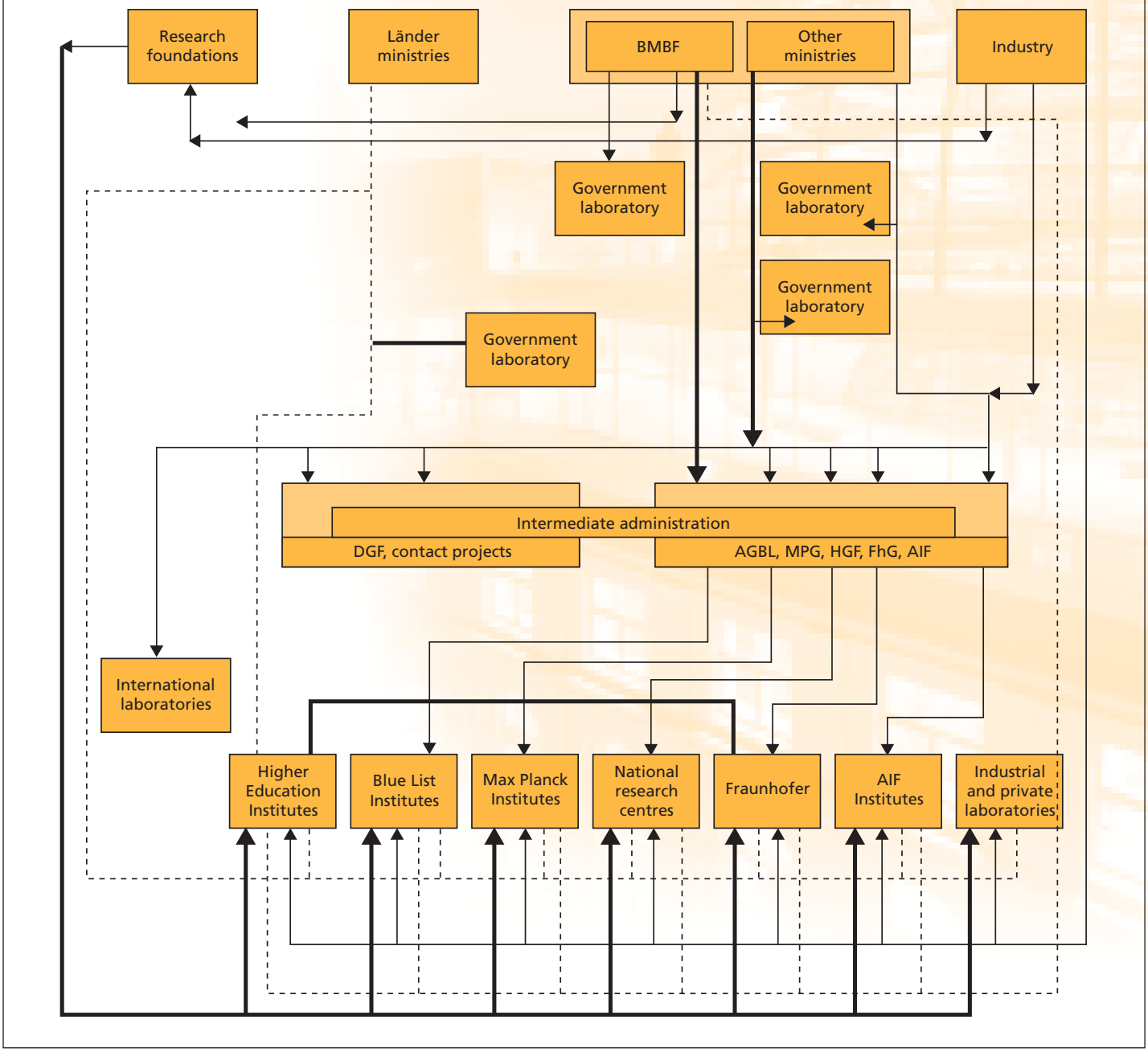
131 www.helmholtz.de

132 Schmoch, Licht & Reinhard (2000)

133 ww.britischebotschaft.de/en/embassy/r&t/notes/rt-note01.3047(M)_CentreOfCompetence.html

134 Harding & Soskice (2000) pp87-88

Organisation of the German R&D System[135]



AN-INSTITUTES

5.8 In addition to the networks of formal research institutions and the Steinbeis Foundations, more informal organisations known as AN-institutes have recently begun to play an active role in the practical application of research:

"First, institutions have existed within the German technology-transfer system that reflect the market-based incentive structures that support radical innovation. For example, AN-institutes emerged in the late 1990s as major sources of dynamism and comparative advantage in innovation. These structures are not new, however. AN-institutes were first established in the mid-1970s to plug the perceived hole in the cascade model that meant that prototypes were not reaching the

135 Harding & Soskice (2000), who comment that "To argue that the system is complex is something of an understatement." pp86-87

market as viable products. The AN-institutes, funded largely by contract research, were given clear incentives to assist in the production of such marketable goods."[136]

GRANTS, SOFT LOANS & INCENTIVES

5.9 If Germany has an insufficiency of venture capital and limited specialist banking services for the innovation sector, European, federal and regional programmes have increased in numbers to fill the gap. However, by concentrating funding at specific points (such as start-ups) and by increasing the tax burden, incentive schemes may be "crowding out" more effective private sector solutions. In analysing government funding schemes in Germany, two problems recur frequently: the variety of schemes almost defies classification; and little work has been done until recently to evaluate them.[137] We were informed by one specialist agency that in the area of new firm support alone there are more than 200 separate programmes. Grants and incentives operate at the critical point where the social market in seeking to address weaknesses may in fact be reinforcing them.

5.10 A recent review of the Mittelstand prepared by the Gerhard-Mercator University in Duisburg commented:

"It is impossible to portray all existing institutions. Due to the increasing attention which was given to SMEs in the last three decades, hundreds of support programmes were introduced and more than 1000 organisations work in the field of economic support, mostly in a decentralised way. This may be one of the most important features of the development of SME policies during the last 30 years."[138]

5.11 However, the contrary view emphasises the critical role of state measures and government funded-institutions in kick-starting Munich as a serious cluster:

"The underlying causes of continued high technology growth in Munich are underpinned, and in part surpassed in importance, by technology policy measures of the federal and state governments. Of all German planning regions, Munich is the best served by fully or partially state-funded research facilities. It has 13 of the 79 German Max-Planck Institutes, three of the 47 research institutes of the Fraunhofer Society, as well as two of the 16 large scale research institutions (Helmholtz-Centers) […] The volume of federal R&D support is a good proxy measure for the importance of Munich as a high technology region […] Munich ranked above the other 74 western German planning regions and continued to do so after reunification despite a decline in its share."[139]

SUMMARY

5.12 The institutional framework for knowledge transfer favours organisations outside the university context. The benefits of specialisation should be weighed against the risks of losing the cultural advantages of having teaching and research (and the enquiring energy of students) involved in the same enterprise. The wealth of government support schemes can lead to fragmentation, and Germany has reached the phase where greater evaluation of the effectiveness of government intervention is required.

136 Harding & Soskice (2000) p90. Note also that "the professors who are engaged in these associated units are very much under stress." Schmoch, Licht & Reinhard (2000)

137 In great contrast to the UK, where at the time of writing, the Lambert Review of University–Business relations and the House of Lords Select Committee on the European Union (covering the Green Paper on entrepreneurship) were studying similar ground, and the DTI was conducting its own internal review of innovation services

138 Jörg Meyer-Stamer & Frank Wältring (2000), *Behind the Myth of the Mittelstand Economy,* p21. They went on to comment: "To establish monitoring and evaluation systems and make SME support (as well as ofter meso-level activities) more performance-oriented is one of the main challenges the German system is currently confronting." ibid. p51

139 Rolf Sternberg & Christine Tamasy (1999), *Munich as Germany's Number 1 High Technology Region,* pp370-371

Entrepreneurship, Incubation and Advice

"We need a Darwinian approach to dealing with failing companies. Darwin has not come to Germany yet."

US-trained venture investor active in Germany, October 2002

"He [Adenauer] was born a Prussian subject, but as an ardent Catholic in an area of the Rhineland that had merely been thrown to Prussia at the 1815 Congress of Vienna his loyalty to Berlin was negligible. As a child he lived through the anti-Catholicism of Bismarck's Kulturkampf. As a young man, he found Bach 'too protestant' for his taste."

Lord Jenkins of Hillhead[140]

INTRODUCTION

6.1 In America for a generation at least, and in Britain more recently, entrepreneurship has become an increasingly important component of university curricula, notably at leading business schools and for students in science and engineering with an interest in commerce, particularly self-employment. "Entrepreneurship" has become a protean term, but for simplicity can be taken to combine "subjective" or personality factors (such as the willingness and aptitude of students to act on imperfect information, to take risk, to be independent and to control their circumstances) with such "objective" factors as the ability to undertake business planning, understand accounts, employ others and raise finance.[141]

6.2 Environmental factors also play a critical role. In addition to macro issues such as regulation and bureaucracy or the supply of risk capital, the availability of flexible working space, networking and mentoring through incubation are now also generally accepted as significant contributors to entrepreneurial success. In both the US and Israel, we also identified professional advisers – lawyers, accountants, consultants – as being integral to the success of start-ups. The picture in Germany is mixed, with incubation taking root but entrepreneurship lagging, and professional advisers playing a lesser role since the recent downturn.

STUDENTS AND ENTREPRENEURSHIP

6.3 Entrepreneurship as an academic subject has grown, but among the universities we interviewed (formally and informally) there was a propensity to research the subject as a "second order" activity – to study entrepreneurship as if it were musicology rather than music, or to teach students mechanics and the highway code rather than how to drive. Using a standard hierarchy (data, information, knowledge, wisdom[142]), there is undoubtedly much knowledge of entrepreneurship in the sense that numerous individual aspects have been measured and

140 Jenkins (1993) p66

141 For a morphology of entrepreneurship see Amar V Bhide (2000), *The Origin and Evolution of New Businesses,* New York, Oxford University Press, pp3-23, 319-359. The European Commission *Green Paper on Entrepreneurship* defines entrepreneurship as "the mindset and process to create and develop economic activity by blending risk-taking, creativity and/or innovation with sound management, within a new or an existing organisation." Commission of the European Communities (2003) p6

142 For a pioneering account of information theory, see Claude Shannon & Warren Weaver (1964) *The Mathematical Theory of Communications,* University of Illinois Press, Urbana

6 Entrepreneurship, Incubation and Advice

ODEON Centre for Entrepreneurship, University of Munich

ODEON was founded in October 2000 on the initiative of the Rector of Ludwig Maximilians University (LMU) and funded thanks to a DM1m donation from Rolf Christof Dienst of Wellington Partners Venture Capital GmbH. It is an inter-faculty resource jointly headed by Professor Dietmar Harhoff and Professor Dr Bernt Rudolph. It has three goals:

- Research into entrepreneurship.
- Teaching entrepreneurship.
- Commercial outreach.

More focus is placed on the first two elements and no director is specifically in charge of outreach

ODEON project managers work closely with other initiatives such as the MBPW (Munich business plan competition) and the Munich Network. In theory, this enables ODEON to integrate potential start-ups from the university in relevant subjects (biotech, ITC, dentistry). Courses such as E-Lab are claimed to be more focused than equivalent models at MIT.

There is also a form of Technology Transfer Office that has less of an IPR management role than one might expect in equivalent higher education institutes in the UK or US – Kontaktstelle für Forschung und Technologietransfer (KFT). Two Siemens Technology Accelerator spin-outs have been hosts to E-Lab teams from LMU.

The total number of students at LMU is 43,705 – ODEON core teaching programmes attract between 20 and 30 students. Fragmentation of initiatives and organisations in the Munich area is noted as a risk, and Anna-Lee Saxenian's analysis (*Regional Advantage,* published in 1994, suggested that in the early 1990s Boston was too fragmented to compete with Silicon Valley) has been studied.

With regard to the EXIST programme, six regions were shortlisted to receive federal money to coordinate entrepreneurship activities on a sub-regional basis. Only five received funding – Munich was not successful. However, the group of supporters that were brought together under the "Gründerregio-M" (GRM) umbrella have remained together (with the exception of Siemens and Munich Network) but GRM now administers other regional programmes related to entrepreneurship. These include the EU PAXIS project (linking Milan and Barcelona with Munich) and the regional Hochsprung programmes.

The Flügge programme provides funding for researchers to combine academic work with 2-3 days work on their own business projects. Flügge also encompasses social sciences (eg one start-up is based on speech recognition).

LMU has no start-up funds but Prof Harhoff intends to establish an incubator in LMU. Munich's other university, the Technische Universität München or TUM, does have incubation facilities (UnternehmerTUM GmbH). LMU will refer companies on to other sources of potential funding and support within the Munich sub-region. Only a handful of LMU bio companies received funding in 2002, so incubation space may not be a prime concern. The city of Munich has provided renovated office space on Frankfurter-Ring for new start-ups. Upside Ventures, another incubator operating in Munich, is also used by ODEON. The life science incubator and science park, together with the medical school and Max Planck Institute, are situated outside the city at Martinsried (see www.bio-m.de).

How will ODEON be funded in the future? There are several possibilities:

- Research activities will contribute some income. Examples include analysis of MBPW performance, and writing of case studies for Munich Network.
- Donations are possible but there is no alumni association for LMU. This makes the founding donation for ODEON even more remarkable.
- The university may provide funding for PhD students for 2-3 years but this limits the range of applied entrepreneurship work that can be taken on by the centre.
- It is likely that TransRegio (a German research organisation) will fund two research positions but with the same reservations as above.

Little, if any, networking with similar organisations in other regions in Germany takes place with the exception of Private Equity Conference (www.pec-munich.de), SuperReturn and the business plan competition.

143 "For example, 42 chairs in entrepreneurship were established between 1997 and 2001 […] In addition, several universities [in German-speaking countries] have designed entrepreneurship education and training programmes without establishing dedicated chairs." Nikolaus Franke & Christian Lüthje, *Antecedents of Entrepreneurial Intent among Students* (unpublished working paper) Section 1

144 This is not to imply that (university) study should only have a practical application: "impressive though the development of technology has been, the almost equally long-standing human project of understanding both the natural and the social world to the end not of increasing welfare but of reducing ignorance, confusion and misconception, is no less impressive an outcome of intellectual analysis, reflection and enquiry." Gordon Graham (2002), *Universities: the Recovery of an Idea,* p72. Cited in Martin Wolf (2002) p3. But entrepreneurship is a subject, like medicine, for which study and application go hand in hand

catalogued.[143] But in general, this knowledge is not converted into wisdom – the practical application of distilled insight – in the way that it is at such leading US entrepreneurial schools as Stanford, MIT and Babson.[144]

6.4 Despite this, some encouraging initiatives are in place to help students and other would-be entrepreneurs convert a sound theoretical framework into successful, dynamic practice. One example is the ODEON centre for Entrepreneurship at the Ludwig Maximilians University in Munich (see box study). Another, also in the university context, is the EXIST programme for new business start-ups from universities. This government-sponsored initiative is described in the Innovation Policy paper issued jointly by the Federal Ministry of Economics and Technology and the Federal Ministry of Education and Research in April 2002 as follows:

"As part of a competition for ideas, five new business start-up networks were selected for promotion in 1998 in a graduated procedure. They were "bizeps" (Wuppertal/Hagen), "dresden exists", "GET UP" (Jena/Ilmenau/Schmalkalden/Weimar), "Keim" (Karlsruhe/Pforzheim) and "PUSH" (Stuttgart). The network activities include information events and intensive public relations work to draw attention to the idea of setting up in business. A wide range of basic and further training courses related to setting up in business has been worked out and some have been integrated in curricula. In addition, measures to support concrete plans to set up a business have been taken in all the networks (eg special coaching programmes, new business guides, an exchange for reference orders)."[145]

6.5 In measuring the success of the five projects over the first four years of their operation, the federal government concluded:

"So far more than 450 innovative new businesses have evolved in the EXIST regions. A study presented last summer on courses in German universities that are relevant to setting up in business confirmed the success of EXIST. Of the seven universities that have the best attitude and activity on entrepreneurship, six are in the EXIST regions."[146]

IMPROVING ENTREPRENEURSHIP?

6.6 Can the German entrepreneurial "run rate" be improved? A recent study benchmarking Vienna and Munich Universities with the Massachusetts Institute of Technology (MIT) noted that although "MIT students' entrepreneurial intentions are stronger and more ambitious in terms of business growth,"[147] personality traits and attitudes to self-employment may be less important than environmental factors:

"The comparison between Munich and MIT students shows dramatic differences in the perception of environmental factors related to entrepreneurship. In all 10 variables, MIT students perceived their environment as more favourable, with six of the 10 variables showing significant differences. Specifically striking are the discrepancies with regard to the perception of government policy (service support and state laws) and the different image of the entrepreneur in society […] In addition, the impact of the universities is rated very differently […] *We conclude that these perceived environmental factors might be responsible for the huge differences in entrepreneurial intentions among the samples.*"[148]

6.7 Franke and Lüthje also considered the university as a specific environmental factor and concluded that:

"both German speaking universities can in no way keep up with MIT as a benchmark […] the most striking discrepancy is related to atmosphere […] The students at MIT believe to a greater extent than the students from Munich and Vienna that their lectures provide knowledge and skills which are critical for future entrepreneurs."[149]

6.8 Given that the university-specific environmental factors were the strongest (personality traits were similar in all three

Footnotes 143 and 144 appear on facing page

145 *Innovation Policy – More Dynamic for Competitive Jobs,* Berlin 2002, p26

146 ibid.

147 Franke & Lüthje, op cit, paragraph 4.1

148 ibid. paragraph 4.2.3; emphasis added

149 ibid. paragraph 4.2.4

universities, attitudes to self-employment were more favourable in Munich and Vienna), Franke and Lüthje conclude that:

"It is possible for German-speaking universities to instil a similar entrepreneurial propensity in their students by organising the entrepreneurship-related environment more positively […] Our results confirm that such endeavors will bear fruit, and that the 'sleeping beauty' of graduates' entrepreneurial activities can indeed be revived."[150]

6.9 While there is certainly considerable room to build on the hands-on approach behind such initiatives as EXIST across Germany, moving entrepreneurship away from social science discussion and turning it into an inspiring, practical activity, the list of factors to be addressed identified by Franke and Lüthje

Berlin Adlershof[151]

Adlershof, an airfield on the south-eastern outskirts of Berlin, is where the German aircraft industry has its roots. During the Cold War, Adlershof was home to the German Aeronautical Research Institute, a number of the institutes of the Academy of Sciences of the DDR, the East German Broadcasting Corporation and around 11,000 troops.

After reunification, all these activities ceased, with the Academy of Science institutes assessed and integrated into the research activities of the Federal Republic of Germany, leaving a vast swath of scientific and military buildings covering some 420ha to be put to new purpose. In 1991, a development organisation was established to create and manage a new science and technology science park at Berlin Adlershof in partnership with the Berlin Land.

Berlin Adlershof has now become the 15th-largest mixed use science park in the world, encompassing a science and technology park, various faculties of the Humboldt University, the "Mediacity", and residential developments. Aside from the traditional activities of a mainstream science park, some of the diverse activities currently underway at Adlershof include:

Humboldt University in Adlershof:[152] Six mathematics and natural science institutes of the Humboldt University – chemistry, geography, computer science, mathematics, physics and psychology – will start their teaching activities in Adlershof by the end of 2003. It is anticipated that by this point, more than 3,000 students and over 600 scientific staff and other employees will be based at Adlershof. One of the first joint projects of Humboldt University with non-university Adlershof research institutes has been the set-up of the International Humboldt Graduate School that focuses on the structure, function and application of novel materials.[153]

Ost-West-KooperationsZentrum (OWZ)[154] – East West Cooperation Centre: The OWZ was opened in September 1997 as the international incubation centre in Berlin for projects and entrepreneurs from Central and Eastern Europe. OWZ has provided facilities for 50 companies from 14 different countries since its launch.

Innovations- und GründerZentrum (IGZ)[155] – Innovation and Entrepreneurship Centre: IGZ was opened in September 1991 as an incubator for new ventures emerging from research at the various public and private research institutes based at Adlershof. IGZ has incubated over 150 new ventures since its launch.

Both the OWZ and IGZ are managed by the same company – *Innovations-Zentrum Berlin Management (IZBM)* – set up as a subsidiary of the Berlin Economic Development Corporation (Wirtschaftsförderung Berlin). This, coupled with the presence of the Humboldt University, provides a network of contacts to support integration with innovation and technology transfer activities across the Berlin region. It is interesting to note that it is anticipated that Adlershof will become a key location not only for education and research for the Humboldt, but also for practical application: "Adlershof will become the main focus of technology transfer for Humboldt University" was the clear view of the University's Technology Transfer Office.

With the dire state of the Berlin regional economy (and the city itself being bankrupt), much hope is now being placed on Adlershof providing the source and nurturing environment for the new, successful technology ventures that will drive the recovery of the Berlin (and then German) economy. Growth to date has been spectacular in terms of firms moving to Adlershof (see separate table) and levels of public and private investment (over €1.5bn up to 2001). Whether this growth can be maintained along the levels predicted and turned to active wealth creation remains to be seen.

150 ibid. paragraph 5.1
151 www.adlershof.de
152 www.hu-berlin.de/hu/adlershof
153 www.graduate-school.hu-berlin.de
154 www.izbm.de/english
155 ibid.

themselves is daunting. General environmental factors include market pressures, financing difficulties, government policy and the image of entrepreneurs in society. Perceptions specific to universities, when contrasted with MIT, include the lack of an inspiring atmosphere, the lack of relevant training, the unlikelihood of the university actively promoting the founding of new companies, the dearth of investor networks and the infrequency of multi-disciplinary student team-building.

EASTERN WINDOWS

6.10 Nevertheless, where the existing commercial environment offers relatively limited high-value employment prospects (in Dresden, for example) we found that entrepreneurship may not only benefit from government resources (channelled through "dresden exists" in that particular instance) but may also gain significant momentum of its own. In addition to market necessities created by the absence of sufficient "mainstream" employment opportunities, it was put to us that a number of locations in the former East Germany benefit from a combination of structural and cultural circumstances. Property and other costs are lower (especially where exemptions to national pay regimes apply); in some (but far from all) locations, quality of life is good; researchers in the East were often application (though not market) oriented; and owing to limited access under the *ancien régime* to "benchmark" western technology, they developed a rare capacity for work-arounds or improvisation. Some locations – Dresden, Berlin – are also becoming trans-regional hubs for innovators in the rest of Mitteleuropa.

BUSINESS INCUBATION

6.11 One of the earliest examples of a true business incubator in Germany can be found in Berlin. The Berlin innovation and business incubation centre (Berliner Innovations- und GründerZentrum – or BIG[156]) was opened in 1983 at the site of a former AEG production facility. This is now part of the integrated network of technology, innovation and business incubator centres across Berlin that includes the significant developments at the Berlin-Adlershof location (see box – Berlin Adlershof).

6.12 Business incubators have since become "one of the most important instruments of regional and urban development in Germany."[157] Recent research shows that there are now around 330 "technology centres" in Germany that demonstrate the characteristics of business incubators. In Germany, incubators are classified for the purposes of eligibility for grants and for benchmarking purposes as follows:[158]

- **Technology centres –** where between 75% and 100% of the tenants are classified as technology-based firms.

Berlin Aldershof, a Major Mixed-Use Science Park

	Companies / Institutes	Workplaces	
		As per: 1/2003	Planning up to 2010
Science and technology park	360 companies	3,600	20,000 including seven institutes with 620 employees and professors
	12 extra-university research institutes	1,450	
MEDIACITY	124	970	
Business park and services	175	4,100	
Humboldt University	3 institutes	360 scientific employees and professors	
		2,750 students	6,000 students
Total	**674**	**10,480 +2,750 students**	**20,000 6,000 students**

Source: www.adlershof.de

156 www.izbm.de
157 Nolan (2001)
158 CSES (2002)

6 Entrepreneurship, Incubation and Advice

- **Technology-orientated incubators (*Gründerzentrum*) –** where between 50% and 74% of tenant firms are classified as technology-based firms.

- **Business centres (Gewerbezentrum) –** where less than 50% of tenant companies are defined as technology-based.

6.13 The centres are regularly surveyed by the Association of German Technology Centres (Arbeitsgemeinschaft Deutscher Technologiezentrum, or ADT[159]) to help ensure the capture and dissemination of best practice. The ADT was founded in 1988 and has a membership of around 200 incubators.[160] The ADT has been active in promoting linkages between German incubators and those being established in Eastern Europe through its "Innovation Centres in Eastern and Central Europe" or ICECE as part of its Science Park and Innovation Centre Expert Group.

6.14 The Technologiezentrum Stuttgart (see box) provides an example of many of the features of a typical German business incubator: links to local universities and research institutes, strong local business and public sector network and supporters, and a strategy that reflects the evolving relationship with university technology transfer functions

TTI GmbH – Business Incubation at the Technologiezentrum, Stuttgart

The Technology Centre was constructed in 1984 as one of the first tech centres in Germany but at the outset was nothing to do with the university, simply a building for start-ups and erected during the era of Lothar Späth, the former prime minister of Baden Württemberg and now chief executive of Jenoptik AG.

The Centre's current manager had worked in technology transfer administration for Stuttgart University since 1995 and was intrigued by this Centre with no apparent relationship with the University. The building was the property (*Eigentum*) of a consortium of banks headed by the Landesbank Baden Württemberg. Difficulties were encountered filling the space with tenants, which is no longer the case under the new management. Since 1998 the Centre has been managed by TTI.

TTI was initiated by Prof Dr rer nat EW Messerschmid (of the Department of Aeronautics and Aerospace, Germany's first astronaut on Challenger in 1986). He established TTI not just to provide services but to be domiciled in this building, "so bringing the two chains together and henceforth connecting the University and the incubator".

Two years ago a new storey was added but the building is still not oversized given the potential for its services. The university Rector is considering a new technology centre nearby but this will require external investment.

There are 25 firms on-site, half of them university start-ups. The rest are from the Fraunhofer or other interdisciplinary development centres requiring space outside the university for projects close to market. Rents are subsidised by the Ministry of the Economy; this has been declared legal until 2006. Start-ups are subject to step rents: first two years €6/sq m; then €7/sq m; after year five €9; after eight years market rents (€12). Units are flexible with dismountable partitions. Unit sizes range from 20sq m to 200sq m but more than one room can be rented if required. Six months' notice to quit is standard.

TTI has five shareholders:

- The University of Stuttgart.
- The Alumni association (see below).
- The Steinbeis Foundation (see below).
- The Centre of Technology of Stuttgart-Pfaffenwald GmbH (previously owner of the Centre, which has recently offered its shares to the University).
- Circle of sponsors of business administration at the University of Stuttgart (in effect, the association of friends of TTI).

The Alumni association (Vereinigung von Freunden) is more of a business circle than a conventional alumni association, but many CEOs of both large and Mittelstand companies are former Stuttgart students.

The Steinbeis Foundation has its headquarters in Stuttgart and is responsible for running the administration of tech-transfer projects in universities. Steinbeis centres are *ad hoc* and led by individual professors. Services provided include template legal format, accounting and regulatory requirements. Use of Steinbeis services is voluntary, but common, especially in Fachhochschulen as the model can be rolled out and all services are systematised. A management fee of 9% of income is

159 www.adt-online.de

160 Details of all ADT member organisations are listed at www.adt-online.de/mitglieder/ordentliche.htm

following the change in the law on ownership of academic IPR.

PROFESSIONAL ADVISERS

6.15 In the US, we found lawyers cited as the professional advisers most frequently sought out by entrepreneurial technology firms at early stages: the need to protect intellectual property was dominant, and legal advisers were also often seen as a route into the more select or active venture funds. In Israel, accountants were often the first port of call; to succeed, an Israeli firm needs to become international (or at least American) at the earliest possible opportunity, hence the need to retain from the outset one of the major accountancy practices with a global franchise and to implement US GAAP.

6.16 In Germany, few entrepreneurial firms mentioned either lawyers or accountants – or banks – as important sources of advice at early stages. Management consultants were prominent at the height of the market (as one investor put it, "they want early sight of product to push to their other clients"), sponsoring or participating in business plan competitions or even establishing in-house funds. Their presence has been more muted since the downturn, and firms with minimal seed capital rarely have the funds to pay for

charged. Steinbeis companies are to be found all over Germany but are most concentrated in Baden Württemberg.

TTI provides effective competition for Steinbeis at the University of Stuttgart, with similar administration and accounting services and a charge-out rate of only 7%. Either way "principal investigators" can act with the outside world as if they have a limited liability company and at the same time are provided with the legal framework for dealing with intellectual property, technology transfer, and funding issues. It took two years for the TTI legal framework to be accepted by the Ministry, given the public finance/private resource potential conflicts. TTI takes away the administrative burden and can employ staff at standard rates. Both TTI and Steinbeis act as a "pre-incubator" enabling the researcher to try out a business concept before establishing a company.

Until February 2002, intellectual property was vested in the researchers; under the new federal law such rights rest in a university, but this has not proved an insuperable problem. If a researcher has a commercial idea she/he can call for support from the technology licensing office responsible for all Baden-Württemberg universities. If the proposal is to license out, this will be dealt with centrally but if the researcher seeks to exploit the research in a personal capacity, support is provided through each individual university. The university must decide at the outset whether it wishes to claim the IPR for itself and spin-out decisions are always made at the level of the local university.

At Stuttgart, university protocols ensure one-third of licensing economic benefit accrues to each of the inventor, the institution and university itself. The university uses this income to support its technology transfer activity. The current system encourages individual solutions (which "may not be easy but can be found"). Previously researchers used to have to leave the university "to have a good idea". The university has some 300 chairholders in 10 faculties (reduced from 14 in 2002), some 17,000 students and 5,000 staff. TTI is an agent for PUSH! on campus.

The following results have been achieved by TTI since 1998:

- 203 founders (16 women).
- 140 founding projects.
- 93 companies.
- 46 sponsorship commitments.
- 12 programmes under the banner of "Junge Innovatoren".
- Eight programmes under EXIST-SEED.
- 25 companies currently as tenants in the Centre (12 being university spin-outs).

Sponsorship commitments and Junge Innovatoren programmes include use of university resources such as laboratories and IT for free. Many companies find TTI provides value beyond tangible support: it is a partnership in an information-rich environment. The tangible support is nevertheless impressive: conference rooms, exhibition stands, free high-bandwidth connectivity provided by the university, Porsche and DaimlerChrysler. In addition to day-to-day advice from the incubator manager, tenants benefit from *Stammtisch* meetings (about 20 people once a month); social events are held twice a year for the wider network of some 100 people at a variety of locations, including the Fachhochschule in Esslingen and Hohenheim University.

professional or consultancy services. Many appear to rely mainly on the added-value provided by incubators and related organisations, such as Land-sponsored business promotion agencies.

SUMMARY

6.17 Although entrepreneurship, especially university entrepreneurship, is not as embedded in German business culture as many commentators and policy-makers wish, related features – including incubation – are making considerable inroads through a plethora of grass-roots initiatives. The image of the former East Germany is not high in the West (and most westerners have not visited the Neue Länder, apart from Berlin) but seeing a limited number of research-intensive locations in the East as potential future "winners" is not simply *Ostalgie*: the applied approach and historical need to improvise are beginning to outweigh a lack of commercial experience in some growing centres.

Siemens Technology Accelerator

The Siemens Technology Accelerator (STA) has no overlap with equity investment, although it does share a board member with Siemens Venture Capital. Other incubators within Siemens include one at Berkeley (Technology to Business (TTB)) and one other in Germany (Siemens Mobile Application Center (SMAC)). The Corporate Technology Group, of which STA forms part, is the "guardian" of intellectual property (IP) within Siemens, regardless of who financed it. The basic principle is "If you spin-out a business, Siemens must not be harmed and the IP will be on a non-exclusive back-licence to Siemens when VCs invest."

The six companies in the portfolio as at September 2002 were chosen out of 250 proposals; the overall success rate is 2.5% but is considerably higher for internally sponsored projects.

In general STA assigns 50% of costs to a start-up, with the rest being borne as accelerator overhead. Total expenditure per deal is around €500,000. "This is not very much, our attitude is near to stinginess. Every opportunity to use people on a 'free lunch' basis is taken." Costs are also reduced by limiting the incubation timeframe. Costs and time are also saved by using existing companies to adopt new technologies, ie a technology with an agreed business model is "reversed" into an existing corporate vehicle.

Critical steps identified by STA are:

- Selection process.
- Domain-specific experts whether within or without Siemens.
- Market experts including "Fallen Angels".
- Selection of CEO. The risk-profile of these deals is tough. STA is not just interested in smaller improvements in a crowded market.
- Incentives at the time of transfer. What is the executive salary, will they get share options?
- IP transfer is critical and as discussed above must not damage Siemens.

To be taken on, a proposal must have a Siemens relationship but need not be Siemens generated. Contrast this with Siemens Venture Capital, which focuses on external companies. For STA, commercialisation of non-core Siemens projects has become the mission. "We feel entrepreneurs have turned away from VC as valuations are too low and as technology is best brought forward within small firms, you no longer need the big vision. The start-up market in Munich has dried up somewhat, there are too many support networks and organisations for entrepreneurs and technologists – they should consolidate."

"We did not use to need Government funding but now we make it possible from the outset." This means ensuring that majority ownership remains with the management team at the beginning and that Siemens may never own more than 49% of the equity. This in turn may mean that investment by SVC is a disadvantage from a regulatory point of view, as Siemens could be considered to be majority owners. Technology is transferred by share ownership, for example by non-voting participation rights."

Germany and the Factors for Successful Clustering

The 10 factors identified by Professor James F Gibbons of Stanford University as necessary for high-tech clusters may need some adaptation from market to market. However, how well does Germany score according to this list?[161]

Universities and centres of academic excellence: Germany has a respect for learning throughout society but no Ivy League. Both the public and the private sectors invest relatively highly in R&D by OECD standards. Universities, which traditionally have not engaged at the institutional level with the community, have been complemented in their research and commercialisation work by organisations such as the Fraunhofer Gesellschaft. However, it is only recently that technology transfer has been a major item on the university agenda, and hiving off commercialisation to separate institutes loses some of the vitality and anti-hierarchical élan of anglophone universities.

Entrepreneurs with marketable ideas and products: as in the US in the 1980s, entrepreneurship is becoming an issue not through choice but by necessity. During the height of the market (1996-2001) entrepreneurs had a cachet, as Munich, Stuttgart, Berlin and other cities set up networks to foster new business creation. More recently, the pendulum has swung back away from risk-taking as a business strategy, and having a "broken CV" (as it was put to us) is still actively avoided. But as large corporations make skilled employees redundant and young graduates cannot find jobs, self-employment may be a least-worst option. Necessity, plus a redundancy cheque, spawned much of the new wave of entrepreneurship in the US;[162] the jury is still out as to whether it will achieve the same in Germany.

Business angels and established seed funds: some notable attempts to bring angels, advisers and opportunities together have been witnessed in recent years, one example being the Munich Network. However, real (hands-on) angels need to have had personal entrepreneurial experience, preferably several times over. Given that the current phase of innovation only started around 1996 and is going through a plateau, not enough experienced, wealthy managers exist to inject new momentum into Germany's entrepreneurship movement. Seed funds are often supported by the government, which is admirable insofar as a market failure is being addressed. However, the market is showing only sporadic signs at best of filling the gap once the pump-priming role has concluded.

Sources of early-stage venture capital: insufficient funds exist to take up the baton from where the seed-funds leave off. Hitherto, many seed investors have had a tacit role in business creation as part of regional or sector policy (eg, life science start-ups in Bavaria). From now on, much consolidation among early-stage tech investees is inevitable as the original investors no longer have the funds to support their entire portfolio while they wait for a third party investor at the next round. Many fledgling clusters will go from company "creationism" to commercial "Darwinism" in the space of three or four years.

Core of successful large companies: Germany has some of the most respected corporations in the world and is a leader in a range of fields for which a technology background is essential, from chemicals and electronics to the auto industry and pharmaceuticals. Spin-outs have not been integral to the business model of most such corporations (with one or two notable exceptions, such as Siemens). The traditional approach ("Deutschland AG"), based on technical excellence and niche marketing, may be being replaced by a more internationalist trait ("Germany Inc") but this has been taking place at a time of reduced profits and constrained resources. The need to work with spin-outs and start-ups, as corporate venturer or seed investor, is greatest as funds and appetite for new ventures are lowest.

Quality management teams and talent: German management is well, often highly, educated and there is a large pool of managers with experience in large technology-driven companies. However, larger German companies, with some exceptions (such as BMW), have tended to be technology-driven rather than market-led. This, combined with an historic "job for life" mindset among managers, has held back the highly adaptable, entrepreneurial culture which has characterised the most successful new technology-based businesses, especially in the US or Israel. That said, there seems to be a shift starting in the attitude of younger technologists and research scientists, realising that liftetime employment is gone, towards a more entrepreneurial view of technology and a preparedness to get involved in start-up and early-stage businesses.

Supportive infrastructure: Germany has a well-developed infrastructure with excellent physical and electronic communications. The investment in these, especially in the eastern Länder, over the last 10 years has given the country among the best rail and telecommunications systems in Europe.

Affordable space for growing businesses: space is available, though incubators and incubation should never be confused. BioM, the Munich-based biotechnology network and investor, has its offices in the new purpose-built Campus Martinsried focused on meeting the needs of growing life sciences businesses and several of the technology-based universities have made the provision of incubator space for spin-out businesses a priority. As an example, the Technical University of Munich has developed an incubator at its physical sciences campus at Garching.

Access to capital markets: the equity culture was never deeply entrenched in an economy heavily reliant on the banking system. Germany is now going through a "triple whammy" as the pendulum swings against stock market investing in the aftermath of the Neuer Markt débâcle, as major banks cut back on their exposure to start-ups and the Mittelstand in anticipation of the new Basel 2 capital adequacy regulations and as established public corporations (newly conscious of the needs of shareholders in a world economy) tighten up on terms of trade and supply chain networks.

Attractive living environment and accommodation: Germany has never suffered from a shortage of attractive places to live – from the beauty of Bavaria and its proximity to some of the world's best winter sports resorts to the sophisticated and cosmopolitan atmosphere of Berlin. The German standard of living remains one of the highest in Europe and attracting, or retaining, talent to live and work in the country is not an obstacle to the development of the technology-based economy. Nonetheless, there remain some drawbacks, including high personal taxation and social taxes.

161 Presentation to the Cambridge Network Ltd, 17 March 1998, Robinson College, Cambridge. See *Funding Technology – Israel and the Virtues of Necessity* (2002) p55

162 See F*unding Technology – Lessons from America* (2000) p37

6 Entrepreneurship, Incubation and Advice

Annex A – Research Institutes in the Länder of United Germany

A Annex A – Research Institutes in the Länder of United Germany

Annex B – German Company Structures

The following is an updated version of the summary originally published in *The Mittelstand – the German Model & the UK,* Midland Bank plc, Corporate Finance Department, London 1994.

INTRODUCTION

One of the technical reasons why a direct comparison between the UK and Germany can be difficult is the fact that common business entities in each country tend to be established on different bases. Set out below is a summary of legal forms of business organisation in Germany.

As in the UK, businesses commonly take one of three forms in Germany: a sole proprietorship (*Einzelfirma*); a partnership (*Personengesellschaft*); or a limited liability company (*Kapitalgesellschaft*). Both partnerships and limited companies can be further sub-divided.

LIMITED COMPANY: AKTIENGESELLSCHAFT

Limited companies may be either *Aktiengesellschaft* (AG), which is essentially a public company; or they may take the form of a *Gesellschaft mit beschränkter Haftung* (GmbH), a private company.

The AG is comparable to a public limited company in the UK. It can legally issue shares (minimum capital DM100,000, now €50,000) as proof of ownership, either in bearer or in registered form, though in contrast with the UK bearer stock is more common. Preference shares may also be issued in addition to ordinary shares: while preference shares may be issued with or without voting rights, they must carry a preferential right to cumulative dividends when profits are distributed.

Ordinary shareholders would normally be entitled to a proportionate share of total distributed profits (after preference shareholders have been paid) and to voting rights. But the voting rights of a shareholder may be subject to restrictions in the Articles, limiting the maximum number of votes any one member can cast.

AGs are required to disclose financial results. The balance sheet and profit and loss account must be prepared on an annual basis and generally be audited. They must also be filed with the Commercial Register. Small and medium-sized AGs are allowed to file their financial statements in modified form.

AGs are required to have an annual general meeting of shareholders. Some decisions are reserved for shareholders in general meeting: approval of a distribution of profits proposed by management; changes in equity capital; proposed mergers and liquidations. The shareholders in general meeting will also elect shareholders' representatives to the supervisory board, and may vote on the dismissal of members of the supervisory board or the management board.

DIFFERENCES BETWEEN GERMAN AGs AND UK PLCs

An AG and a KGaA (*Kommandit Geselllschaft auf Aktien* or limited partnership with a share capital) are required to appoint a supervisory board (*Aufsichtsrat*) in addition to the management board (*Vorstand*). AGs with 2,000 or fewer employees must have one-third of the Aufsichtsrat board members elected by the workforce, with the balance elected by shareholders.

Where the AG has more than 2,000 employees, half of the supervisory board members must be elected by the employees. In these cases, the chairman of the supervisory board will be elected either by a two-thirds majority of all members or, if this cannot be achieved, by the shareholder representatives; in the event of deadlock, the chairman will have a casting vote.

The shareholder representatives on the Aufsichtsrat are elected at the shareholders'

B Annex B – German Company Structures

general meeting, usually for the legal maximum of a five-year term. It is also common for the employee representatives to be elected for the legal maximum of five years, and for the majority to come from the works council, with the balance being external trade union representatives.

For an AG with between 2,000 and 10,000 employees, the law requires the supervisory board to have 12 members; 16 where the employees number between 10,000 and 20,000; and 20 where there are more than 20,000 employees.

The legal function of the supervisory board is to control the management. It has the right to appoint and dismiss members of the management board and to fix their salaries. It is not directly involved in management but may require whatever information it deems necessary from the management board, which in turn must inform the supervisory board of policy, performance and the conduct of the business. Depending on the AG's Articles, the supervisory board may also be required to approve major decisions of the management board.

GESELLSCHAFT MIT BESCHRÄNKTER HAFTUNG (GMBH)

The contemporary LLC or limited liability firm prevalent in the developed world for professional practices is believed to owe much of its origin to the German law of 1892, authorising the Gesellschaft mit beschränkter Haftung, though the State of Pennsylvania had enacted a law in 1874 authorising the limited partnership association, which was extensively used.

The GmbH is comparable to the UK private company, but it does not usually issue share certificates and its capital is divided into "business interests" (*Geschäftsanteilen*) rather than shares. If the Articles do permit share certificates to be issued, these are not proof of ownership. Transfer of ownership can only be effected in front of a notary. As with a UK private company, transfer of ownership may require the consent of the other owners, depending on the Articles.

The minimum capital for a GmbH is €25,000, with no upper limit. Interest paid on shareholder loans may be taxed as a dividend once given debt/equity ratios have been reached.

Managers are appointed or dismissed by the general meeting of the owners. A GmbH with more than 500 employees must have a supervisory board as well as a board of managers. The rights of a GmbH supervisory board are more circumscribed than the AG equivalent; it does not, for instance, appoint the managers. Rules concerning employee representation, when applicable, are the same as for the AG. A smaller GmbH may also include provision for a supervisory board in its Articles.

Since 1987 and the implementation of the fourth EC company law directive, disclosure rules for GmbHs publishing financial information are the same as for AGs. Small AGs and GmbHs are not required to file their profit and loss statements and may file their balance sheet in abbreviated form. Medium-sized companies may also file their profit and loss account in abbreviated form. Only large and medium companies are required to have their accounts audited, though an AG will be required to have its accounts audited if it is listed.

PARTNERSHIPS

German company law allows four types of partnership, of which the two most important are: a general partnership (*Offene Handelsgesellschaft* or OHG), in which all partners are jointly and severally liable for all debts; and limited partnerships (*Kommanditgesellschaft* or KG), which must have one or more general partners with full liability and limited partners whose liability is limited to their fixed contribution to the partnership. Special forms of limited partnership are the so-called GmbH & Co KG where the general partner is a GmbH; and a limited partnership able to issue shares (*Kommanditgesellschaft auf Aktien* or KgaA) and similar to a stock corporation but with one or more general partners fully liable for the company's debts.

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Appendix 1 – Organisations and Individuals Interviewed

We are grateful to the following individuals and organisations for providing us with interviews and/or written information in the preparation of this report.

MUNICH

Christian Wedell – *Copan/Munich Network*
David Ayres, Peter Kremer, Rainer Kreifels – *Hale and Dorr*
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David Amis – *Deutsche Venture Capital*
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Dipl-Kfm Gertrud Kneuer – *TTI GmbH*
Prof Dr oec Christoph Müller – *University of Hohenheim Centre of Entrepreneurship*

BERLIN

Dr Brigitte Lehman, Dr Marina Thiede, Simone Petschauer – *Humboldt University Technology Transfer Office*
Prof Dr Christian Schade – *Institute for Entrepreneurial Studies and Innovation Management, Humboldt University*
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Dr Kai Uwe Bindseil – *BioTop Berlin-Brandenburg*
Dr Carsten Heide – *ipal Gesellschaft für Patentverwertung Berlin mbH*
Dr Lorenzen, Dr Thomas Multhaup – *Federal Ministry of Economics and Labour*
Dipl-Ing Wolfgang Krug – *Wissenstransfer, Technologietransfer/Unternehmensgründungen, Technische Universität Berlin*
Dr Matthias Werner, Jürgen Ilgner – *Microtechnology Innovation Team, Deutsche Bank AG*
Prof Dr Hans Georg Gemünden, Dr Sören Salomo, Dr Thilo Andreas Müller – *Lehrstuhl für Technologie- und Innovationsmanagement, Technische Universität Berlin*

DRESDEN

Sven Reichardt, Paul Georg Guggemoos – *Dresden Exists, Technische Universität Dresden*
Prof Dr rer nat Johann W Bartha – *Institute of Semiconductor Technology & Microsystems, Technische Universität Dresden*
Dr Ann De Beuckelaer, Dr Marc W Hentz – *Biopolis Consultants*

Organisations and Individuals Interviewed

FRANKFURT

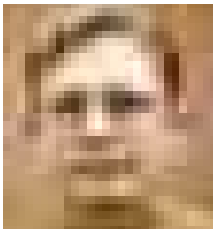
Prof Dr Thomas Heimer – *Hochschule für Bankwirtschaft*
Richard Willis – *Deutsche Börse*

UNITED KINGDOM

Dr Rebecca Harding – *London Business School and The Work Foundation*
Daniel Rosenberg – *Taylor Wessing*
Dr Phil Larkin – *Trade & Industry Committee Specialist, House of Commons*
Professor Gordon Murray – *Exeter University*
Gordon Duncan, David Hawkins – *Dunhaw Capital Limited*
Deno Fischer – *Xbridge Limited*

Appendix 2 – Report Authors

David Gill is Head of the Innovation & Technology Unit at HSBC Bank plc in London. The Unit develops products and services to assist technology-based early-stage companies. These have included establishing HSBC Chairs of Innovation at Brunel University and at the University of York, and a network of Technology Banking Managers across the UK. HSBC has recently supported a number of technology entrepreneurship projects, such as the Iceni Seedcorn Fund and the PARK Seed Fund, and is a founder sponsor of *inter alia* the Cambridge Enterprise Conference and UK Business Incubation. David is a member of the Enterprise Panel, a member of the London Development Agency Innovation Steering Committee, an Industrial Fellow of Kingston University Business School, a member of the advisory board of the University of Reading Centre for Entrepreneurship and a Fellow of the Royal Society of Arts. Educated at Cambridge, David qualified as a barrister before working in corporate finance for US and UK banks. He also holds an honorary degree from Brunel University.

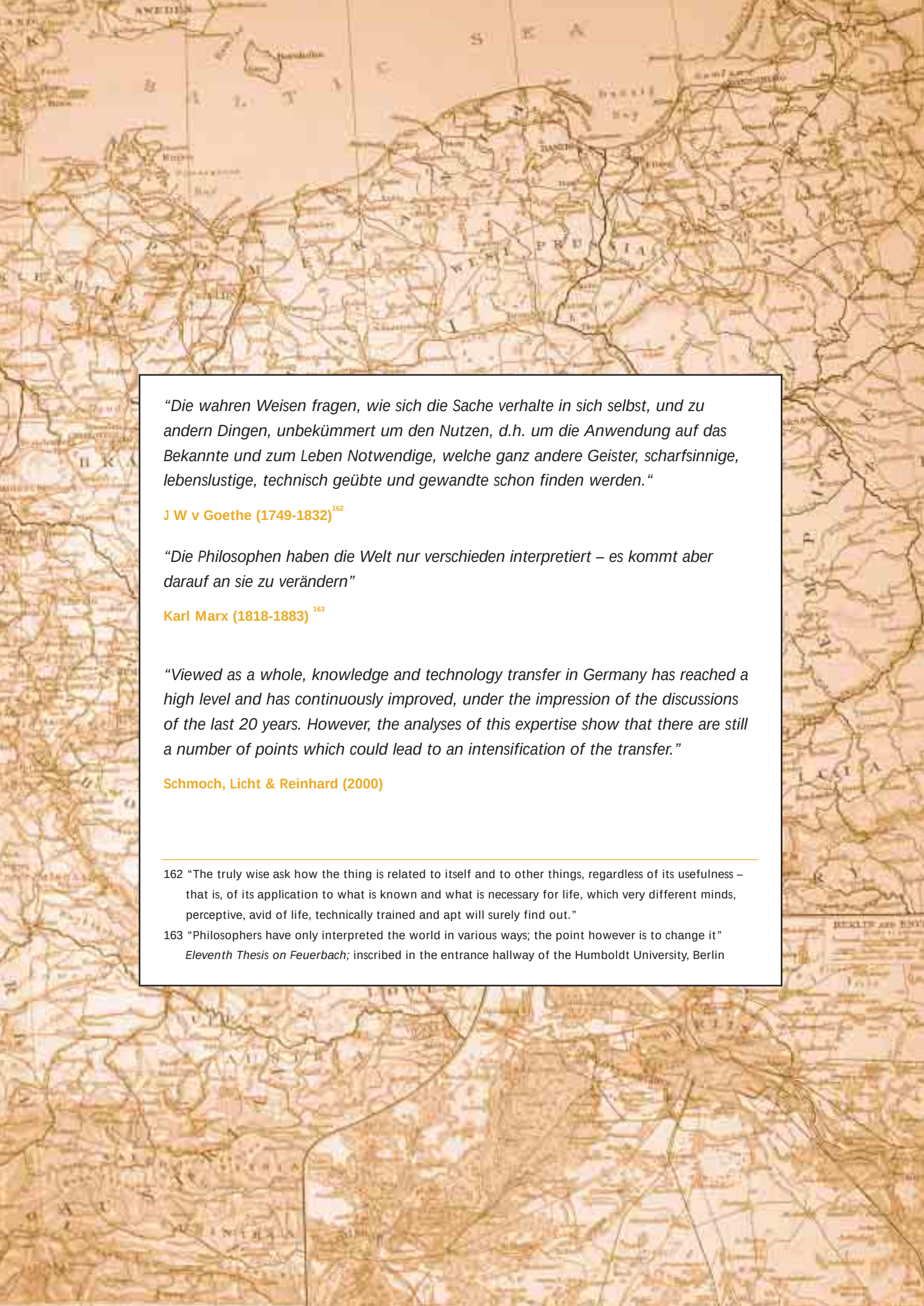


Tim Minshall is a lecturer at the University of Cambridge Centre for Technology Management. Since moving to Cambridge in 1993, he has worked on a wide range of activities in the fields of innovation and technology entrepreneurship as a researcher, consultant and company director. Prior to joining the University of Cambridge in 2002, he worked for St John's Innovation Centre Ltd, Cambridge, managing a series of projects, funded in part by the Gatsby Charitable Foundation, to support technology transfer in the Cambridge area. One key area of activity was the business planning, fundraising and interim management for the University of Cambridge Entrepreneurship Centre. He is currently a member of the board of St John's Innovation Centre Ltd. Tim has a bachelor's degree in engineering from Aston University, and a PhD from Cambridge University Engineering Department. Before moving to Cambridge, he worked as a plant engineer, consultant, teacher and freelance writer in the UK, Japan and Australia.

Martin Rigby is a venture capital fund manager based in Cambridge. He joined the Cambridge office of 3i in 1986 as a specialist investor in start-up and early stage technology businesses. In 1992 he founded ETCapital Limited. He has made investments in nearly forty technology businesses over the past 16 years. He sits on the boards of six investees of QTP (one of the funds managed by ETCapital), including: Bango.net, gosurprise, Impak, Oi! Bagel, Force12 and WAX info. He is also a non-executive director of the Cascade Seed Fund. Martin read history for his first degree at New College, Oxford, and was a regular army officer for seven years before completing an MBA at Cranfield University.

All of the authors also co-wrote *Funding Technology – Lessons from America* (2000) and *Funding Technology – Israel and the Virtues of Necessity* (2002).

Appendix 2 – Report Authors



"Die wahren Weisen fragen, wie sich die Sache verhalte in sich selbst, und zu andern Dingen, unbekümmert um den Nutzen, d.h. um die Anwendung auf das Bekannte und zum Leben Notwendige, welche ganz andere Geister, scharfsinnige, lebenslustige, technisch geübte und gewandte schon finden werden."

J W v Goethe (1749-1832)[162]

"Die Philosophen haben die Welt nur verschieden interpretiert – es kommt aber darauf an sie zu verändern"

Karl Marx (1818-1883) [163]

"Viewed as a whole, knowledge and technology transfer in Germany has reached a high level and has continuously improved, under the impression of the discussions of the last 20 years. However, the analyses of this expertise show that there are still a number of points which could lead to an intensification of the transfer."

Schmoch, Licht & Reinhard (2000)

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162 "The truly wise ask how the thing is related to itself and to other things, regardless of its usefulness – that is, of its application to what is known and what is necessary for life, which very different minds, perceptive, avid of life, technically trained and apt will surely find out."

163 "Philosophers have only interpreted the world in various ways; the point however is to change it" *Eleventh Thesis on Feuerbach;* inscribed in the entrance hallway of the Humboldt University, Berlin

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