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Do the Country-Specific Definitions of Knowledge Converge?

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Contents

1. Introduction: Country-Specific Definitions of Knowledge

In different countries, dominant definitions of knowledge and information prevail and structure politics, especially in the fields of research and development (R&D), education, arts and culture, and the media. In 1962, for example, Machlup described the country-specific understanding of knowledge in the United States by pointing to the "idiosyncrasy in favour of the immediately practical and against the general theoretical" (1962: 202). Lane, in 1966, picked this up and concluded: "The United States has been slow to recognise the importance of scientific knowledge (...). Although, in some ways, science grows out of technology, it is often the other way around; even in technology the United States in the 19th Century tended to lag behind Europe" (1966: 652).

The arena of who defines, which knowledge and information is produced, disseminated and stored, varies in each country. Yet, the level of pluralism or singularism in defining knowledge is generally related to the degree of democratic or authoritarian rule exercised by each country's government and enabled by its political system. Furthermore, the definition of knowledge is strongly influenced by the structural realities, i.e. political system, historical experiences, economic situation etc. in each country. Consequently, country-specific definitions of knowledge exist, each of which being a unique result of the structural realities and power interplay in the specific country.[1]

In order to shed further light on these hypotheses, this paper focuses on the definitions of knowledge and information prevalent in Germany and Singapore. I ask (a) which types of knowledge and information, together with their production and dissemination, are regarded as valuable and worthy of support and (b) in what way are these definitions of knowledge influenced by the structural realities of those countries. Due to a change in focus regarding the definitions of knowledge in both countries, the former highly differing knowledge definitions have recently become increasingly similar. This leads me to the third question underlying this paper (c): Do the dominant definitions of knowledge in Germany and Singapore converge and is this at all possible with regard to the countries' wide structural differences?

The assessment is based on the state fundings for R&D[2], education and cultural activities (museums, libraries, etc.), as well as statements of interview partners.[3]

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[1] See also Wall (2006) on power/knowledge interactions in Uzbekistan.

[2] As the main instruments of state-financed R&D-support, three categories can be identified: (a) direct support via state funding; (b) indirect support via tax reductions due to the fulfilling of private welfare criteria; as well as (c) the creation of a positive R&D-climate including positive R&D- and educational policies, high technology acceptance and transfer, as well as an effective legal, financial and information infrastructure (Heinrich, 2003: 76-85; Vogel, 2000: 139-154). Furthermore, privately-financed R&D significantly shapes the definition of knowledge. Due to space limitations, this paper nevertheless focuses on state funding and merely states its relation to private R&D funding.

[3] The research forming the data base for this paper was originally conducted for my PhD-thesis on the construction of k-societies. Consequently I would like to thank my supervisors Prof. Dr. Hubert Knoblauch, TU Berlin and A/P Dr. Tong Chee Kiong, National University of Singapore. Furthermore, I want to express my gratitude to Prof. Dr. Solvay Gerke and Prof. Dr. Hans-Dieter Evers, Centre for Development Studies, University of Bonn who had introduced me to the topic of knowledge governance in Southeast Asia during a research project at the University of Bonn and together with Caleb Wall and Verena Christmann made the publication of this paper possible.

2. The (structurally determined) Defining of Knowledge

The main question probes which knowledge – in terms of its production and dissemination – is primarily supported financially in both countries. This includes (a) the different sectors of knowledge production and hence different knowledge areas (e.g. natural sciences, medicine, engineering, arts, fine arts etc.); (b) the varying applicability of knowledge (basic and/or applied research)[4]; as well as (c) the range of knowledge areas (is the production of some knowledge forbidden?).

With regard to Singapore and Germany, the definitions of knowledge are heavily influenced by their respective structural realities (Hornidge, 2006). As such can be identified (a) difference in size of population and land; (b) aspect of centrally organised versus federal; (c) historical experiences; (d) maturity level of the economy; (e) degree of economic exposure to the world economy; (f) tradition of R&D; (g) tradition of the educational system; (h) the political system, backed by its legal infrastructure; (i) level of civil organisation; as well as (j) model of functional differentiation with structures of decision-making between state and remaining subsystems of society. In Germany, the definition of knowledge is strongly influenced by the decentralised organisation of the state, a tightly organised civil society, the media and education being under the right of the states, the high exposure of the economy to the regional and world economy, the long tradition of R&D and the educational system based on Humboldt's idea of the unity of teaching and research, as well as the democratic political system assuring free speech, opinion and free press. The decentralised organisation of the state determines that not only the federal, but also each state government (Länder) defines independently which knowledge is regarded as valuable. This results in a multitude of differing views, the sum of which forms heterogeneous definitions of knowledge. Furthermore, the civil society is highly organised in associations and non-governmental organisations that independently define which knowledge they regard as valuable. Consequently, a sectorally wide range of basic and applied research is conducted, although the recession of the past years results in an increasing commercialisation of the decision as to which knowledge is produced and financially supported. In Singapore, the small size of population and land, the central organisation of the city state, its historical experiences after independence, the early focus on manufacturing in order to develop from a less developed to an industrial country, the short tradition of R&D and education as well as the one-party democratic system strengthened by a legal infrastructure that enables state intervention in free, critical speech, determine a definition of knowledge that strongly focuses on its economic profitability (Menkhoff/Evers, 2005). The little organised civil society leaves room for the state definition of knowledge to mushroom. Hence, mainly one actor, the state, defines which knowledge is regarded as worthy of support and applied R&D in economically viable sectors is mainly conducted. Yet, the realisation that sustainable long-term development requires creativity that does not result from applied R&D in natural sciences and engineering causes a change of thinking in the past years.

While in Germany, the ongoing recession results in an increasing focus on directly paying-off knowledge, in Singapore the high level of economic development reached, increasingly calls for local creativity and content production in order to assure further long-term

[4] The Commission of the European Union defines 'basic research' as follows: "Basic research can be defined in a combining manner: by reference to its ultimate purpose (research carried out with the sole aim of increasing knowledge); its distance from application (research on the basic aspects of phenomena); or the time frame in which it is situated (research in a long-term perspective)" (2004: 4). Applied research stands in opposition to basic research and is characterised by its intention to directly contribute to a certain application. It generally is research on a short-term basis. The results of it are often regarded to contribute directly to the economy.

growth. Hence, the definitions of knowledge in the two countries – traditionally highly divergent – seem to increasingly converge in recent times. The main difference, nevertheless, remains due to the differing legal infrastructures concerning free speech, opinion and the press.

3. The Case of Germany

3.1. Knowledge

As outlined by Vogel (2000: 155-157), the history of German R&D-politics can be split into (a) the period of construction from 1800 to 1914; (b) the period of extension from 1914 to 1945; and (c) the period of reconstruction after 1945. The period of construction was characterised by the establishment of a research infrastructure in order to keep up with England's industrial development. The two world wars nevertheless affect the R&D politics by focusing on marine, aviation and weapon technology. From 1914 to 1945, research was highly weakened due to the migration and killing of approximately one third of Germany's university professors. After World War II, the phase of reconstruction was coined by the division of Germany. In West Germany, the western allies reconstructed the former R&D structure and rebuilded research institutions such as the Fraunhofer Society for Applied Sciences (Vogel, 2000: 157-159). The freedom of speech, opinion and press was assured in the constitution (Heinrich, 2003: 7-27) and education, research and media politics were assigned under the rights of the states. Slowly, West Germany regained its former competitiveness based on a strong state, as well as a privately-financed R&D backbone, diversifying its research portfolio, increasing its research depth and mutually enriching basic and applied research. The federal government took growing interest and responsibility in the field from the mid 1960s onwards. After re-unification of West and East Germany in 1990, R&D facilities in East Germany were reconstructed and the state governments regained some of their former competencies (Heinrich, 2003: 48-68; Vogel, 2000: 157).[5]

The following table illustrates the financial splitting between the federal government, state governments, municipalities and special-purpose associations referring to education, science and culture. The right to define which knowledge is regarded as valuable is distributed amongst the actor groups accordingly.

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[5] A historical overview of the R&D-politics of Germany, structured into six periods, is, outlined in Bräunling und Harmson, 1975: 11; Fuchs, 1992: 54-100; Fleck, 1990: 47-59 quoted by Vogel, 2000: 159.

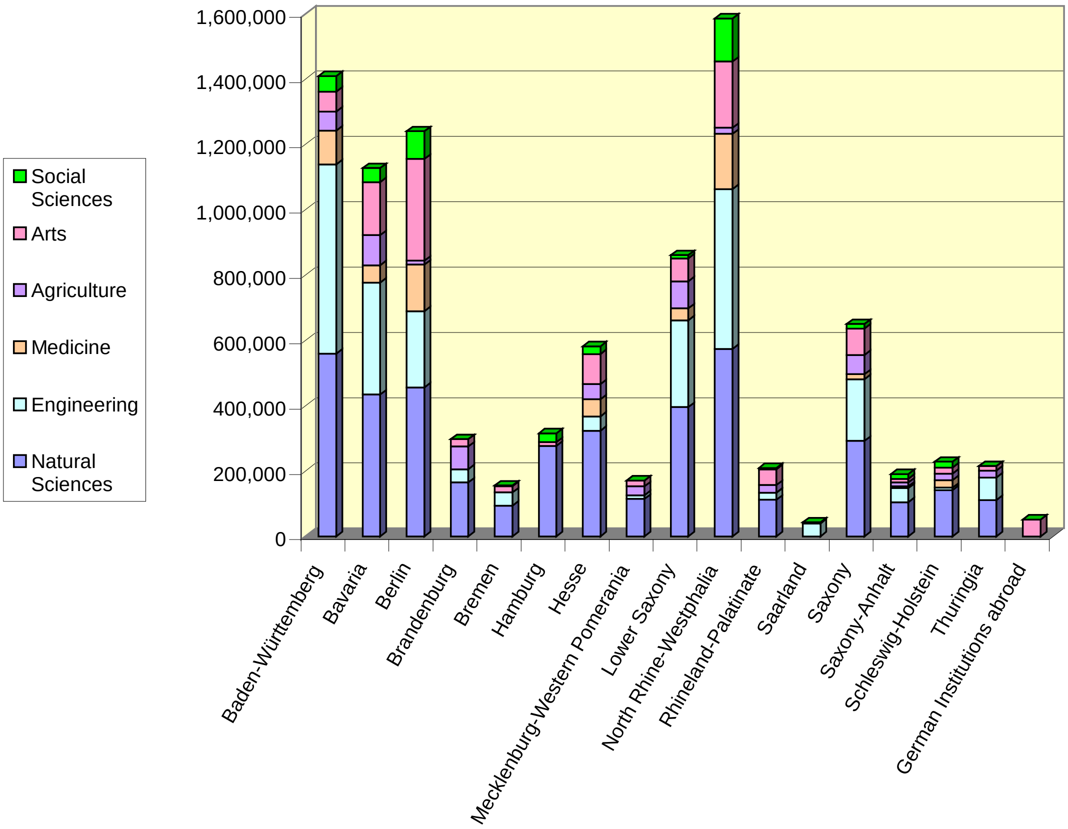
Table Fehler! Kein Text mit angegebener Formatvorlage im Dokument.*-1: Expenditure (Basic Funds) of Public Budgets - on Education, Science and Culture*

Central, regional and local authorities / sectors / indicators	2001 actual	2002 actual	2003 (preli-minary, actual)	2004 (target)
by central, regional and local authorities – EUR m -				
Total	87 207	90 161	90 711	91 761
Federal government	10 178	10 530	10 547	11 534
States (Länder)	62 293	64 850	65 316	65 379
Communities and special-purpose associations	14 735	14 781	14 848	14 848
Indicators of education, science and culture, total				
EUR m	87 207	90 161	90 711	91 761
EUR per inhabitant	1 059.11	1 093.09	1 099.26	1 112.27
Shares in the public sector budget (%)	17.29	17.97	19.65	19.62
Shares in the gross domestic product (%)	4.20	4.28	4.26	4.21
Indicators of education				
EUR m	70 444	73 444	73 972	74 898
EUR per inhabitant	855.52	890.43	896.41	907.87
Shares in the public sector budget (%)	13.97	14.64	16.02	16.01
Shares in the gross domestic product (%)	3.40	3.49	3.48	3.44
Indicators of science and research outside institutions of higher education				
EUR m	9 342	9 233	9 354	9 506
EUR per inhabitant	113.46	111.94	113.36	115.22
Shares in the public sector budget (%)	1.85	1.84	2.03	2.03
Shares in the gross domestic product (%)	0.45	0.44	0.44	0.44
Indicators of culture				
EUR m	7 421	7 483	7 385	7 357
EUR per inhabitant	90.12	90.72	89.49	89.18
Shares in the public sector budget (%)	1.47	1.49	1.60	1.57
Shares in the gross domestic product (%)	0.36	0.36	0.35	0.34

Source: Statistisches Bundesamt, 2005, last updated on 08 August 2005.

Since the end of World War II, the state governments (Länder) bear most of the financial burden for education, science and culture (Schäfers, 1981: 220). Each state government decides independently which areas of R&D and cultural activities are financially supported and up to which degree. The different emphasis on specific subjects in the states is expressed in the state budgets as illustrated in diagram -1:

Diagram -1: Expenditure of Public Research Institutions in 2002
- by States and Research Areas
- thousand Euro -



Source: Compiled by the author based on Statistisches Bundesamt, 2004: 19.

As can be seen diagram 3-1, apart from Baden-Württemberg, all states regard natural sciences as the most important field of research and education. Nevertheless, there are slight differences in the rating of the remaining research areas. In Berlin and Hesse for example, arts receive the second highest funding, whereas most other states identified engineering as the second most important field. The reasons for these differing foci amongst the states are mainly historical, economical and party-political in nature. An historical reason is for example a long tradition of knowledge production and cultivation in certain fields. An economic reason is the indirect support of local industries with public R&D funding in the fields of knowledge production that are of interest to the industries forming the economic backbone of the area. Political reasons evolve from the party-political orientation of each state government and the resulting support of certain lobby groups and their interests. Berlin, for example, looks back on a long tradition as a capital-city where the arts, fine arts and architecture have been cultured and attracted tourism. Baden-Württemberg, in contrast to Berlin, is Germany's centre of car manufacturing and therefore continues its long tradition of engineering. Hence, the federal structure of Germany enables differing definitions of which knowledge production is regarded as valuable. This heterogeneity of knowledge definitions as a result of the decentralised system does not exist in a centralised system, where merely one state budget decides on the ranking of research and educational areas. The wide range of financed knowledge production and preservation practised in Germany is also illustrated in table -2.

Table -2: Expenditure of Public Research and Academic Institutions in 2002
- by Institutional Group and Research Area
- thousand Euro -

Institutional Group Institutional Form	Natural Sciences	Eng-ineering	Medicine	Agri-culture	Arts	Social Sciences	Total
Public R&D-Institutions	815 622	336 153	190 728	461 549	151 096	48 236	2 003 384
of the Federal Gov.	706 638	290 687	-	213 382	95 801	-	1 527 409
of the State and Municipal Gov. (without Leibniz-Society)	108 984	45 467	-	248 167	55 295	-	475 975
Public R&D-Institutions financed by Federal & State Gov.	2 986 208	1 694 505	395 660	70 627	218 338	186 507	5 551 844
Helmholtz-Centres	1 261 683	863 982	206 881	-	-	13 872	2 356 756
Institutes of Max-Planck-Society	893 762	-	88 370	-	96 221	43 148	1 132 057
Institutes of Fraunhofer-Society	308 044	700 430	15 348	-	-	13 108	1 046 878
Leibniz-Association (“Blue List”)	495 312	119 203	84 299	52 412	72 521	113 468	937 214
Academies	27 407	-	761	-	47 527	2 911	78 939
Other publicly financed organisations w/o financial reward f. R&D	320 371	387 859	41 141	21 403	128 541	168 075	1 067 391
Academic Libraries and Museums (without Leibniz-Society)	50 157	12 410	8 613	8 412	698 677	29 806	808 074
Public Libraries, Archives, Centres for information and documentation	272	-	-	3 964	249 964	3 416	259 326
Publicly sponsored Libraries, Archives, Centres for information and documentation	21 398	7 928	-	4 448	114 476	-	177 790
Museums	28 487	-	-	-	334 237	-	370 958
Total	4 172 358	2 430 927	636 141	561 991	1 196 653	432 623	9 430 693

Source: Statistisches Bundesamt, 2004: 18. Translation by the author.

The financing of knowledge production and preservation, illustrated in table -2, includes research centres such as the Fraunhofer- and Max-Planck-Institutes, which focus mainly on natural sciences, as well as the Max-Planck-Institutes and the Leibniz-Association that also conduct research in the arts and social sciences. Additionally, libraries and museums are financially supported. This financial support of a wide range of knowledge production and dissemination, embracing (nearly) all sectors of research and education, stands for an integrative definition of knowledge in Germany. Knowledge in general is seen as something positive and worthy of support. The question whether this knowledge pays off shortly after, and whether it is profitable, has traditionally not been a prime aspect in deciding on the budget for R&D and education.

Nevertheless, there are some categories of knowledge that are not supported, partly even forbidden by law, in Germany. They include fields of research such as recombinant engineering, stem cell research and other areas of life science, as well as the research on or with radioactive materials. Hence, the generally wide range of knowledge production covering most research fields, cannot be observed in sectors of knowledge production which have been classified as 'unethical' or connected to Nazi-ideology (Hornidge, 2006).

The valuing of basic as well as applied research, expressed in table -2, was also emphasised by several interview partners as characteristic for German knowledge politics. The Head of the Department Information, Publication, Editing (Referat LP 4, Information, Publikation, Redaktion) of the Federal Ministry of Health and Social Security in Germany, explains the role of scientific research in Germany as follows:

> "Politics and industry have to produce results that are graspable and marketable. The academia is far away from this. For the academia, no result is also a result" (J. Zweig, 30.09.04, interview with & translation by the author).

If no outcome is also an outcome of scientific research, outcomes do not necessarily have to be profitable as long as they further scientific enlightenment. Emphasising the role of the state in providing a necessary framework for basic R&D, the Head of the Centre for Advanced Media Technology (CamTech), a collaborative project between the Nanyang Technological University in Singapore and the Fraunhofer Institute for Computer Graphics in Germany, states:

> "It is definitely important that the state creates an environment in which plants can develop; meaning that basic research can be conducted without having to justify it with economic success. In Germany, this is still possible" (W. Müller-Wittig, 03.02.05, interview with & translation by the author).

Based on the above, one can overall identify two country-specific traits of the German politics of knowledge production. Firstly, a wide sectoral range of knowledge production is supported, instead of focusing on few specific research fields. Secondly, basic and applied R&D are conducted, both of which mutually enrich each other. These two characteristics point to an integrative definition of knowledge: Generally all kinds of knowledge are regarded as something positive and worthy of support with the exception of knowledge, explicitly qualified as 'unethical'. Nevertheless, this until now quite open definition of knowledge is increasingly overshadowed by a commercialisation of knowledge and information. The aspect of marketability and profitability of knowledge becomes increasingly important. The current ongoing economic downturn and the felt need to compete with the educational systems of other countries lead to a restructuring of the German system of education and R&D along the demands of the market.[6] New university courses are constructed either in direct preparation for a certain job or a scientific, academic career. Humboldt's theory of the unity of teaching and research is neglected in a time in which critical thinking and the ability of decision-making becomes increasingly the best qualification for a job (Nida-Rümelin, 2005: 3). Diplom and

[6] The vacuum after World War II was – in West Germany – filled by the identification with the strong D-Mark, the economic miracle and the establishment of the welfare state. Due to the introduction of the Euro, the economic downturn since the beginning of the 1990s, and the following reduction of the welfare state, these former bases of identification no longer exist. Furthermore, the results of the Program of International Student Assessment (PISA) from 2000 and 2003, placing German schools below average in international comparison, took away the strong belief that German schools were of world class quality (Artelt/et al, 2001; Prenzel/et al, 2003).

Magister, the traditional German university degrees which include training for a certain job as well as research, are replaced by bachelor and master courses in which the transfer of job-oriented knowledge in a modular system is common practice.

Hence, it is questionable whether the picture, drawn above of the German definition of knowledge, characterised by the support of a wide range of knowledge production as well as basic and applied research, remains valid. One has to be aware of the changes taking place towards a commercialisation of knowledge production in Germany although the decentral structure with education and research being mainly under the responsibility of the states continues to make an integrative and heterogeneous definition of knowledge possible.

3.2. Information

The information politics of Germany are until today – and with an exception during the Nazi-Era – structured by decentralism.[7] This goes back to the influence of the allied forces (USA, USSR, England and France) after World War II on West Germany's media and information politics. Siegmar Mosdorf, Head of the enquete-commission "Future of the Media in the Economy and Society" confirms this:

> "The allies aimed to prevent a central power as the Nazis reaching power again and therefore created completely decentral structures in the media and information sector" (S. Mosdorf, 27.10.05, interview with & translation by the author).

Similar to the decentralised structure of knowledge production in Germany, information politics are conducted in a decentralised fashion. The decision as to what kind of information is accumulated, archived and made available depends on each information and documentation institution itself. Hence, the range of available information is wide and influenced by the interests of each subsystem of society, which are welcome to maintain their own information and documentation centres.

The disadvantages of a decentralised system, such as the lack of coordination between libraries, are addressed in six programs of the federal government.[8] According to Thomas (2002), one can observe a cyclical up and down in the degree of responsibility taken on by the federal government in information sciences. In the 1960s to 70s the importance of information as a resource for economic development is recognised and the complete supply of information for all citizens is regarded as a task of the state.[9] In the 1970s to 80s this perception changed, the state now supports fades and the private sector is regarded as mainly responsible for the information market. The state only steps in when the market fails. In the 1980s to 90s, international cooperation, especially European cooperation, increases, national institutions receive less financial support and the centres for information and documentation are partly transferred to the private sector. Yet, from the 1990s until today, information is increasingly regarded as an important factor for economic prosperity. The role of the state in information politics is re-discussed and its responsibility increased.

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[7] Today's only central body concerned with information politics in the federal government's administration is the department Digital Library in the Federal Ministry of Education and Research. It digitally connects mainly scientifically oriented libraries and information centres (Fachinformationszentren).

[8] (a) The Information and Documentation Program 1974 – 1977; (b) The Information Program of the Federal Government 1985 – 1988; (c) The Information Program of the Federal Government 1990 – 1994; (d) The Program of the Federal Government 1996 – 2000: Information as Resource for Innovation; (e) Innovation and Jobs in the Information Society of the 21st Century 2000 – 2003; (f) Information Society Germany 2006.

[9] Also see Häußer, 1986: 351-364.

Consequently, information gets, just as knowledge, increasingly measured according to its economic profitability. The economic value of information is manifested in patents and copyright laws which establish information as a valuable and protected commodity and therefore hinder its free flow. By doing so, these patents and copyrights divide society into information 'have' and information 'have-nots'. In a time, when information and knowledge increasingly become factors of production, this determines one's own chances for further development.[10]

4. The Case of Singapore

4.1. Knowledge

The Singaporean politics of knowledge production seem to focus on (a) certain fields of R&D, which are identified by the government as future economic growth areas; and (b) applied research. The focus on certain fields of research and education goes back to the economic development of Singapore after independence in 1965 as well as the construction of a Singaporean culture by the government based on the values meritocracy, performance orientation, efficiency and pragmatism (Chan/Evers, 1978). Traditionally, Singapore's economy was based on the port as the centre for international and regional trade.[11] Around this port, numerous small manufacturing sites were established, producing wigs, kitchenware and other low skill manufacturing items. Yet, with increasingly low-skilled manufacturing sites moving out of Singapore to neighbouring countries, the Singapore government had to identify new economic sectors to tap into. As such the computer and disk drive production was chosen in 1980 (Ang, 1992). Yet, the neighbouring countries developed as well and Singapore realised in the late 1980s that it had to increase local content production and the local development of advanced technologies in order to move up the value chain further (Anwar/Zheng, 2004; Evers/Gerke, 2003; Evers/Gerke/Schweisshelm, 2004; 2005). Consequently, the total public and private R&D spending as a percentage of the GDP was increased from 0.85% in 1990 to 2.15% in 2003. The public R&D spending as percentage of the GDP was responsible for 0.39% in 1990 and 0.84% in 2003.[12] The yearly increase in the R&D funding resulted in a steady increase of research scientists and engineers. The total number of research scientists and engineers (RSEs) holding a PhD degree rose from 970 (of 4329) in 1990 to 3791 (of 17074) in 2003.[13] Government statistics on the sectoral splitting of the R&D funding could only be found with regard to science and technology. Information on the R&D expenditures regarding the humanities, arts, social sciences and fine arts are neither part of the yearly published 'National Survey of R&D in Singapore' of A*STAR[14], nor stated in the yearly budget of the government (Government of the Republic of Singapore, 2005). Concerning science and technology, table -3 illustrates the spending by type of R&D and research areas.

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[10] This was also discussed during the UN-World Summit for the Information Society in 2003 (Geneva) and 2005 (Tunis), where there was no consensus found on a just system of information dissemination which would prevent knowledge divides from opening up further (WSIS, 2003a, 2003b).

[11] For details on traditional trading networks of Southeast Asia, see Evers, 1991.

[12] Private R&D funding traditionally exceeds the public. It therefore contributes to the definition of knowledge prevalent in society. Nevertheless, it does not influence the definition of valuable knowledge given by the state and expressed in the public R&D funding (A*STAR, 2005: 26).

[13] The yearly increase is illustrated in A*STAR, 2005: 26.

[14] Referring to the definition of R&D published by OECD (OECD, 2002), the National Survey of R&D in Singapore 2004 assesses the government spending for basic research, applied research and experimental development. Regarding the R&D-subjects covered, it states: "The scope of the definition of R&D for this survey extends to R&D in science and technology only and excludes the social sciences and humanities" (A*STAR, 2005: 30).

Table -3: R&D Expenditure by Type of R&D and Field of Science and Technology

$ million

Field of Science & Technology	Private Sector: Basic Research	Private Sector: Applied Research	Private Sector: Experimental Development	Government Sector: Pure Basic Research	Government Sector: Strategic Basic Research	Government Sector: Applied Research	Government Sector: Experimental Development	Higher Education Sector: Pure Basic Research	Higher Education Sector: Strategic Basic Research	Higher Education Sector: Applied Research	Higher Education Sector: Experimental Development	Public Research Institutes: Pure Basic Research	Public Research Institutes: Strategic Basic Research	Public Research Institutes: Applied Research	Public Research Institutes: Experimental Development	Total: Basic Research	Total: Applied Research	Total: Experimental Development
Agricultural & Food Sciences	1.04	24.66	9.95	0.00	0.00	4.76	0.65	0.04	2.85	0.91	0.27	0.00	0.00	0.00	0.00	3.93	30.33	10.87
Biomedical & Related Sciences	37.52	134.46	60.75	2.77	11.96	75.25	26.71	9.51	58.42	33.29	10.28	161.07	39.72	67.85	9.31	320.98	310.84	107.06
Basic Medicine	4.75	14.53	3.40	0.00	1.77	2.01	1.88	0.39	9.16	6.03	0.71	0.00	2.72	0.00	0.00	18.80	22.57	5.99
Biological Sciences	26.18	50.55	12.38	2.77	8.95	10.22	0.00	4.69	26.76	9.60	3.97	161.07	33.58	43.51	9.31	264.01	113.89	25.66
Clinical Medicine	0.00	8.41	15.79	0.00	0.28	45.13	2.05	4.33	21.12	15.48	5.60	0.00	2.06	6.00	0.00	27.79	75.03	23.44
Health Sciences	0.00	0.79	2.19	0.00	0.96	0.85	0.85	0.09	1.38	2.15	0.00	0.00	0.00	0.00	0.00	2.43	3.79	3.04
Pharmaceutical Sciences & Manufacturing	0.55	13.19	22.68	0.00	0.00	0.00	0.91	0.00	0.00	0.00	0.00	0.00	0.00	18.33	0.00	0.55	31.52	23.59
Other Related Biomedical Sciences	6.04	46.98	4.31	0.00	0.00	17.04	21.03	0.00	0.00	0.03	0.00	0.00	1.36	0.00	0.00	7.40	64.05	25.34
Engineering & Technology	102.39	406.94	1,338.15	0.00	1.72	65.03	180.13	20.70	49.59	69.74	51.31	1.55	94.35	112.40	9.41	270.29	654.11	1,579.01
Aeronautical Engineering	0.08	2.27	7.01	0.00	0.00	0.00	11.70	0.00	0.01	0.01	0.00	0.21	0.43	1.49	0.00	0.73	3.77	18.71
Biomedical Engineering	0.00	4.76	0.63	0.00	0.00	0.00	0.00	1.68	3.96	4.15	3.62	0.00	2.72	0.00	0.00	8.36	8.91	4.26
Civil & Architecture Engineering	0.23	1.75	3.50	0.00	1.72	13.44	9.89	0.83	5.02	9.21	7.01	0.00	0.00	0.00	0.00	7.80	24.39	20.39
Computer Engineering	7.61	20.45	84.05	0.00	0.00	0.00	0.00	3.07	6.35	2.68	1.16	0.00	0.00	0.00	0.00	17.03	23.13	85.21
Electrical & Electronics Engineering	55.73	201.45	950.04	0.00	0.00	36.53	92.57	6.09	13.62	20.11	14.79	0.36	30.28	36.10	1.98	106.09	294.20	1,059.38
Infocommunication & Media Technology	10.38	42.66	87.00	0.00	0.00	0.00	0.00	0.04	1.42	5.56	2.82	0.00	20.47	24.55	0.00	32.31	72.77	89.82
Marine Engineering	0.13	7.58	2.00	0.00	0.00	0.26	6.82	0.05	0.55	1.84	1.68	0.25	0.50	1.74	0.00	1.47	11.42	10.50
Material Sciences & Chemical Engineering	5.71	28.26	46.80	0.00	0.00	4.86	1.54	4.58	8.84	9.93	6.75	0.00	31.71	39.92	6.56	50.85	82.97	61.65
Mechanical Engineering	21.84	94.03	148.06	0.00	0.00	9.95	57.61	4.36	9.22	14.40	11.85	0.73	8.23	8.59	0.87	44.38	126.96	218.39
Metallurgy & Metal Engineering	0.68	3.74	9.07	0.00	0.00	0.00	0.00	0.00	0.61	1.84	1.63	0.00	0.00	0.00	0.00	1.29	5.58	10.71
Natural Sciences (excluding Biological Sciences)	43.37	80.19	105.67	0.00	0.00	21.14	41.44	7.94	34.28	31.50	16.96	1.23	45.33	21.74	0.00	132.14	154.57	164.07
Chemical Sciences	6.02	25.97	36.21	0.00	0.00	8.55	0.00	0.80	13.79	3.63	0.30	0.23	36.20	15.09	0.00	57.04	53.24	36.51
Computer & Related Sciences	36.84	53.62	63.72	0.00	0.00	7.10	41.19	1.52	4.95	8.19	4.42	0.66	5.05	6.65	0.00	49.02	75.57	109.33
Earth & Related Environmental Sciences	0.08	0.26	3.33	0.00	0.00	0.04	0.25	0.00	7.97	13.60	9.64	0.00	0.00	0.00	0.00	8.05	13.90	13.22
Physical Sciences & Mathematics	0.42	0.34	2.41	0.00	0.00	5.45	0.00	5.62	7.57	6.08	2.60	0.34	4.08	0.00	0.00	18.03	11.87	5.01
Other Areas	7.87	50.50	186.53	0.00	4.28	0.00	6.33	0.84	24.60	1.24	0.43	0.04	0.07	8.39	32.56	37.70	60.13	225.86
Total	192.19	696.74	1,701.06	2.77	17.96	166.17	255.27	39.03	169.74	136.69	79.25	163.88	179.47	210.38	51.29	765.05	1,209.98	2,086.86

Source: A*STAR, 2005: 15

Besides the focus on science and technology, i.e. research areas regarded as directly contributing to economy, the table also indicates a strong focus on applied rather than basic research. While the total R&D expenditure for basic research amounts to SGD765.05m, applied research was supported with 1,209.98m and experimental development with 2,086.86m. Hence, the two types of research that are regarded as directly leading to economic growth – applied research and experimental development – are supported the most.

My interview partners explained the rather sudden emphasis on R&D investment from the early 1990s onwards, the focus on natural sciences and engineering as well as on applied research, with the following. The recession in the mid 1980s urged the government to implement its first Economic Review Committee in 1986 in order to assess Singapore's economy and identify potential growth areas. This committee advised the government to emphasise the production of scientific knowledge as well as the bio and life sciences. It resulted in the National Science and Technology Board (NSTB), later renamed into Agency for Science, Technology and Research (A*STAR).[15] As a statutory board of the Singaporean government, A*STAR oversees 12 research institutes working in the areas of biomedicine, science and engineering (Menkhoff/Evers, 2005). In 2002, Singapore's President S. R. Nathan explains the increased emphasis on science and technology at the opening of the 25th Singapore Youth Science Festival at the Singapore Science Centre:

> "But what is clear is that the future will favour nations which are best able to innovate, create new knowledge, and upgrade human skills to exploit the economic opportunities that science and technology makes available for us. There is no dispute that embracing and harnessing science and technology is the way forward for our nation" (Singapore Science Centre, 2002).

President S. R. Nathan identifies science and technology as future growth and prosperity promising sectors, while arts, humanities and social sciences are neglected. Besides the founding of A*STAR, R&D conducted by Singaporean universities moved into the centre of attention. The Director of Temasek Laboratories, a research institute of the National University of Singapore (NUS) explains that only 15 to 20 years ago universities in Singapore were granted regular budgets for R&D. Before, they were mainly producing skilled manpower (Lim H., 17.02.05, interview with the author). The research conducted by universities as well as A*STAR institutes today is basic as well as applicable research, with the latter forming the main focus. The Director of Temasek Laboratories outlines the history of R&D in Singapore:

> "Before 1990s, people tended to believe that technologies can be bought, and it was not necessary for Singapore to undertake R&D. Yet, as Singapore strived to move up the technology ladder, we learned that leading-edge technology with high commercial value cannot be bought, and without strength in R&D, we also had difficulty attracting high-tech investment to Singapore. This led to a change of mindset, and A*STAR was founded to undertake R&D in a range of topics of 'economic relevance'. This was to develop a local R&D capability and to demonstrate to potential investors our commitment to support high-tech investment" (Lim H., 02.06.06, email to the author).

Nevertheless, basic research forms the smaller share of R&D conducted in Singapore. Its high costs and little direct financial pay-offs are continuously a topic of debate in Singaporean knowledge politics and the quest for applicable research, rather than basic research, has yet to

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[15] The Director of Temasek Laboratories, a research institute of the National University of Singapore (NUS) describes the process leading up to A*STAR's founding: "The government realised, that all industrialised countries were investing more than 2% of GDP into R&D, while Singapore invested 0.85%. So it was decided to aim for 2% of GDP and the National Science and Technology Board (NSTB), which later was renamed into A*STAR, was formed" (Lim H., 17.02.05, interview with the author).

be resolved.[16] The Dean of the School of Communication & Information, Division of Journalism of the Nanyang Technological University describes this emphasis on applied research by relating to Germany in the 1940s when theoretical physics, enabled the USA to build the atomic bomb:

> "Singapore is still where Germany was in the 1940s, asking, what is the point in knowing how many atoms are in somewhere. The Singaporean approach is how can we make economic value of certain knowledge, and ideally fast. This mentality is very pervasive. (...) There isn't the idea of producing knowledge just for the knowledge sake. So a lot of research in Singapore is applied research. This might change slowly, but I think Singapore will be very cautious and you probably will need some basic output at least" (Ang P. H., 21.02.05, interview with the author).

The change indicated by this statement is also expressed by the founding of a Ministerial Committee on R&D, chaired by the Deputy Prime Minister and Coordinating Minister for Security and Defence, Dr. Tony Tan in October 2004. The aim of this committee is to review the national R&D strategies and directions and to identify new growth areas for the country. On 11 August 2005, Dr. Tony Tan recommends that Singapore should be transformed into "a R&D-driven innovative knowledge-based enterprise economy" to compete (People's Daily Online, 12.08.2005). Furthermore, the government should increase its R&D funding to at least 3% of GDP in the next five years with the clear focus "on selected areas of economic importance where Singapore can be internationally competitive". Consequently, the change towards increasing basic research as a sustainable foundation for economic development is focused on R&D fields that potentially ensure Singapore's competitiveness.

Although the high costs of basic research are difficult to legitimise on a short-term basis, Singapore's government is aware of basic research creating a depth of knowledge that, in effect, contributes to applied research. This awareness secures the basic research's insecure position. Hence, the motivation to support basic research, just as the support for applied research, is driven by the aim for economic prosperity. Therefore, basic research is merely supported in fields such as science, technology and biomedicine that are of economic importance and potentially ensure Singapore's competitiveness. A change towards increasing basic research is consequently not a change of the overall definition of knowledge. But knowledge in Singapore, no matter whether from applied or basic research, is very much weighted according to the financial profit and economic growth generated by it. This can also be observed in the government's turn towards creative industries in 2002. Here, the government formulated the aim to develop the arts, design and media as economic sectors which contribute to GDP. The Director of the Educational Technology Division in the Ministry of Education describes:

> "The one who has made the most compelling and convincing argument in terms of supporting the creative industries is Dr. Tan Chin Nam. As Permanent Secretary in the Ministry of Information, Communication and the Arts (MICA), he cleverly positioned the whole thing not as 'arts for arts sake' but art as the foundation for a new industry, the creative industries" (Koh Th. S., 30.03.05, interview with the author).

This rather recent development towards supporting arts and culture, heritage preservation and the building of various, thematically divergent museums expresses the government's realisation that the focus on a few areas of knowledge production and dissemination stands in the way of long-term sustainable development of an industrialised country. It is based on the awareness that Singapore as a developed economy can no longer rely on ideas coming from overseas, but has to increase its own local content production. Singapore's government wants to make Singapore innovative and 'creative'. This poses an

[16] The Director of the School of Information Systems at the Singapore Management University describes: "'Technopreneurship' became a commonly used term, describing the need for research but also the need for this research to be applicable and marketable" (A. D. Narasimhalu, 29.03.05, interview with the author).

immense change in the definition of which knowledge is regarded as valuable. The former stringent focus on natural sciences and engineering is dissolved by the felt need to become creative. Singapore now discovers the arts, humanities, social sciences, theatres, museums and libraries as attractive fields and places of knowledge production and dissemination. Yet, it is not the experimental arts that get actively fostered by the government, but 'money-making' arts such as movie production, design and media. Experimental arts are merely respected, since they might eventually contribute to commercial arts. The Director of Creative Industries Singapore in the Ministry of Information, Communications and the Arts describes this process:

> "We will not promote experimental arts, but we also don't draw a distinctive line between commercial and experimental arts. We should improve the commercial, marketing infrastructure of the non-commercial sector to help it become more financially successful. (...) The arts-infrastructure has to allow for the initial spark of creativity to happen. Then some company could market this intellectual property for the artist and exploit it commercially" (Baey Y. K., 30.03.05, interview with the author).

Hence, the definition of knowledge in Singapore opens up for a wider range of knowledge creation and dissemination. Nevertheless, this opening up is very much market oriented and market driven. Basic research as well as experimental, non-commercial arts is respected as long as there is potential that the knowledge and ideas created develop further and enrich applied research or the commercial arts. They are not respected as arts for arts sake or knowledge for knowledge sake. But the statement above shows that the following conclusion of Cordeiro and Al-Hawamdeh of Nanyang Technological University Singapore (2001) has been heard by the government and its administrative bodies: "Singapore cannot simply produce managers and engineers as it has been doing for the last 30 years. Today, it needs a convincing nucleus of inherent and intrinsic entrepreneurial talent". The government of Singapore today fosters a vibrant culture of specifically Singaporean knowledge production that enables sustainable economic development. The opening up of Singapore's definition of knowledge goes back to the will of the Singaporean government to create a form of economy and society that uses knowledge for sustainable development.

4.2. Information

Just as the production of knowledge was heavily restructured after gaining independence, Singapore does not look back on a very long tradition of information politics. In the first years after independence in 1965, foreign investment driven economic growth was at the centre of political interest. Information preservation, the development of a nation wide system of archiving and documentation was of much lower priority. Nevertheless, several libraries and documentation centres existed and new ones were slowly created. In the beginning of the 1970s however, Singapore's government restricted press freedom (Masterton, 1996). Starting with the Chinese-language newspapers Sin Chew Jit Poh and Nanyang Siang Pau, which were urged to merge and form Singapore News and Publication Ltd in 1983, all newspapers – apart from 'Today' – were eventually merged into the 'Singapore Press Holdings', of which the government is a major share holder. Additionally, several laws were passed enabling the government to control the media, i.e. the Newspaper and Printing Press Act from 1974 (Amendment in 1979). These restrictive measurements resulted in limited press-freedom and high self-censorship among journalists (Gomez, 2000).

Following Singapore's first recession in 1986 and the recommendations of the Economic Review Committee for Singapore's economy to diversify in order to continue moving up the value chain, the Minister for Information and the Arts, George Yeo, established the Library 2000 Review Committee in 1992. Its task is to review the possible contribution of the library system to Singapore's development in the 21st century. In 1994, the report "Library 2000: Investing in a Learning Nation" was published and results in the establishing of the National Library Board (NLB) (Library 2000 Review Committee, 1994).[17] NLB centrally manages the network of national, public and government department/junior college libraries.[18]

In the recently published strategic plan of the National Library Board called "Library 2010", NLB increasingly regards libraries as centres of knowledge exchange, fruitful discussion and critical thinking,[19] especially the fostering of knowledge sharing and exchange, which could lead to a fundamental change in the definition of knowledge and information in Singapore. This development is backed by a legal infrastructure that protects the individual, free opinion and free speech. Yet, if free speech can lead to legal consequences which are currently still governed by the Internal Security Act (ISA) as well as the Newspaper and Printing Press Act, a library system that encourages knowledge sharing will nevertheless be unable to turn this sharing of knowledge into a pool of discussion, with free and critical thinking, as a step towards creative ideas and innovation.

The definition of information in Singapore is strongly influenced by the state and communicated by information politics, implemented by the National Library Board, as well as the legal infrastructure concerning the freedom of the press, freedom of opinion and speech. The centrally organised information system assures efficiency and at the same time enables control over information which is accumulated, archived and made available. A tendency to create room for creativity which requires free flow of information exists, as expressed in "L2010" (NLB, 2005). Nevertheless, the space for creativity to take place is predefined by the government, which raises the question whether creativity can and does take place in a predefined space.

5. Discussion: Converging or Diverging Definitions of Knowledge?

While the aspect of being a small, tightly governed country such as Singapore poses an advantage in constructing an island-embracing information and communication infrastructure, the decentralised federal structure of Germany, with a highly organised civil society and education and research system largely under the right of the states, can pose an advantage for raising the level of culture and creativity in society. At the same time, a centrally governed city-state with restrictions on free speech and press freedom might find the development of a heterogeneous cultural scene rather difficult. And a decentralised federal country might have difficulties with installing modern ICTs in all regions of the country. Nevertheless, not only are (a) the differences in size and (b) the aspect of centrally organised versus federal systems responsible for different definitions of knowledge, but furthermore each country's (c) historical experiences; (d) maturity level of the economy; (e) degree of economic exposure to the world economy; (f) tradition of R&D; (g) tradition of the educational system; (h) political system, backed by its legal infrastructure; (i) level of civil organisation; as well as (j) model of functional

[17] On 16 March 1995, the Parliament of Singapore passes a bill to establish the National Library Board (NLB) from 01 September 1995 onwards. Furthermore, NLA 1958 is replaced by the National Library Board Act (NLBA), which forms the legal basis of NLB.

[18] Exceptions include the university libraries as well as few libraries of research institutes.

[19] Nevertheless, the Chief Executive of the National Library Board points out that the role of libraries is restricted to providing the infrastructure for creativity: "NLB and the library network provide the people with the resource information for ideas, but it can't convince the people to actually have ideas and to make money with the idea" (N. Varaprasad, 11.02.05, interview with the author).

differentiation with structures of decision-making between state and remaining subsystems of society.

Regarding the influence of historical experiences (c) of each country on the dominant definition of knowledge, one has to point to the distribution of media responsibilities to the state level rather than the federal government in Germany after World War II. In Singapore, the nation's aim to rapidly develop from a less developed to an industrial country contributed to a strong focus on applied R&D and on profitable knowledge after independence. The low level of maturity of Singapore's economy (d) after independence can be held responsible for a strong focus on low-skilled manufacturing and hence the production of knowledge that could be applied in the manufacturing processes. In Germany's economy, the level of maturity demanded R&D that looked far beyond low-skilled manufacturing but instead into design and new inventions. Similarly, the level of exposure to the world economy (e) furthered in both countries the already existing tendencies. Singapore's economy was mainly exposed to the world economy due to the export of manufactured goods. Hence, further knowledge production concentrated on the improvement of these manufacturing processes. In Germany, the exposure to the world economy was far more versatile and its competitiveness was increasingly secured by R&D outcomes rather than merely manufacturing. This was further supported by Germany's long tradition in basic as well as applied R&D (f). When Singapore began to conduct local R&D, its economy was mainly based on manufacturing and the conducted R&D concentrated on this. Similarly, the educational system in Singapore (g) merely goes back to the end of the 19th century when the first tertiary educational institution was established in order to produce graduates that could work in the colonial administration. Hence, education was very much focused on qualifying for certain professions. In Germany, the educational system looks back to Humboldt's idea of the unity of teaching and research. Education was not merely geared toward a job qualification, but to enable the conduct of research. The differing political systems in both countries, their legal backing (h), the level of civil organisation (i) as well as the model of functional differentiation with structures of decision-making between state and remaining subsystems of society (j) support the singular-defined definition of knowledge by the state in Singapore and the multiple-defined definitions of knowledge by multiple actors of society in Germany. Germany's long tradition of basic, wide ranging research is backed by a democratic political system in which every citizen possesses the right to voice his/her opinion. The freedom of opinion and speech are embedded as basic rights in the German constitution and therefore allow for a culture of critical discussion. This is also fostered by a high level of civil organisation, which involves the existence of a multitude of knowledge and strongly opposing, socially constructed truths next to each other. This again is further supported by independently acting subsystems of society, which can voice their own interests when aiming to influence the activities of another subsystem but are not necessarily heard. No subsystem possesses decision-making-rights regarding activities of another subsystem. Nevertheless, this quite integrative definition of knowledge is increasingly adapted to economic requirements and its value measured by its marketability. In Singapore, the legally insecure position of free speech, opinion and press freedom strengthen the position of the state in defining which knowledge and information is created, disseminated and preserved. The permeable boundaries between the subsystems of society enable the state to influence the decision-making processes of subsystems such as the scientific community, civil society and media, but at the same time also grant selected members of these subsystems decision-making power in activities of the state. Furthermore, the low level of civil organisation results in little critical definitions of knowledge which possibly oppose the state's definition. Nevertheless, the urge for long-term sustainable development increasingly welcomes types of knowledge that merely indirectly contribute to economic growth. The formerly quite restricted definition of knowledge is increasingly opening up to knowledge areas such as arts, social and human sciences. It is hoped that the integration of these yields sustainable, long-term economic growth. Areas for free, critical discussion are created in public libraries in order to foster creativity in the hope to maintain Singapore's economic growth.

While Germany's decentralised and traditionally integrative definition of knowledge is hampered by an increasing focus on marketable knowledge, Singapore's focus on profitable knowledge areas is opening up towards arts, human and social sciences. The two formerly quite differing definitions of knowledge in Germany and Singapore are moving closer to each other. Yet, in Singapore this movement of convergence lacks legal foundation until today. The vast library system and the investments in arts, human sciences and museums provide grounds for an increasingly versatile definition of knowledge, supported by the attempt to use libraries as centres for building social capital and fostering creative ideas. Nevertheless, social capital and critical thinking are closely related to social and political criticism. As long as the freedom of opinion and speech of every citizen are not part of the Singaporean constitution, knowledge production and sharing will be guarded and guided by the state.

Opposite to the situation in Singapore, the currently strong movement towards an increasing commercialisation of knowledge in Germany is merely counterbalanced by the heterogeneity of actors defining which knowledge is regarded as valuable. This heterogeneity of actors is secured by the right of free speech and opinion, as well as the decentralised system, where education belongs under the rights of the states rather than the federal government. Hence, the differences between the definition of knowledge in Singapore and Germany can be seen as prevailing due to the differing legal infrastructures, even if a process of convergence is taking place.

References

Agency for Science Technology and Research (A*STAR) (2005). National Survey of R&D in Singapore 2004. Singapore, A*STAR.

Ang, P. H. (1992). Singapore's Disk Drive Initiative. The 42nd Annual Conference of the International Communication Association, Miami, Florida.

Anwar, S. and M. Zheng (2004). "Government spending on research and development and industrial production in Singapore." International Journal of Asian Management 3: 53-65.

Artelt, C., J. Baumert, et al., Eds. (2001). PISA 2000 - Zusammenfassung zentraler Befunde. Berlin, Max-Planck-Institut für Bildungsforschung.

Chan, H. C. and H.-D. Evers (1978). National Identity and Nation Building in Singapore. Studies in ASEAN Sociology. P. S. J. Chen and H.-D. Evers. Singapur.

Commission of the European Communities (EC) (2004). Communication from the Commission. Europe and Basic Research, COM(2004) 9, 14.1.2004. Brussels, EC.

Cordeiro, C. M. and S. Al-Hawamdeh (2001). "National Information Infrastructure and the realization of Singapore IT2000 initiative." Information Research 6(2).

Evers, H.-D. (1991). Traditional Trading Networks of Southeast Asia. Asian Trade Routes, Continental and Maritime. K. R. Haellquist. London, Curzon Press: 142-152.

Evers, H.-D. and S. Gerke (2003). Local and Global Knowledge: Social Science Research on Southeast Asia . Southeast Asian StudiesWorking Paper No. 18. Bonn, Department of Southeast Asian Studies, University of Bonn.

Evers, H.-D., S. Gerke, et al. (2004). Malaysia, Singapur, Indonesien: Wege zur Wissensgesellschaft. Bonn, University of Bonn.

Evers, H.-D., S. Gerke, et al. (2005). "Wissen als Produktionsfaktor: Südostasiens Aufbruch zur Wissensgesellschaft." Soziale Welt 56(1).

Gomez, J. (2000). Self-Censorship. Singapore's Shame. Singapore, Think Centre.

Government of the Republic of Singapore (2005). "The Budget For The Financial Year 1st April 2004 to 31st march 2005."

Häußer, E. (1986). Wissenschaftliche Dokumentation und technische Innovation. Gutenbergs Erben - Die Bundesrepublik Deutschland auf dem Weg zur Informationsgesellschaft. U. Lohmar and P. Lichtenberg. Bonn, Stiftung für Kommunikationsforschung im Stifterverband für die deutsche Wissenschaft: 351-364.

Heinrich, O. (2003). Die rechtliche Systematik der Forschungsförderung in Deutschland und den Europäischen Gemeinschaften unter Beachtung von Wissenschaftsfreiheit und Wettbewerbsrecht. Münster, Lit Verlag.

Hornidge, A.-K. (2006). The Construction of K-Societies: Germany and Singapore. Institute of Sociology. Berlin, TU Berlin.

Lane, R. E. (1966). "The Decline of Politics and ideology in a Knowledgeable Society." American Sociological Review 5(31): 649-662.

Library 2000 Review Committee (1994). Library 2000: Investing In A Learning Nation. Singapore, Ministry of Information and The Arts.

Machlup, F. (1962). The Production and Distribution of Knowledge in the United States. Princeton, New Jersey, Princeton University Press.

Masterton, M. (1996). Asian Values in Journalism. Singapore.

Menkhoff, T. and H.-D. Evers (2005). Strategic Groups in a Knowledge Society: Knowledge Elites as Drivers of Biotechnology Development in Singapore. International Conference on Strategic Groups, Essen.

National Library Board (NLB) (2005). L2010 - Our Vision for the Future (Overview). Singapore, National Library Board.

Nida-Rümelin, J. (2005). Das hat Humboldt nie gewollt. Die Zeit.

Organisation for Economic Co-operation and Development (OECD) (2002). Frascati Manual - Proposed Standard Practice for Surveys for Research and Experimental Development. Paris, OECD.

People's Daily Online (12.08.2005). Singapore deputy PM recommends measures for R&D strategy. People's Daily Online. Singapore.

Prenzel, M., J. Baumert, et al., Eds. (2003). PISA 2003 - Ergebnisse des zweiten internationalen Vergleichs, PISA Konsortium Deutschland.

Schäfers, B. (1981). Sozialstruktur und Wandel der Bundesrepublik Deutschland. Stuttgart, Deutscher Taschenbuch Verlag.

Singapore Science Centre (23.05.2002). The Opening of the 25th Singapore Youth Science Festival, Singapore Science Centre.

Statistisches Bundesamt Deutschland (08.08.2005). Education, Science and Culture.

Statistisches Bundesamt Deutschland (2004 (Berichtszeitraum 2002)). Ausgaben und Einnahmen der öffentlichen und öffentlich geförderten Einrichtungen für Wissenschaft, Forschung und Entwicklung. Wiesbaden, Statistisches Bundesamt.

Vogel, C. (2000). Deutschland im internationalen Technologiewettlauf - Bedeutung der Forschungs- und Technologiepolitik für die technologische Wettbewerbsfähigkeit. Berlin, Duncker und Humblot GmbH.

Wall, C. (2006). Knowledge Management in Rural Uzbekistan: Peasant, Project and Post-Socialist perspectives in Khorezm. Faculty of Philosophy. Bonn, Rheinische Friedrich-Wilhelms Universität.

Weltgipfel über die Informationsgesellschaft (WSIS) (2003a). Aktionsplan, United Nations/International Telecommunications Union.

Weltgipfel über die Informationsgesellschaft (WSIS) (2003b). Grundsatzerklärung, United Nations/International Telecommunications Union.

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