INSTITUTE FOR INNOVATION AND TECHNOLOGY

ANIS
INDICATOR-BASED ANALYSIS OF NATIONAL INNOVATION SYSTEMS

Summary Report on the Determinants of the Local Innovation System of Manaus, Brazil

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Institute for Innovation and Technology - iit

The Institute for Innovation and Technology (iit) offers tailor-made services to interested parties from politics, economy and science, to explore critical interfaces, quantify new innovation-related tools and models, investigate new paradigms for innovation and develop strategies to address the risks associated with investments in the respective fields. The aim of iit is to leverage the complementary expertise of academia, industry and government by facilitating new systems for innovation and collaborative processes on behalf of our clients. The work of iit is based on a broader understanding of innovation, which also deals, besides core technological developments, with the economic and social preconditions and impacts of technological innovations. As a consequence, iit-experts are involved in many cross-disciplinary, cross-cultural and cross-organisational projects at national and international level.

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Preface

Local and national competitiveness is not only driven by individual companies but increasingly accelerated by the innovative activities of entire industries and branches and has therefore become a key topic of economic and technology policies worldwide. As innovative firms grow faster than average and are more likely to survive during a recession, a strong innovation support policy may be a promising approach to enable companies to cope with any economic crisis.

However, the assets of innovation are not only limited to the original innovator. The innovation process itself generates knowledge spill-over from which other firms can benefit and thus increase their productivity and innovation capacity. In turn, this can create the conditions for a circular flow of economic growth from which the entire society may benefit.

Nowadays, innovation has become high priority as well within emerging and developing countries. Several innovation policy measures and support schemes have been implemented or are being designed, all of them with a different impact. These measures and schemes reflect the diversity of framework conditions, cultural preferences and political priorities. A smart innovation policy may establish favourable framework conditions for innovation. Thus, policy makers may foster the innovation capabilities of their national and local innovation system (NIS/LIS) by setting up appropriate framework conditions and by investing in infrastructure, education and funding R&D innovation programmes. All these measures and related efforts aim at improving the performance of an NIS/LIS.

The indicator-based Analysis of National Innovation Systems (ANIS) includes a comprehensive examination and evaluation of the status of existing national and/or local innovation systems. It is mainly intended for emerging and developing countries for which standard innovation benchmarking and monitoring approaches might not be sufficient as often the statistical data is missing or outdated. Policy makers from these countries can benefit from clear advice as regards to overcoming weaknesses of a national innovation system and to identifying those determinants that should receive special attention.

We are convinced that the ANIS approach will serve as a fact-based platform initiating discussions on how to improve innovation capabilities and competitiveness in the analysed countries or regions.

Berlin, September 2010

Dr. Gerd Meier zu Köcker

Director Institute for Innovation and Technology (iit), Berlin

1 The ANIS Approach for Analysing Innovation and Innovation Systems

Innovation may be considered as one of the main drivers for economic competitiveness, growth and wealth creation. Therefore, innovation policy has become an important part of economic policy. The design of suitable framework conditions for innovation reflected by the maturity level of national/local innovation systems (NIS/LIS) has been given high priority worldwide. Although there is no common definition of an NIS/LIS, the following comments may be useful:

Innovation may be defined as new solutions adding value to both customers and firms.[1] *It can be distinguished between incremental innovation (e. g. further development of existing products and technologies, often realised by SMEs without involving any R&D institutions) and radical innovation (completely new solutions, technologies or products not yet available on the market, usually involving R&D institutions).*

A national innovation system may be defined as a network of institutions in public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies.[2] *This definition can also be applied for local communities. The main elements of an NIS/LIS are: educational and research institutes, firms, industrial parks, incubators, governmental institutions. However, each NIS/LIS is different in terms of how these elements are coordinated or combined.*

Innovation policy may be defined as the creation of framework conditions aiming at supporting innovation capabilities of companies and public entities.

The concept of an NIS/LIS relies on the premise that a good understanding of innovation actors' relationships is crucial to foster technology performance. Innovation and technical progress are indeed outcomes of a complex set of relationships among actors producing, distributing and implementing knowledge. The innovative performance of a country broadly depends on the one hand on these actors' cooperation within a global knowledge creation system and on the other hand on the extent to which they utilise technologies. The actors are mainly private enterprises, universities and public research institutes. Their cooperation ranges from joint research to personnel exchanges, cross patenting, purchase of equipment and a variety of other channels.[3]

[1] Nordic Council of Ministers (2009), Nordic Innovation Monitor, Copenhagen.

[2] Freeman, C. (1995), "The National System of Innovation in Historical Perspective", Cambridge Journal of Economics, No. 19, 1995, Cambridge.

[3] OECD (1997), National Innovation Systems, Paris.

The number of theoretical models, reports and analyses of NIS has been increasing since the beginning of the 21st century. Due to the various factors impacting national innovation capacities, the assessment of a country's innovation system remains a challenging exercise. For years, economists have tried to identify the reasons leading to the nations' competitiveness and growth, and as a consequence many NIS reports and analyses have been generated. Despite the high quality of these reports which describe the essential features of an NIS and summarise its main strengths and weaknesses, the benefits in terms of usable results were unfortunately limited. This is explained by the fact that the implemented methodologies did not sufficiently consider the way policy makers think and operate. Recommendations are neither prioritised nor ranked according to their complexity when turning into practice.

Policy makers, especially in emerging and developing countries usually look for structured descriptions of an NIS and clear recommendations for improving their own NIS's performance. They do not ask for scientific models of the functionality of an NIS or how the single actors are linked. The analysis and comparison of embryonic and less developed NIS against mature ones allows the identification of weaknesses and hence the formation of recommendations. It happens quite often that analyses of the conditions for innovation confuse policy makers as they do not provide clear guidelines for improvement. Indeed, such reports lack precise information or recommendations on how to optimise the effects of innovation capacities, especially when public investments are limited. It is crucial to identify those determinants of an NIS, which can be improved with the tools and the in general limited financial means available.

When considering a LIS instead of an NIS, even fewer analyses have been conducted. The LIS, being embedded in an NIS however can be improved in the same manner. Therefore, the general statements above also can be applied for a LIS.

The ANIS approach is in line with the new tradition of indicator-based studies relying on quantitative data generated by the evaluation of expert interviews. Such an approach differs from traditional benchmarking studies on innovation performance. The Global Competitiveness Report and the European Scoreboard or the Nordic Innovation Monitor are excellent approaches for measuring or benchmarking innovation-related performance indicators. However, since the statistical base is often insufficient, the latter is rather intended for well-matured economies than for developing or emerging countries' issues. The Global Competitiveness Report uses a mix of statistical data and expert interviews but since it focuses on the competitiveness of nations, the issue of innovation is not sufficiently targeted. In addition, these sources do not focus on any specific local regions within the countries.

The ANIS approach is based on the assumption that at national or local level an NIS/LIS is mainly influenced by 30 determinants.[4] ANIS takes up this challenge by providing an indicator-based assessment of these determinants, each of which reflects an aspect of the complex reality of the innovation system. The determinants may be grouped according to a three level hierarchy:

- **Macro Level: Innovation Policy Level**
- **Meso Level: Institutional Innovation Support Level**
- **Meso Level: Programmatic Innovation Support Level**
- **Micro Level: Innovation Capacity Level**

The 30 determinants' level classification is shown in figure 1. A comparison between the determinants of these different levels allows the identification of key policy areas requiring a potential intervention to strengthen the NIS/LIS. Please note that a further description of the methodology is given at the end of the document.

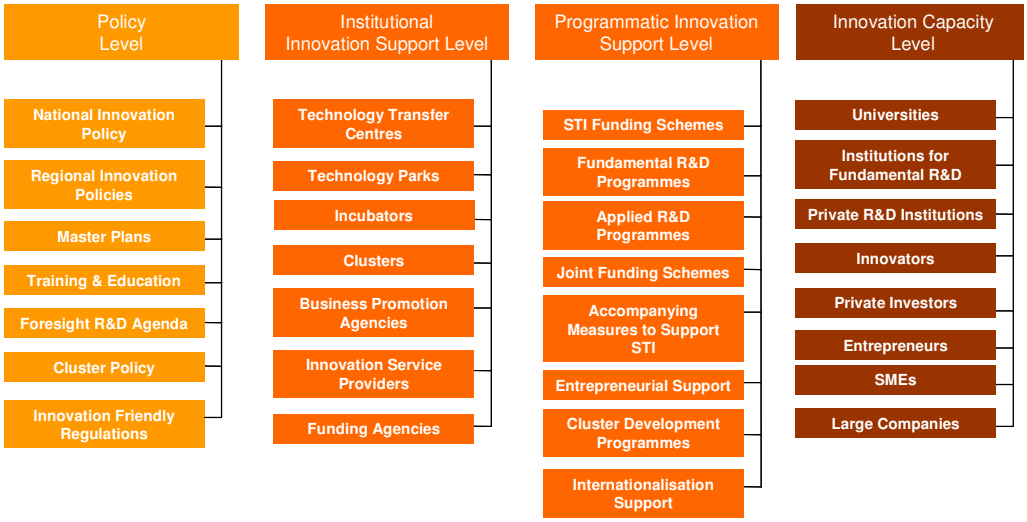


Figure 1 Main determinants of a national innovation system

Besides assessing and benchmarking the determinants, policy makers prove to be much more interested in receiving guidance for action. Therefore, the ANIS report provides comprehensive recommendations for improvement, taking into account the realistic efforts national or local policy makers or third donors are able and willing to provide.

[4] We are fully aware that NIS/LIS are also influenced by determinants outside of a country. However, as they need a different approach of adjustment, they are not regarded within our analysis.

2 Brazil's Economic Situation in Brief with Special Emphasis on Manaus

This section briefly describes the scenario for scientific, technological and innovation activities as regards to the development of Brazil, the Amazonas state and Manaus, through the analysis of three topics:

i. socio-economical data;

ii. infrastructure and public policy in science, technology and innovation;

iii. capability, innovation and performance.

2.1 Economic Outlook of Science, Technology and Innovation in Brazil

Socio-economic data

Brazilian GDP was estimated about US$ 2.013 trillion in 2009 (CIA world factbook, 2010), being the 10th largest economy worldwide (Brazil Competitiveness Report, World Economic Forum), with an average of US$ 10,100 per capita, which has doubled during the last 15 years getting to 63rd place in the World (CIA world factbook, 2010; JB Online, 2010). Since the second half of the 90's inflation has dropped drastically getting to around 5 %. Today, inflation is expected to rise above 5 % again for 2010 decade (CIA world factbook, 2010; Central Bank of Brazil, 2010).

Brazil is amongst the ten largest markets in the world, counting with abundant natural resources. It produces and exports a wide range from commodities such as iron to aircrafts, though oil and gas production has increased in importance. Brazil also has diversified commercial partners. Nevertheless, the country figures with one of the worst distribution of wealth in the world with the Gini coefficient of 0.813 figuring in 75th position. In 2009, household wealth represented 14.5 % under extreme poverty and 34.1 % under poverty line (FGVSP, 2010).

However, Brazil has advanced in both social and educational areas. In the educational area, despite of 8 % of the population (around 192 million) being illiterate, the indicators of 2009 show improvement in education quality at all educational levels (Inep, 2010). The Institute of Applied Economics Research (IPEA) highlights as main cause the fact that youth between 15 and 24 have been able to spend more time in classrooms (ANDIFES, 2010). The growth of about 1,000 % in the number of doctorate holders (1987-2008) is a good example of public policy (CGEE, 2010). Coordination of Improvement of Higher Level Personnel (Capes) contributes with more than 35,000 master graduations and around 11,000 doctor graduations per year (Raupp, 2010).

The Global Competitiveness Report 2008-2009 gives the following picture about the situation in Brazil as regards to the allocation of the GDP:

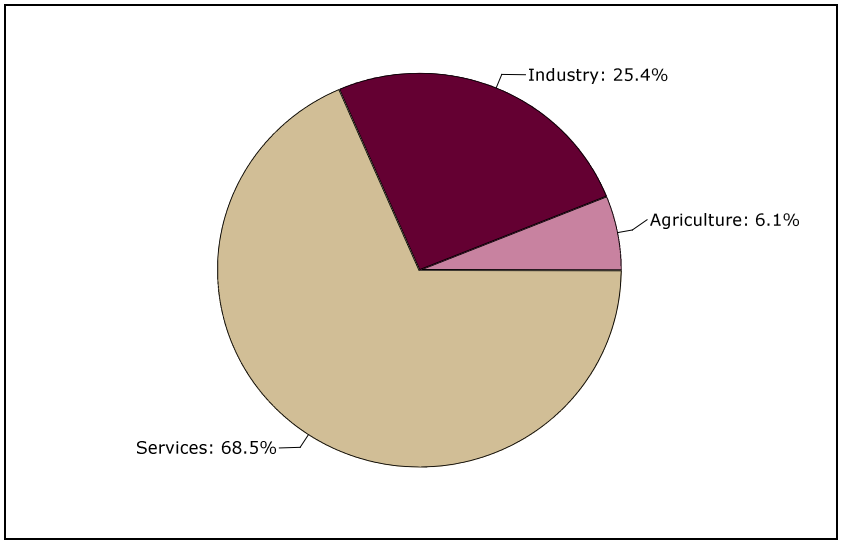


Figure 2 Origin of GDP according to sector

Infrastructure and public policy for science, technology and innovation

The National System of Science, Technology and Innovation, being implemented officially since the 1970ies, expanded significantly along the last years, but just recently it started to reflect on policies for technological innovation. In May 2010, the 4th National Conference of Science, Technology and Innovation was organised in Brasília (4CNCTI).[5] One particular topic addressed during the conference has been the State Policies of Science, Technology and Innovation for Amazon Sustainable Development: Fundamentals, Policies, Proposals and Commitments.

A set of four important actions guides the efforts of the Ministry of Science and Technology to promote Science, Technology and Innovation activities in Brazil:

i. Expansion and Solidification of the National System of Science, Technology and Innovation (interactions regarding infrastructure and funding for R,D&I are shown in the following figure);

ii. Technological innovation promotion for enterprises;

iii. Research, development and innovation in important strategic areas; and

iv. Science, Technology and Innovation for Social Development.

[5] This is an event where academics, business persons, government representatives and other segments of Brazilian society meet to make proposals and discuss development issues concerning technology and innovation in the country.

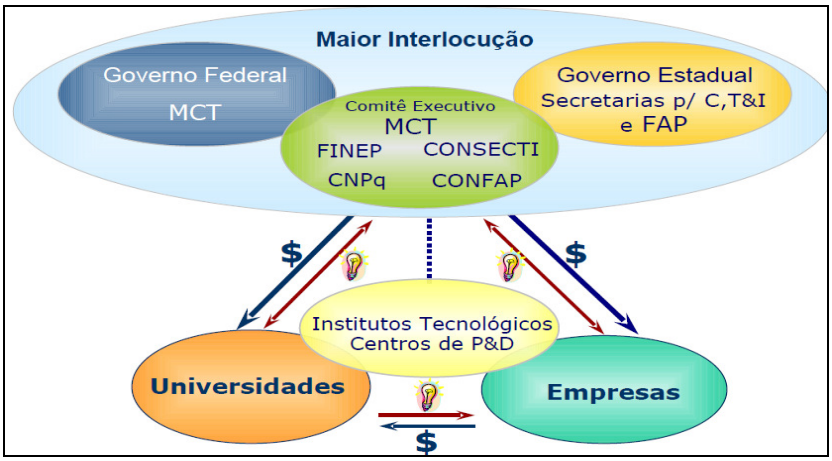


Figure 3 Interactions regarding infrastructure and funding for R,D&I (Source: MCT's site)

Table 1 shows the historical overview of foundations of important institutions for science, technology and innovation in Brazil:

Year	Institution	Year	Institution
1899	Institute for Technological Research (IPT)	1948	Brazilian Society for Science Progress (SBPC)
1900	Oswaldo Cruz Foundation (Fiocruz)	1951	National Research Council (CNPq) and Coordination of Improvement of Higher Education Personnel (Capes).
1916	Brazilian Academy of Sciences (ABE)	1962	Foundation for Research Support of São Paulo State (FAPESP)
1920	Federal University of Rio de Janeiro (UFRJ)	1967	Research and Projects Financing (FINEP)
1934	University of São Paulo (USP)	1985	Ministry of Science and Technology (MCT)

Table 1 Foundations of important S,T&I institutions in Brazil (Source: adapted from Ministry of Science and Technology's website)

The main sources for R,D&I (research, development and innovation) activities are the National Council of Research (CNPq), Research and Projects Financing (FINEP) and the Ministry of Science and Technology (MCT) to which all previous are subordinate. It also figures with great importance the Foundation for Support on Research of the State of São Paulo (FAPESP). Other important sources are:

i. grants;

ii. preferred purchase of products/services with technological innovation; and

iii. Support to innovation through Innovation Law (2004)[6] and the Law that concerns productive firms that carry out R&D (2005)[7].

Training, innovation and performance

Science and innovation activities in Brazil are concentrated in the South and Southeast of the country, mostly in São Paulo. Some products and technologies designed and developed by Brazilian organisations have already reached a certain level of competitiveness, for instance in farming, aviation and bioenergy. Brazil ranks on the 13th place worldwide concerning science, but on the other hand there are only very few Brazilian enterprises investing in R&D of new products or services (Raupp, 2010).

According to the Global Competitiveness Index, Brazil holds position 56 at the world rank list, although still unsatisfactory for its size and importance. Some possible explanations are: low "innovation for market" (product innovation); low private investment in R&D; few qualified people for R&D; and low public funding for R&D (Global Competitiveness Report 2010; Estadão, 2010).

Despite that, with few exceptions, Brazil's manufacturing base lags with respect to innovation—especially when Brazil is compared with China or India, countries that have taken giant steps in growth-enhancing innovation (Rodriguez et al., 2008).

2.2 Economic Outlook of Science, Technology and Innovation in the State of Amazonas

Socio-economic data

The economy of Amazonas State has gone through significant changes since the launch of Manaus Free Trade Zone in 1967. At the very beginning the economy was based on natural resources extraction, such as: forest species (aromatic herbs, medicinal plants, nuts, guaraná, pepper,

[6] Law No. 3476, 2004, provides incentives for innovation and scientific and technological research in a productive environment, with a view to capacity building and technological autonomy and industrial development of the country

[7] Law No. 11,196 authorizing the granting of economic subsidies to companies that hire masters or doctors researchers to carry out R&D and technological innovation.

urucum etc.), moreover, timber, jute fibre, rubber, açaí, cupuaçu, oil, minerals etc. Although such natural resources still continue to be important – mainly for the potential bioeconomy success – their participation on state's economy has been reduced. Nowadays, the Industrial Pole plays a much greater development role of state through its more than 450 diversified enterprises that use other kind of raw material.

Its industry is mainly based in Manaus but it upholds the whole state economy. This fact is pointed out as one of the main reasons for the rain forest preservation. Nevertheless, exploration of natural gas and oil is getting progressively stronger. Amazonas state figured as the 15th contributing to the National GDP with a participation of 3.5 %, and it ranked 14th amongst 27 states regarding HDI in 2007 (Skyscrapercity, 2010).

Infrastructure and Public Policies for Science, Technology and Innovation

One of the first known events that mobilized a fair number of important stakeholders to deal with S,T&I issues was the First Meeting for Science and Technology Organisations in Amazonas State, promoted in 1984 by State Secretary of Planning and General Coordination (Seplan) and Center for Development, Research and Technology of Amazonas (Codeama) (Araújo Filho et al, 2008).

Albeit 2001 could be considered the real start of core changes on the S,T&I local scenery, when the Institute of Environmental Protection of Amazonas – at that time responsible for S&T activities – invited several institutions representing Government, Academy and Enterprises in order to discuss policies for such activities (Araújo Filho et al., 2008).

There is a favourable environment for discussions on policies and strategies on the topic of innovation. Two events considered significant took place: First Symposium of Innovation and Local Development, in which experiences in Brazil and Overseas were discussed, the event was organized by the Centre of Studies and Research on Innovation – NEPI; the other one which is intended to be included in the calendar of events, it was organized by the State Secretary of Science and Technology – SECT and other partners for first time in 2009 and was named InovAmazonas – First Amazonas State Workshop on Innovation.

The Foundation of Support for Research of the State of Amazonas – Fapeam was created in 2002, preceding the creation of State Secretary of Science and Technology – SECT, which was created in 2003. In that year for the first time, during the creation of a local institution, it was explicitly mentioned the existence of an innovation system (…)", when the Superintendence of Manaus Free Trade Zone – Suframa stimulated the creation of the Centre for Technology of Manaus Industrial Pole – CT-PIM (Araújo Filho et al., 2008). Other important events such as creation of organisations, programmes, and laws concerning support to S,T&I activities on Amazonas State are shown in table 2 below:

Year	Organisations	Year	Programmes and Laws
1909	National University of Amazonas (Ufam)[8]	1990	Brazilian Programme of Molecular Ecology for Sustainable Use of the Amazon Biodiversity (Probem)
1952	National Institute of Research of the Amazon (Inpa)[9]	2004	Pappe – Programme for Research Support in Enterprises – Pappe; - Integrated Programme of Research and Technological Innovation – PIPT; Programme of Technological Innovation – PIT.
1982	Centre of Analysis, Research and Technological Innovation Foundation (Fucapi)[10]	1991/ 2004	"Informatics Law"
2001[11]	State University of Amazonas (UEA)	2006	Law on Innovation for the Amazonas State

Table 2 **Events and history of creation of organisations, programmes and laws to support S,T&I in Amazonas (Source: Adapted from the publication: "Emergence of an Innovation System for the Amazonas State: Strengthening through Governance" (2008))**

Training, innovation and performance

There is a great effort that has been done by UEA and UFAM to create higher education units along municipalities in Amazonas State. From 2002 to 2008, according to CNPq, North region had a great increase on the number of PhDs (149 %). However, industrial activity in Amazonas is located in Manaus, therefore technological education is driven by applied technologies brought by overseas enterprises that are majority in Manaus Industrial Pole – PIM. Although without solid results on advancements of R,D&I concerning regional potentialities such as agribusiness and bioeconomy, there is always a great expectation of its exploitation since resources are abundant.

[8] Considered the first University of Brazil

[9] Research unity of MCT

[10] Centre for Studies and Research on Innovation (Nepi), a unit in Fucapi was deployed in 2006.

[11] It has also deployed the Committee of Research Activities and Scientific and Technological Development (CAPDA).

2.3 Economic Outlook of Science, Technology and Innovation of Manaus

Socio-economic data

The settlement of first factories, in the decade 1970-1980 in Manaus, could be considered the starting point for the establishment of an industrial culture at such time inexistent in the State. Its important spill over could be assured by industry participation on GDP's composition of State that advanced from 18.9 % in 1960 to 53.7 % in 1980 and 61.3 % in 2000; nowadays, it is close to 80 %.

Manaus Industrial Pole with its more than 450 enterprises produces from televisions to motorcycles, with annual revenue around US$ 30 billion, exports close to US$ 3 billion yearly and it generates nearly 100,000 direct job posts. Manaus reached the 4th biggest GDP amongst municipalities, it also became 1st in per capita income and 3rd richest city of Brazil (2008) (Amazonas 24 Horas, 2010). The pursuit for jobs in Manaus Industrial Pole, however, associated with few opportunities in countryside has been contributed with migration to the capital, where approximately 65% of the Amazonas State population lives, with high income concentration.

Infrastructure and public policies for science, technology and innovation

Manaus has more than 20 higher education institutions. However, the availability technology courses are rare. The city also has several public and private institutions that provide services and technological development, there are also associations belonging to private sector and financial agents that configure actors for the Local Innovation System in progress.

Training, innovation and performance

The Project Manaus Free Trade Zone with its model based on elevated tax concession to enterprises (static resources) has been criticized for limiting endogenous technological capability (dynamical resources). However, Manaus Industrial Pole has influenced learning and capability development in different areas such as knowledge and techniques on industrial planning and production management and capability to access more competitive markets, for instance

Productivity of innovative industrial enterprises in most states of Brazil gets close to 200 % superior to non innovative enterprises, while in Amazonas the percentage is only 7 %, according to the Brazilian Institute of Geography and Statistics (IBGE, 2005). Furthermore, Amazonas is figured as the first place regarding innovation with 50.6 % (innovative firms) and with the third innovative effort with 3.1 % (R&D investments) of Brazil. Nonetheless, such innovation rate could be understood by improvement and introduction of new products and processes with exogenous technologies combined with innovative effort by acquisition of new machines and equipment deployed on productive process, both with low local R&D activity.

3 The Local Innovation System of Manaus

The LIS of Manaus consists of a broad variety of stakeholders. Due to the fact that Manaus is a free trade zone, the industrial base is strong, with a significant number of large companies. Figure 4 gives an overview of the main stakeholders of the Manaus LIS. Stakeholders being consulted during the course of this study are marked in bold letters. Stakeholders which, even though being considered as an important local actor, do not have a local representative are marked in italic letters.

The stakeholders are grouped according to the different levels they belong to. There is much evidence at all levels that the awareness of the importance of innovation has considerably increased over the last years in Manaus.

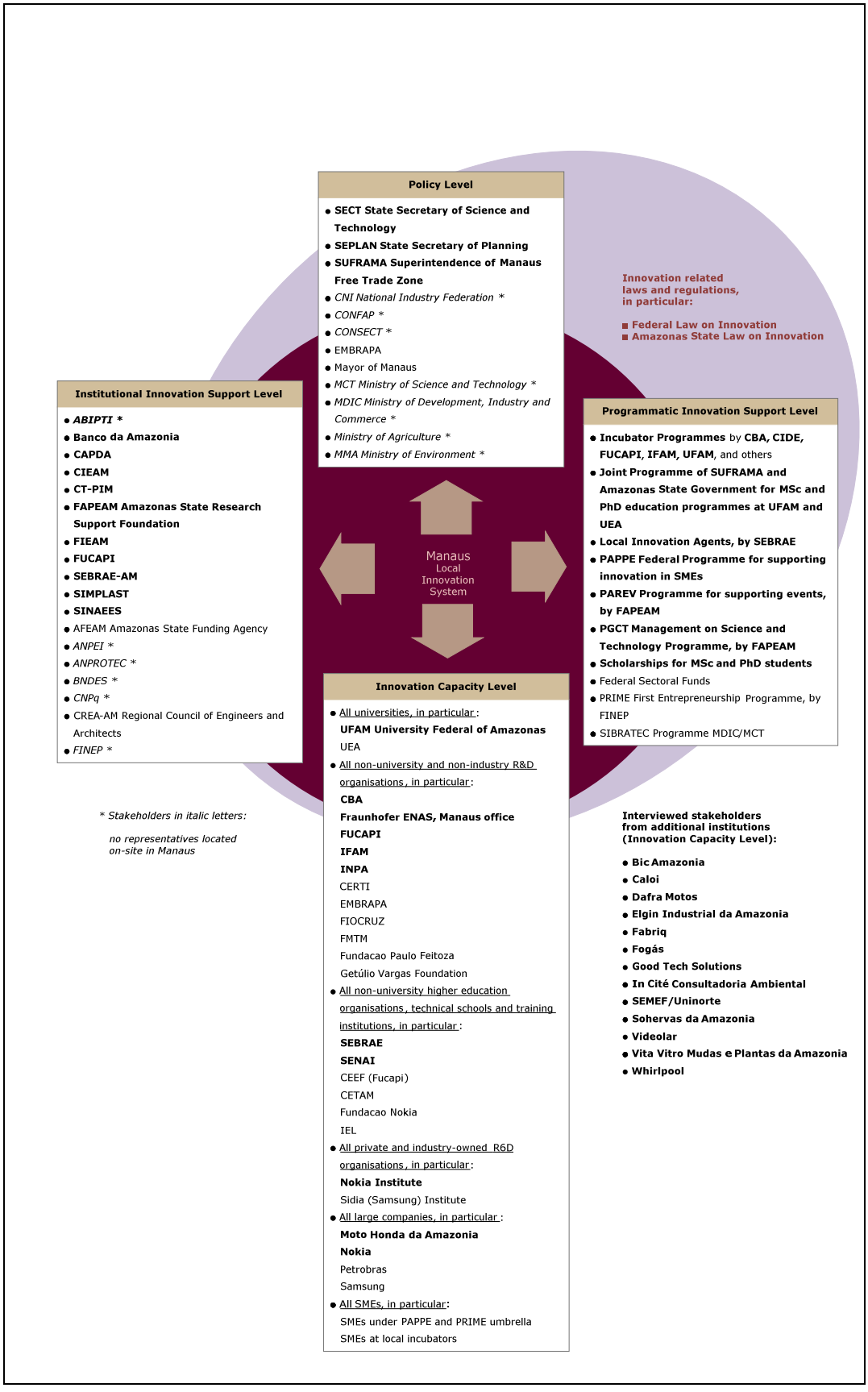


Figure 4 Main actors in the local innovation system of Manaus

4 Indicator-based Analysis of the Determinants of the Local Innovation System of Manaus

4.1 The Experts Opinion Survey (EOS)

Experts to be consulted in the context of the study were identified by the local partner FUCAPI. The interviews were carried out with a comprehensive questionnaire in Portuguese language, which was adapted to cope with the specific situation in Manaus. The interviews with the experts were conducted either within a workshop with several experts involved or within an individual discussion between a FUCAPI representative and the expert during July and August 2010. A small number of personal interviews were carried out by an iit representative, as well.

The interviews consist of questions describing a situation and environment within a well established innovation system (positive statement) and a contradicting statement (negative statement). The experts were asked to give their opinion for Manaus whether they

- Fully agree with the positive statement (4 points)
- Partly agree with the positive statement (3 points)
- Partly agree with the negative statement (2 points)
- Fully agree with the negative statement (1 point)
- Statement that this issue does not exist at all (0 points)

It was also allowed to leave out certain questions if the expert was not able to answer.

The experts were classified according to their relationship to and responsibility for the four different levels of the innovation system (macro, meso institutional, meso programmatic, micro) and concerning their position within their organisation (top management, medium/low management, operational position). This classification will allow identifying different viewpoints of the experts in relation to their occupation.

In the following, the main findings from the EOS are described, based on the assessed 30 determinants, analysed in total and analysed according to different levels and positions of the stakeholders within their organisation.

4.2 Innovation Policy Level Determinants of Manaus

The framework conditions for innovation and actors within an NIS/LIS are strongly influenced by the policy level. The corresponding level of maturity may be described by means of seven determinants of the policy level. Figure 5 shows the pattern of the values regarding the seven determinants of the policy level. Figure 6 shows which of the determinants are higher or lower than the average value of all innovation policy determinants.

The patterns demonstrate that the National Innovation Policy (determinant 1) and the Innovation Friendly Regulations (determinant 7) seem to be most advanced in the LIS of Manaus. However, deficits are observed in the context of Master Plan for Innovation (determinant 3), training and education (determinant 4), the issue of foresight for R&D (determinant 5), and cluster policy (determinant 6).

The values between 1.5 and 3 (except foresight for R&D, determinant 5) indicate that the determinants already exist and currently are developing.

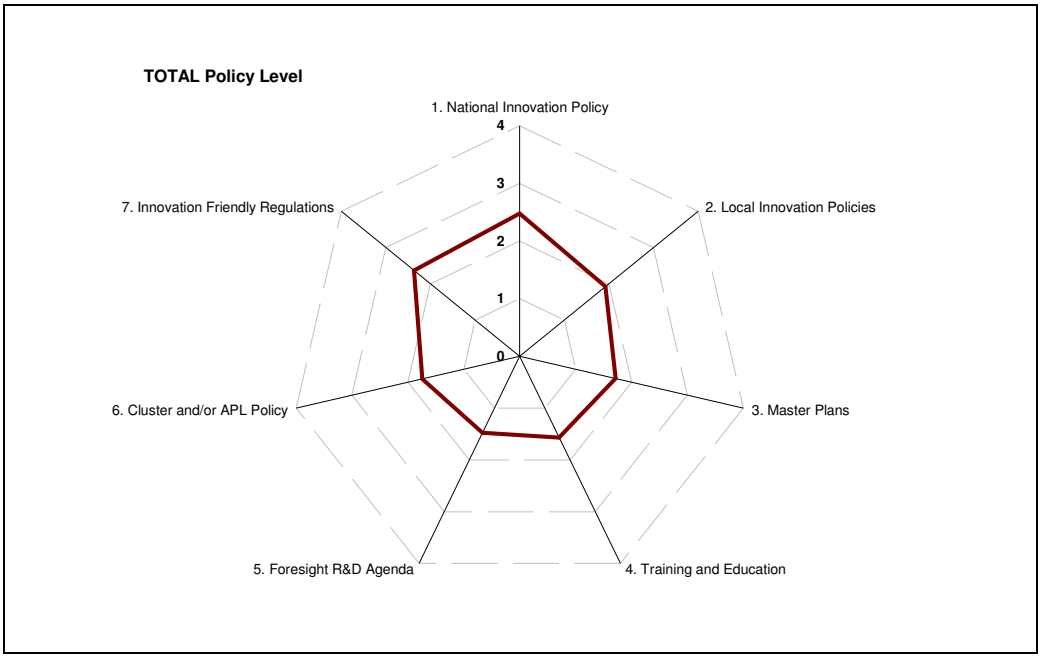


Figure 5 Pattern of the *Innovation Policy Level* related determinants

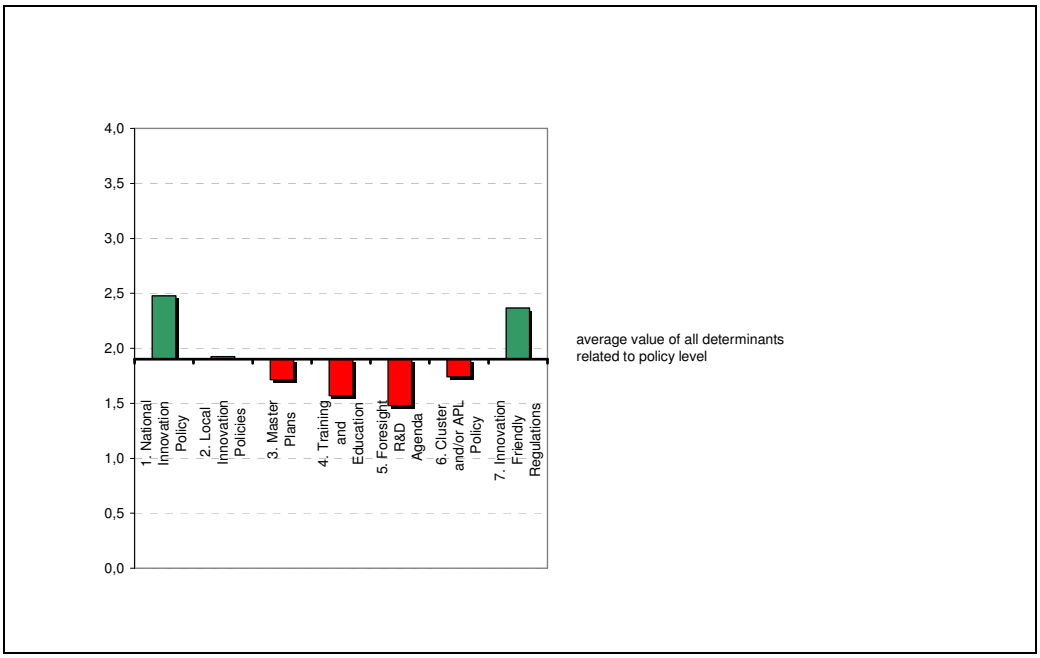


Figure 6 The seven determinants compared to the *Innovation Policy Level* average

How do these results vary according to the relationship of the experts to the four levels of the innovation system (figure 7)?

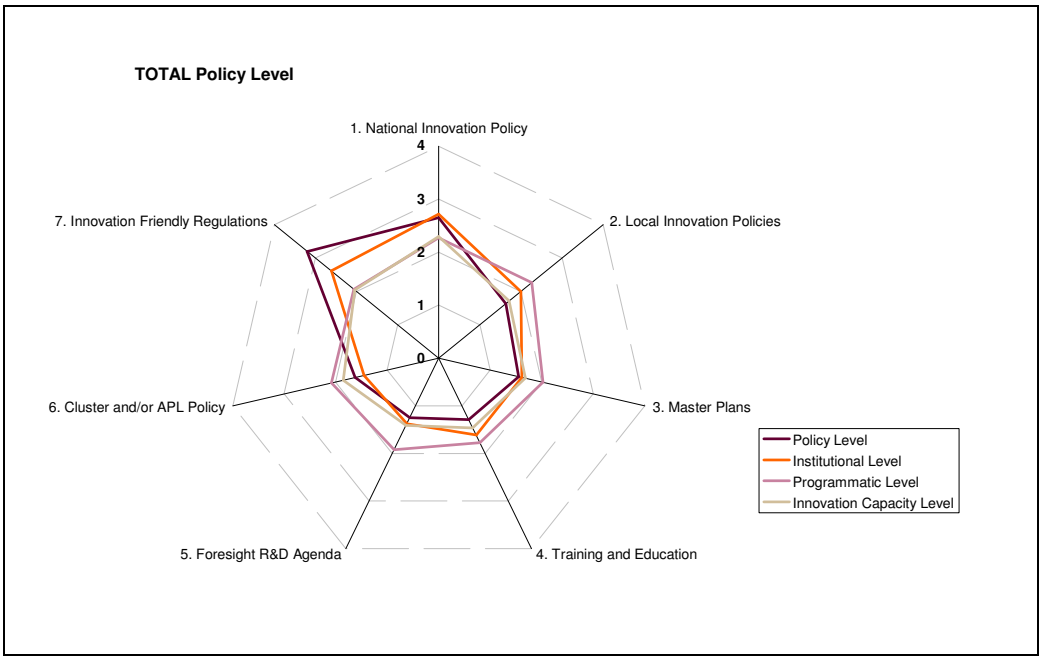


Figure 7 Comparison of the *Innovation Policy Level* determinants regarding the origin of the experts

It appears that experts from the innovation policy level in particular highlight the determinant 7 (Innovation Friendly Regulations) whereas all other determinants are within +/- 0.5 points despite the origin of the values. Figure 8 demonstrates that the answers do not vary regarding the position of the experts within their organisation.

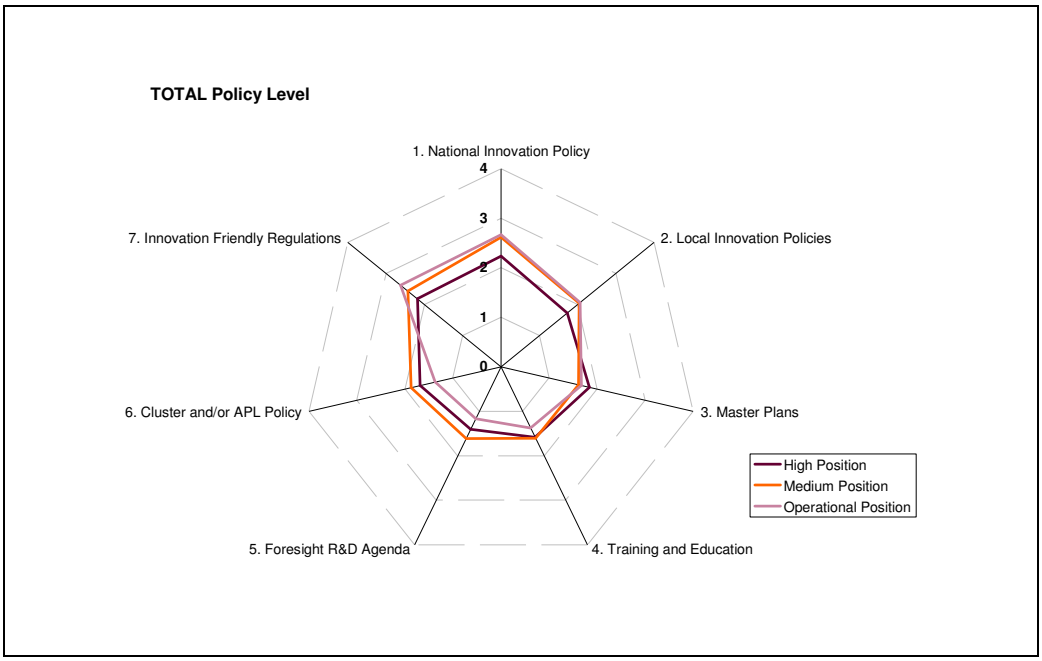


Figure 8 Comparison of the *Innovation Policy Level* determinants regarding the position of the experts within their organisation

4.3 Institutional Innovation Support Level Determinants of Manaus

The seven determinants concerning the institutional innovation support level represent a quite representative overview of opinions. With 21 interviewed experts from more than ten organisations, the answers shall be a reliable and stable base for further considerations.

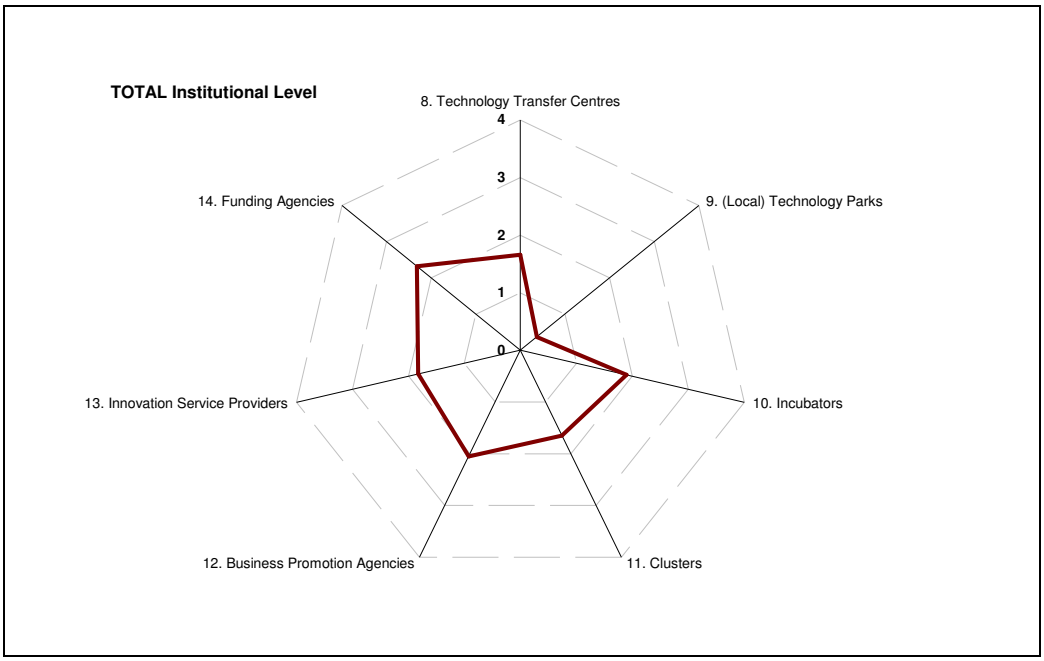


Figure 9 Pattern of the *Institutional Innovation Support Level* determinants

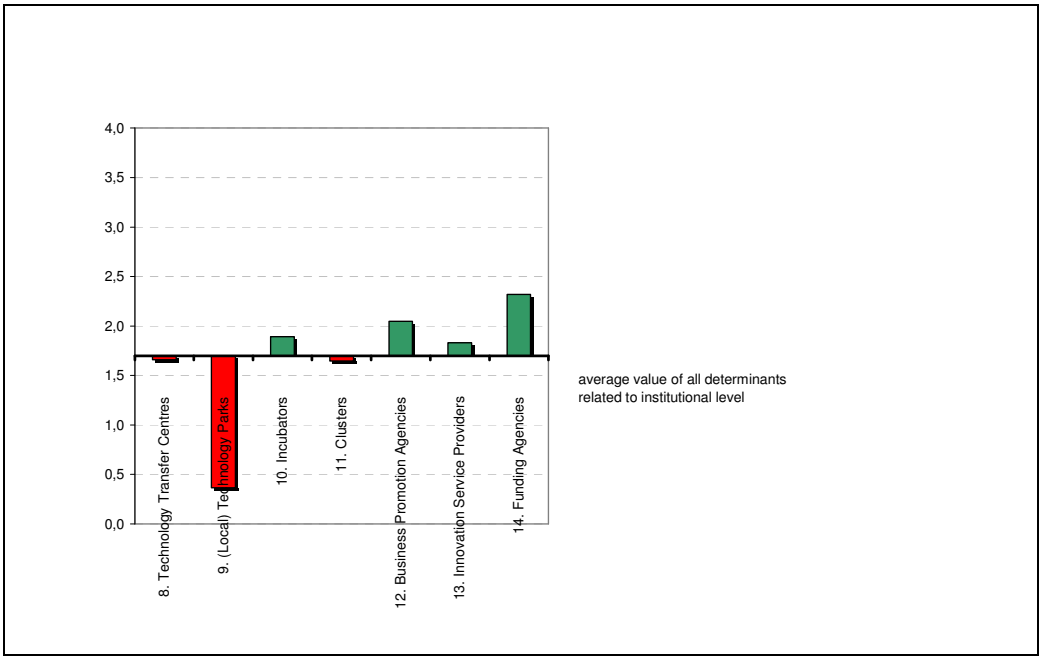


Figure 10 The seven determinants compared to the *Institutional Innovation Support Level* average

Figure 9 and figure 10 show that in particular two determinants of the institutional innovation support level seem to be developed clearly above average (determinant 14 / Funding Agencies and determinant 12 / Business Promotion Agencies). Determinant 9 (Technology Parks) is near 0, since such parks in Manaus so far do not exist. Manaus however has a large industrial park, the PIM (Pole Industrial de Manaus). Here, other than in a technology park, industry of various sectors is residing.

The values between 1.5 and 3 (except technology parks, determinant 9) indicate that the determinants already exist and currently are developing.

How do these results vary according to the relationship of the experts to the four levels of the innovation system (figure 11) and the position of the experts within their organisation (figure 12)? No significant dependence in the experts' opinion can be observed concerning their job position or their responsibilities within the Manaus LIS.

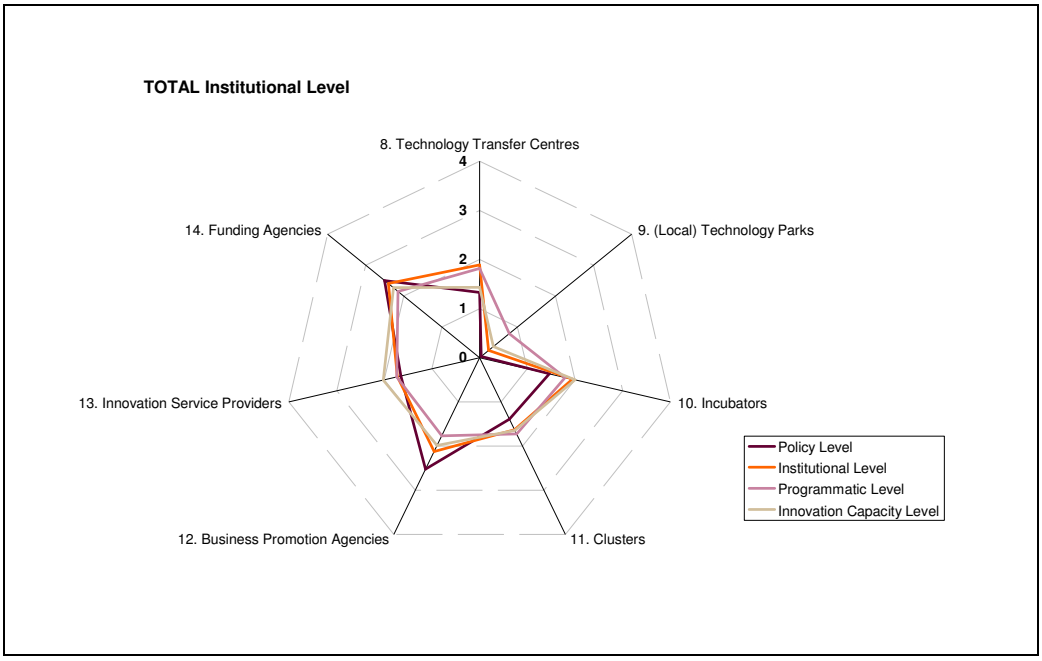


Figure 11 Comparison of the *Institutional Innovation Support Level* determinants regarding the origin of the answers

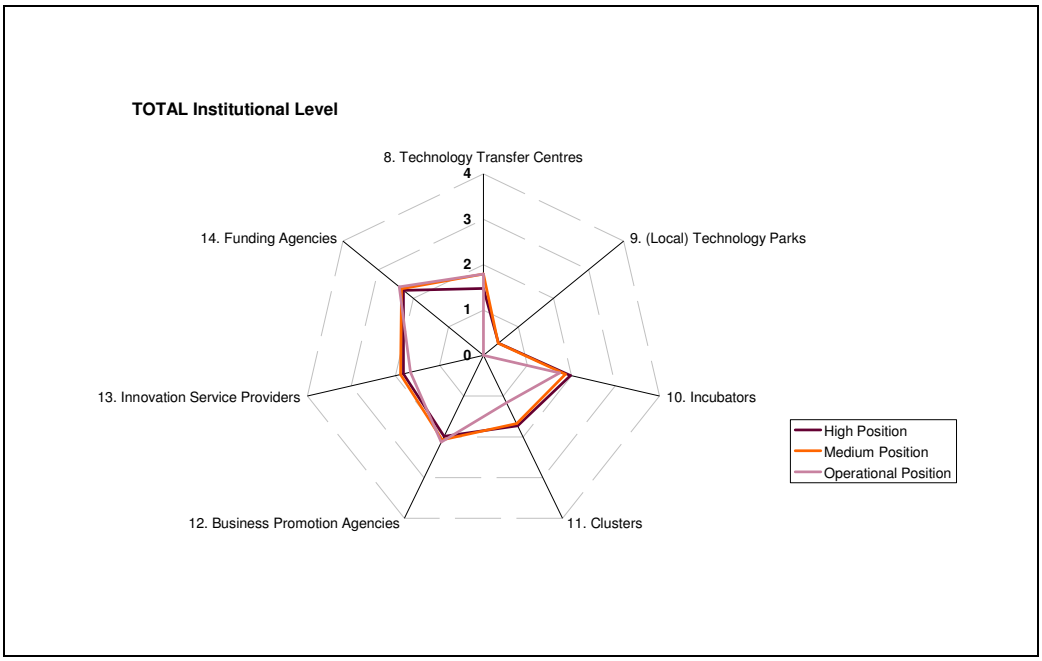


Figure 12 Comparison of the *Institutional Innovation Support Level* determinants regarding the position of the experts within their organisation

4.4 Programmatic Innovation Support Level Determinants of Manaus

Figures 13 and 14 show the eight different determinants related to the programmatic innovation support level. It appears that funding schemes for Science and Technology (determinant 15), in particular for fundamental Research and Technology (determinant 16) are considered as a comparable strong issue within the LIS in Manaus. Below average the determinants 22 (Internationalisation Support), 19 (Accompanying Measures), 18 (Joint Funding Schemes) are the least developed.

The values between 1.5 and 3 (except Accompanying Measures, determinant 18, and Internationalisation Support, determinant 22) indicate that the determinants already exist and currently are developing.

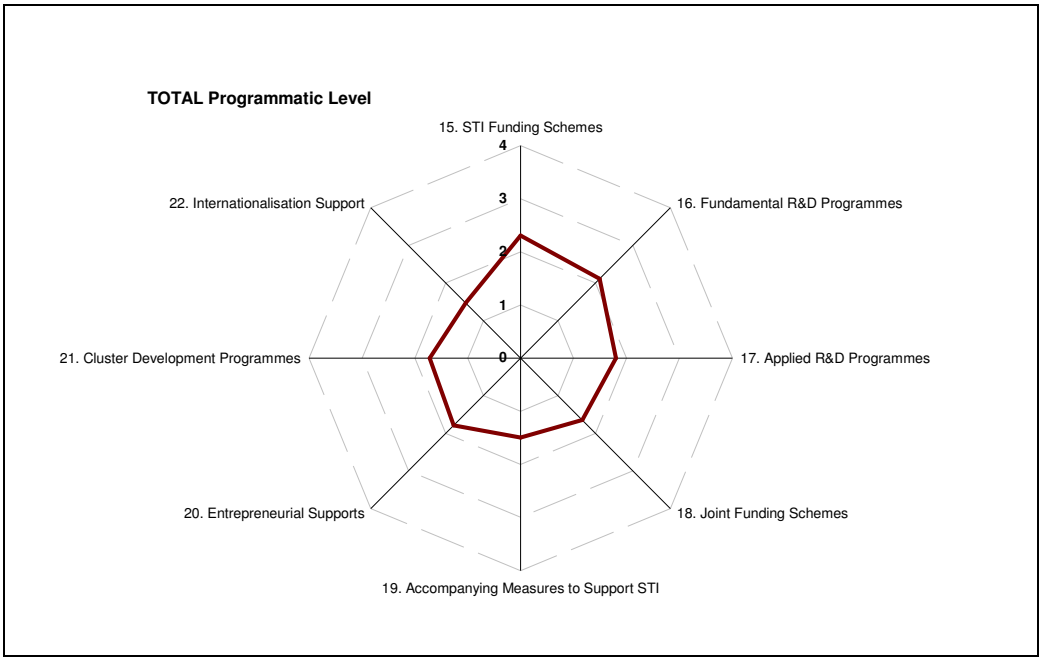


Figure 13 Pattern of the *Programmatic Innovation Support Level* related determinants

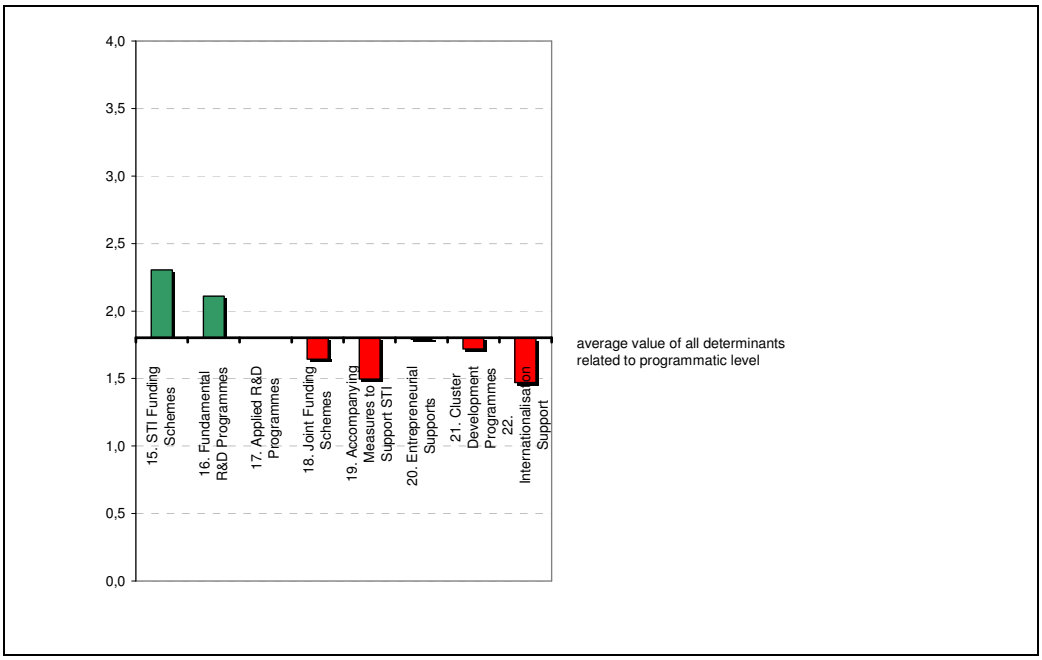


Figure 14 The eight determinants compared to the *Programmatic Innovation Support Level* average

When looking to the answers in respect to their origin more in detail, it appears that the experts from policy level judge programmes for Applied Research and Development (determinant 17) to be much stronger than the experts from other innovation levels consider this issue (figure 15 and figure 16). Experts of the operational level in the organisations see the issue of cluster development programmes (determinant 21) to be comparably stronger developed.

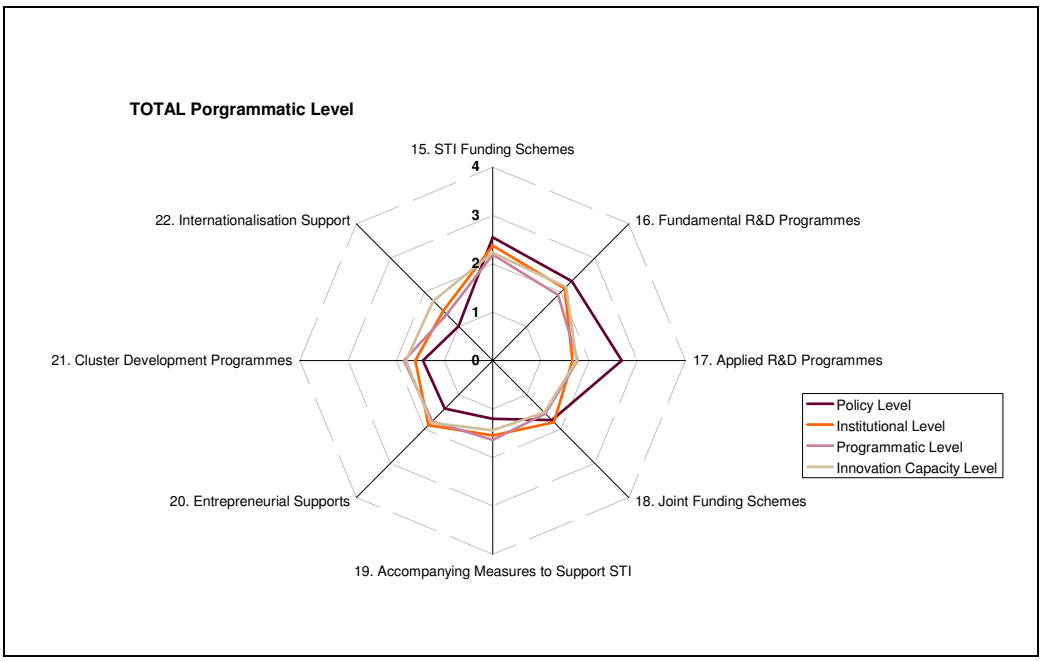


Figure 15 Comparison of the *Programmatic Innovation Support Level* determinants regarding the origin of the answers

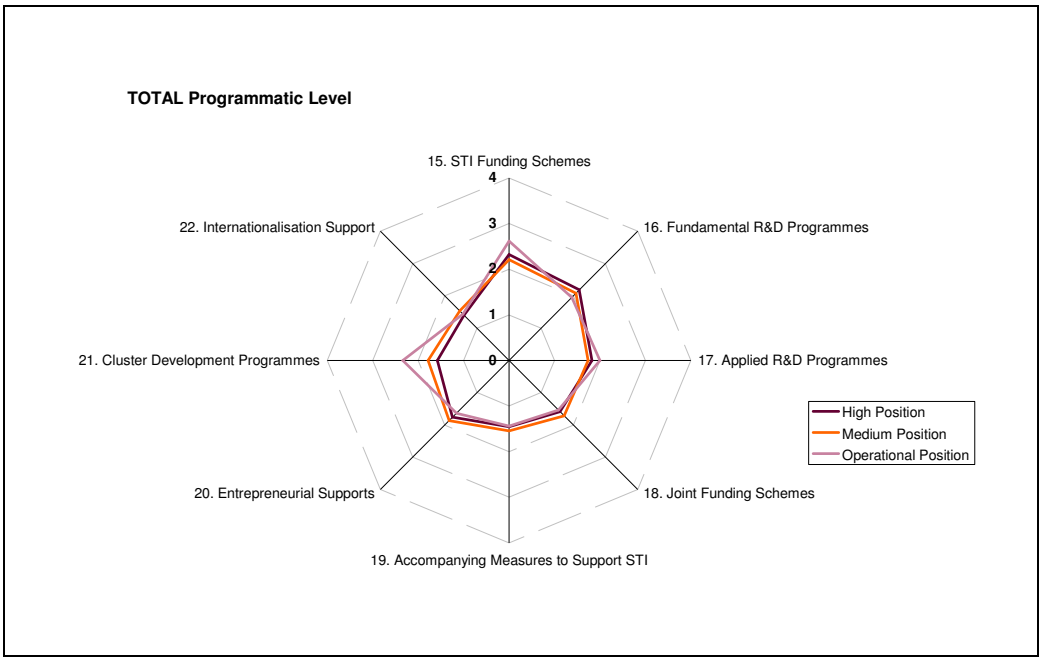


Figure 16 Comparison of the *Programmatic Innovation Support Level* determinants regarding the position of the experts within their organisation

4.5 Innovation Capacity Level Determinants of Manaus

The eight determinants reflect the level of development of the main actors on beneficiary level within the LIS of Manaus (figure 17, figure 18). As a clear strength of the Manaus LIS, the high number of large companies can be recognised. These however are not linked to other actors or to innovation issues in general, when analysing the respective determinant 30 more in detail. Significant weaknesses are seen for determinants 27 (Private Investors), 26 (Innovators), and 28 (Entrepreneurs).

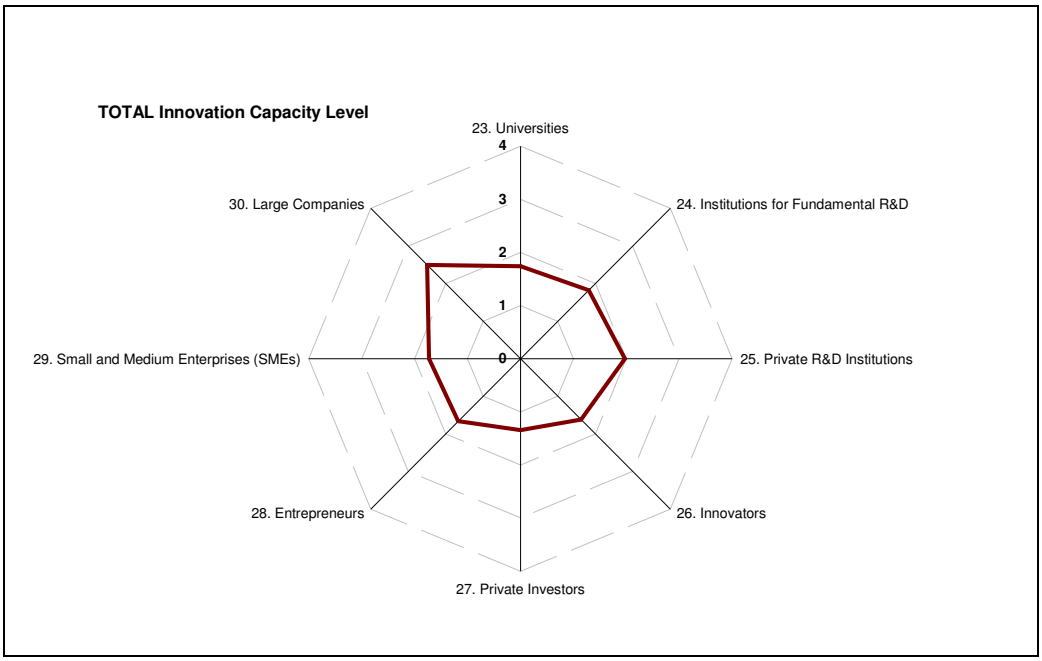


Figure 17 Pattern of the *Innovation Capacity Level* related determinants

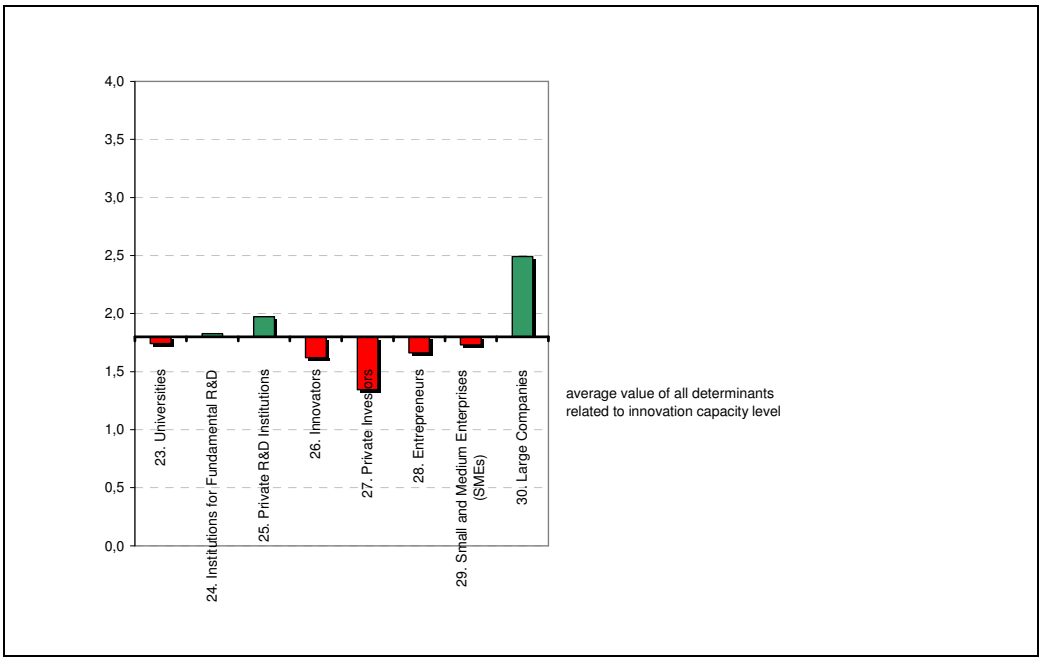


Figure 18 The eight determinants compared to the *Innovation Capacity Level* average

The values between 1.5 and 3 (except private investors, determinant 27) indicate that the determinants already exist and currently are developing.

When considering the origin of the answers, it appears that the experts at policy level judge several determinants representing the private sector lower than all other experts (figure 19).

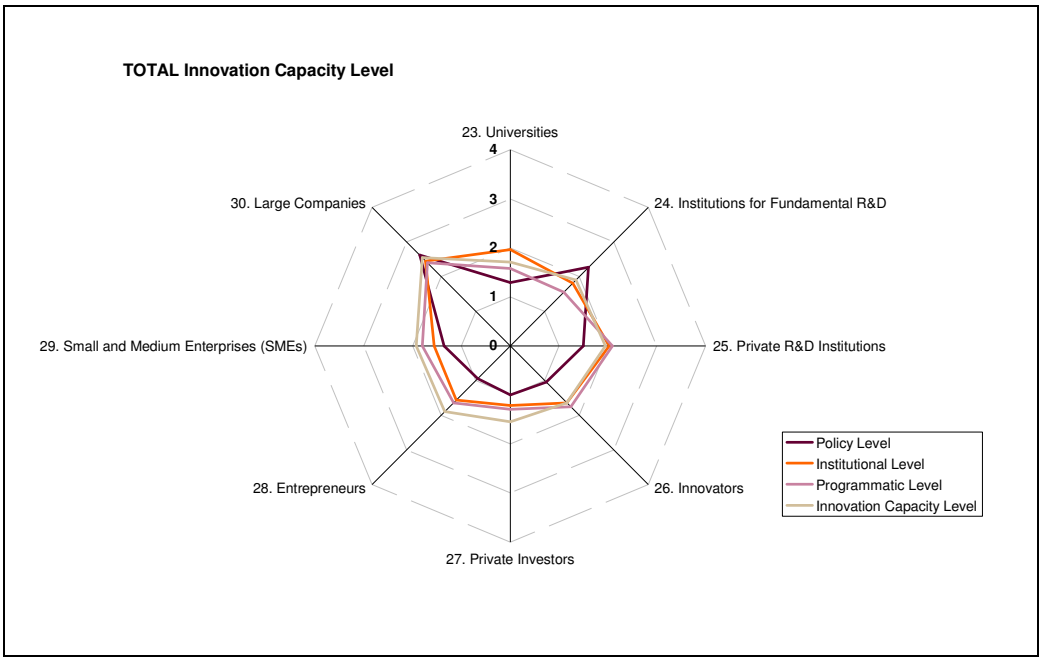


Figure 19 Comparison of the *Innovation Capacity Level* determinants regarding the origin of the answers

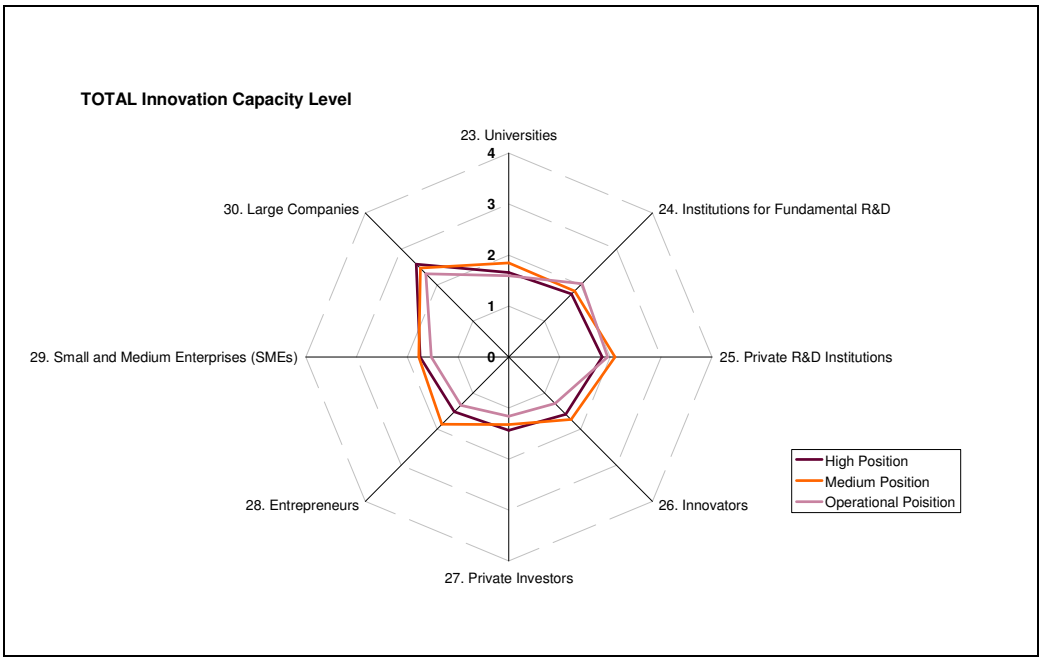


Figure 20 Comparison of the *Innovation Capacity Level* determinants regarding the position of the experts within their organisation

5 Scope of Intervention

The maturity level of an NIS/LIS as well as the performance of its actors may be improved by a broad range of policy measures addressing either each individual determinant or a group of them. The potential impact may be magnified since the determinants often appear to be closely linked to each other. Some determinants will be easy to improve whereas others require complex measures for enhancement.

5.1 Prioritisation of Determinants for Further Consideration

The methodological idea of ANIS is in a first step to select all determinants for further consideration which are below a certain average. In general, the overall average of values of various comparative regions can be used. When no data is available from comparative regions, the average values from the data of each level shall be used.

Recommendations for the improvement of the LIS shall address mainly these low determinants (weaknesses) in order to aim for a general improvement of the LIS including all aspects.

Table 3 reveals again those determinants of the local innovation system which are significantly below the corresponding national average (figures 6, 10, 14, 18) according to the overall average of the experts' answers.

In total, 17 determinants have been identified for further consideration. This is the first main prioritisation when elaborating the most feasible recommendations for policy makers. Any improvement will increase the average, and as a result of a further ANIS analysis in the future, additional determinants will fall below average and then being considered.

Level	Determinants	Value
Policy Level	5 Foresight R&D Agenda	- 0.4
	4 Training and Education	- 0.3
	3 Master Plans	- 0.2
	6 Cluster Policy (APL Policy)	- 0.2
Institutional Innovation Support Level	9 Technology Parks	- 1.3
	11 Clusters (APL)	- 0.1
	8 Technology Transfer Centres	minimal
Programmatic Innovation Support Level	19 Accompanying Measures	- 0.3
	22 Internationalisation Support	- 0.3
	18 Joint Funding Schemes	- 0.2
	21 Cluster Development Programmes	- 0.1
	20 Entrepreneurial Support	minimal
Innovation Capacity Level	27 Private Investors	- 0.5
	26 Innovators	- 0.2
	23 Universities	- 0.1
	28 Entrepreneurs	- 0.1
	29 SMEs	- 0.1

Table 3 Determinants of the local innovation system of Manaus below the level-specific average

Any improvement of every single determinant needs a different extent of efforts on the one side, but also may lead to a varying impact on the other side. The determinants can be grouped into an intervention portfolio. One scale represents the "effort needed" in terms of capacity to provide public funds, investments in infrastructure and human resources, policy reluctance, structural changes, etc. The other scale represents the "expected impact" in terms of improved framework conditions or improved innovation capacity of the actors. The most feasible determinants for recommending priority actions thus will be located in the upper right area (high expected impact and low efforts needed).

Using the experience of iit with similar projects in other countries, in discussion with FUCAPI contributing detailed knowledge of the local situation, and involving selected local stakeholders such an intervention portfolio was developed within a two-step approach.

Within a first step, the 17 determinants below average were grouped according to the expected impacts of any related measures, resulting in the following ranking (table 4).

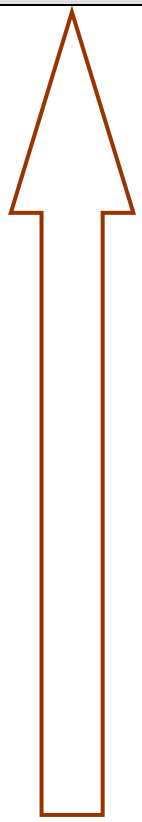
High expected impact
 • 29 Small and Medium Sized Enterprises • 28 Entrepreneurs • 20 Entrepreneurial Support • 18 Joint Funding Schemes 23 Universities • 4 Training and Education 8 Technology Transfer Centres 9 Technology Parks • 11 Clusters/APLs • 21 Cluster Support Programmes • 6 Cluster Policy • 26 Innovators 27 Private Investors • 3 Master Plan • 5 Foresight R&D Agenda 19 Accompanying Measures for STI • 22 Internationalisation Support for STI
Low expected impact

Table 4 **Expected impact of actions improving determinants of the Manaus innovation system, according to selected local stakeholders**

Within a second step, the efforts for possible actions and measures were considered, finally agreeing on the intervention portfolio (figure 21). When thinking of efforts needed, specific measures are considered in the background. These ideas were documented, building the starting point of deriving the recommendations from the intervention portfolio.

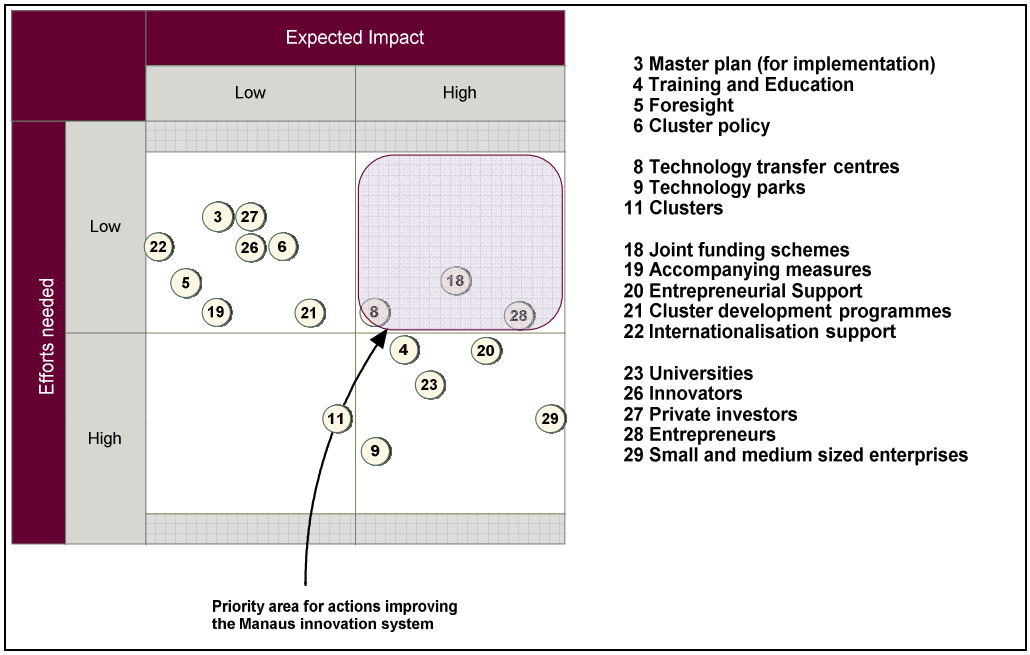


Figure 21 Intervention Portfolio of the Manaus innovation system

A few general findings can be derived; main emphasis however is only put to determinants where a higher impact is expected. Recommendations to be derived should target in particular the determinants of the upper right area (low effort, high impact).

- 28 Entrepreneurs (in some way in conjunction with 20 entrepreneurial support) / 18 Joint Funding Programmes / 8 Technology Transfer Centres are the determinants for priority action for improving the Manaus innovation system.
- 29 SME: Improvement of the SME community towards innovation would expect the highest impact, however needs significant efforts. This finding reflects the important role that SME worldwide play within various innovation systems. SME are flexible and fast reacting on opportunities, however are often lacking important competences and resources. The experience shows that a high number of SMEs implies high efforts if this group shall be significantly supported.
- 4 Training and Education Programmes / 23 Universities have significant impact on the Manaus innovation system, but again require significant efforts and longer term activities. In general terms, educated people have to first reach their position in the innovation system and research has to achieve results which are practically used, both issues require significant time before generating any impacts.
- 9 Technology Parks will only have limited impacts, however requiring very high and longer term investments.

Thus, the most promising fields of intervention taking the specific situation of Manaus into account would be:

- 28 Entrepreneurs:
- 18 Joint Funding Schemes
- 8 Technology Transfer Centres

These three determinants were considered further for proposing the priority recommendations for improving the Manaus innovation system.

Table 5 shows all those determinants above the averages thus summarising the relative strengths of the Manaus LIS. The knowledge of the strengths is a helpful asset when thinking of the feasibility of possible actions for improvement.

Level	Determinants	Value
Policy Level	1 National Innovation Policy	+ 0.6
	7 Innovation Friendly Regulations	+ 0.5
Institutional Innovation Support Level	14 Funding Agencies	+ 0.6
	12 Business Promotion Agencies	+ 0.3
	10 Incubators	+ 0.2
	13 Innovation Service Providers	+ 0.1
Programmatic Innovation Support Level	15 Science and Technology Funding Schemes	+ 0.5
	22 Funding Programmes for Fundamental Research	+ 0.3
Innovation Capacity Level	30 Large Companies	+ 0.7
	25 Private R&D Institutions	+ 0.2

Table 5 Determinants of the local innovation system of Manaus above the level-specific average

When analysing table 5, it appears that determinants of the meso level are over represented. Determinant 14 (Funding Agencies), determinant 15 (Science and technology Funding Instruments), determinant 12 (Business Promotion Agencies), and determinant 22 (Funding Programmes for Fundamental Research) in particular reach high levels. This leads to the impression that even though the prerequisites for turning innovation into practice are existing, the resulting activities seem not to focus on industrial demands or the effects and impacts on industry are limited or not visible. It can be assumed that a local innovation policy, more focused on the demands and needs of industry and the regional industrial development, and a consequent implementation of this policy would allow a significant improvement with limited efforts. It is therefore recommended to regard also

determinant 3 (Master Plans) for deriving recommendations, even though this determinant was not considered in the upper right corner of the intervention portfolio.

5.2 Recommendations for Improving the LIS of Manaus

Based on the experience of iit using comparisons with developments in other regions of the world, the upper right area of the intervention portfolio is considered further to derive specific recommendations for the local innovation stakeholders, for the policy level in particular..

As discussed above, the most promising fields of intervention would be:

- 28 Entrepreneurs:
- 18 Joint Funding Schemes
- 8 Technology Transfer Centres
- 3 Master Plans

What could be possible actions that address those determinants achieving high impact with rather little effort? A detailed knowledge of the local situation is required; therefore these recommendations were developed, discussed, and agreed together with FUCAPI personnel and furthermore with selected stakeholders of the Manaus LIS within several interactive workshop sessions.

Recommendation 1: Improve the "well-being" of entrepreneurs

Determinant 28 (Entrepreneurs) describes the general situation of entrepreneurs in the innovation system. The determinant consists of opinions related to the following four areas:

- Number of people/researchers with individual interest in starting own commercial activities related to technology, science, modernisation, innovation
- The awareness, acceptance and social position of entrepreneurs in the general society
- The existence and level of entrepreneurial education and general management skills
- The social and financial risk portfolio of an entrepreneur and the tools and measures of the securing a sufficient economic situation for the entrepreneur.

It does not cover any particular monetary support for the entrepreneurs or specific programmes for entrepreneurial support.

The following actions are recommended:

- Promote and stimulate entrepreneurial activities “out of the university” and/or “out of R&D institutions” (Spin-Off programmes) (also addresses determinants 23, 26).
- Integrate an “entrepreneurial culture” in the curricula/programmes of all levels of formal education (also addresses determinants 4, 26).
- Implement a broad variety of training programmes in entrepreneurship, management skills, innovation management. Allow easy access to such programmes (also addresses determinants 4, 26, 29).
- Promote campaigns and prizes to recognize the best business ideas and most successful entrepreneurs (Business Plan and Start-up Competitions) (also well addresses determinant 26).

Recommendation 2: Increase R&D cooperation by dedicated support

Determinant 18 (Joint Funding Schemes) describes the status of cooperation between academia and industry in the area of science, technology and innovation, with a special emphasis on industry and SME in such cooperation schemes. The following general recommendation can be derived:

- Make attractive and support the cooperation concerning new and/or improved products, processes and services between the public sector (universities, research organisations) and the private sector (companies) and/or between different type of stakeholders of the private sector (private R&D institutions interacting with enterprises for instance) along new and innovative value-added chains by specific and dedicated funding measures.

A two-fold approach for actions is proposed:

- Create a funding programme or alter an existing programme, to support a mandatory joint participation of academia/research partners and the private non-R&D sector within an innovation project, where all partners have balanced access rights to the project results and/or a fair handling of the different interests of the partners is clearly laid down (also addresses determinants 3, 8, 23, 29).
- Assess and prioritise industrial demands for specific research priorities to be covered by the universities/research organisations. Give incentives to the universities and research organisations if they take up these research priorities. Let the private non-R&D sector control and justify this process. Give incentives to SME when they get involved in such governance activity (also addresses determinants 6, 11, 21, 23, 29).

Recommendation 3: Provide high-quality technology transfer services in the key technology/industry sectors of Manaus

Determinant 8 (Technology Transfer Centres) describes the issue of technology transfer services to be available locally. The services can be integrated in a dedicated technology transfer centre. On the other hand, they can also be carried out within an organisation dedicated to science, technology and innovation. The questions within the EOS covered the following areas:

- Existence of a national scheme for technology transfer centres
- Dependency of technology transfer centres from public sources
- Role and recognition of technology transfer in general
- Equipment, staffing, and resources of technology transfer centres
- Industry and SME orientation of technology transfer centres
- Scientific excellence and recognition of the technology transfer centres.

The main recommendation is that technology transfer services shall be available for the priority key technology and industry sectors of Manaus and by this shall foster solving technological problems of industry on local level as well as the fast transfer of knowledge into industrial application and exploitation. In this context, the following actions are proposed:

- Define the key technology and industry sectors of Manaus (also addresses determinants 3, 6, 11, 21).
- Assess industrial demands for specific technology transfer services in the key sectors and beyond (also addresses determinants 3, 5, 6, 11, 21, 28, 29).
- Make sure technology transfer services are available and being used, incentives for in particular SMEs for using the services shall be considered (also addresses determinants 28, 29).
- Make the issue of technology transfer to be a driver for leadership in further development of the key technology sectors of Manaus (also addresses determinants 3, 5, 6, 11, 21).

Recommendation 4: Evaluation and impact assessment as an instrument of innovation governance

Determinant 3 (Master Plans) describes issues of prioritisation according to local needs and implementation of a local innovation policy by clearly defined specific programmes and actions. The recommendation is to increase the efficiency of already existing and of new innovation programmes by consequent evaluation and impact assessment of policy, programmes, projects, and organisations. In particular the following action is recommended:

- Assess and analyse all existing innovation programmes concerning their:
    - Aims and objectives
    - Implementation procedures
    - Proper use, in terms of matching the aims and objectives and in terms of quantity and quality of projects
    - Impact of the achieved results on the participating parties and on local development in Manaus.
- Increase successful programmes / discontinue less successful programmes.
- Make the awareness, methodology and procedures of the above measures a common issue. Do not rely on self-assessments only, but involve neutral experts for methodological and advisory support and create an atmosphere of mutual learning of all parties involved.

Such measures of monitoring of innovation actions are well implemented in many developed countries and regions in the world (France, Germany, USA, European Union, etc.).

6 LIS in Comparison: Manaus – Cape Town – Munich

The ANIS methodology was applied for a LIS the first time in Manaus. Due to this reason, no full comparison is possible to other, comparable regions. However, a plausibility check of the findings in comparison with other city regions is helpful for a further justification of the results.

For the comparison with Manaus, two city regions (Cape Town, South Africa and Munich, Germany) were selected according to the following selection criteria:

- Similar size of the city regions in terms of population,
- No capital of the country,
- City region with its boundaries clearly identified,
- From a country in similar development status (BRICs) and/or representing a high end of the LIS development,
- Possibility for iit to access the necessary data without high efforts.

VDI/VDE-IT, the mother organisation of iit has established contracts in the area of innovation support in Bavaria for more than ten years. Within their contracts with public authorities as well as with research organisations and the private sector, VDI/VDE-IT has a very neutral position and can represent a broad spectrum of viewpoints from innovation policy level to innovation capacity level. Since 2006, VDI/VDE-IT operates an office in Munich, where all projects in the local context are carried out. The staff of this office (5 people) has a very detailed knowledge of the LIS of Munich and provided the comparative data. Munich can be considered to have a very well developed innovation system which has developed over long period of time.

South Africa can be considered as the “fifth BRIC-country” (BRIC = Brazil, Russia, India, China), slightly less developed than Brazil. The LIS of Cape Town is strongly dominated by a university landscape; industry plays a minor role. Cape Town therefore can be considered being developed above the general South African average. Manaus can be considered being developed slightly below the Brazilian average. Therefore, a similar development level can be expected. The necessary data was provided by high-level individuals being part of Stellenbosch University and by the policy side through a representative of the Department of Science and Technology in Pretoria.

The determinants of the Manaus innovation system were compared to the determinants of the local innovation systems of Cape Town and Munich. In general, the results show a pattern that was expected beforehand: Munich in very many determinants has the full score of four points, indicating that the innovation system is in best operating condition.

Cape Town and Manaus have judgements around 1.5 to 2.5 points, indicating that the determinants already exist and currently are developing.

At the Innovation Policy Level, the comparison between Manaus and Cape Town shows the relative strengths of Brazil on determinants covering the national issues of innovation policy (determinant 1) and innovation-friendly regulations (determinant 7), whereas Cape Town obviously is stronger in the more university related determinants on training and education (determinant 4) and R&D Foresight (determinant 5). Munich's innovation system is very well developed only showing slight weaknesses in implementation (determinant 3) and local innovation policy (determinant 2).

At Institutional Innovation Support Level, Munich is very well developed. Only the issue of technology parks (determinant 9) is seen slightly weaker. Manaus overall is slightly weaker than Cape Town, only the infrastructure of innovation service providers in Manaus (determinant 13) builds a comparative strengths here. As discussed earlier, technology parks (determinant 9) do so far not exist in Manaus. In Cape Town the issue of Technology Parks is assessed on a level slightly below the other determinants of the Institutional Innovation Support Level. Looking at the parks in detail however, it appears that the technological specialisation of these parks is rather low, they more tend to be business parks than technology parks.

At Programmatic Innovation Support Level, the determinant on internationalisation support (determinant 22) needs further discussion. Munich shows a rather weak value here. The reason might be the fact that international cooperation in innovation programmes takes place, without requiring support (for instance by the strong industrial R&D activities of the local large and small enterprises). For a country significantly smaller than Brazil, the issue of supporting international cooperation in innovation is much more important. Cape Town shows the respective higher value compared to Manaus. For Manaus, the full integration of innovation activities into the quite well developed Brazilian National Innovation System shall be to be prioritized by public support more than international cooperation in innovation.

At Innovation Capacity Level, Cape Town and Manaus are judged nearly equal. Exceptions can be seen only for the determinant universities (determinant 23) and private R&D institutions (determinant 24), where Cape Town clearly exceeds Manaus. The reason is the already given description of Cape Town to be considered a "university city". Interestingly, Munich shows weaknesses in the area of private R&D institutions (determinant 25) although Munich is known for its number of private R&D organisations and has R&D being carried out within the various industrial premises. These however in total are much less visible than the world-class universities and the several institutes of well-known large research organisations, e.g. Fraunhofer Association.

In total, it always has to be considered, that for Munich and Cape Town no fully comprehensive ANIS studies were carried out, but only a small number of selected opinions are the basis of this comparison. The more interesting issue would be in any case a comparison of Manaus with other city regions in Brazil rather than with city regions of other countries.

7 Analytical Design of ANIS

The overall implemented ANIS approach of analysing an innovation system may be divided into the following steps:

- Analysing of existing literature regarding the NIS/LIS
- Conducting interviews with experts regarding NIS/LIS, the expert opinion survey (EOS)
- Evaluating and measuring of the outcomes
- Prioritise further only determinants below a certain average
- Identifying determinants having a high impact with little efforts
- Formulating recommendations to improve the prioritised determinants

ANIS takes up this challenge by providing an indicator-based assessment of these determinants, each of which reflects an aspect of the complex reality of the innovation system. The determinants can be grouped according to a three-level hierarchy. Table 6 describes the different dimensions and its actors.

The main strengths of the ANIS methodology is the collective and participatory approach that promotes the involvement of different actors and by this, sharing the responsibilities for the ideas, the results and the successful implementation of proposed actions.

The Local Approach of ANIS

Since local facilities, institutions and organisations are important parts of the national innovation system, it is of major interest to analyse the determinants at local level by interviewing experts and decision makers that represent a specific local environment.

The collected data from the EOS additionally provides useful information on how the local point of view differs from the national point of view, when ANIS is carried out on both national and local level.

Level		Actors	Functionality within an NIS/LIS
Macro	Policy	Public authorities, policy makers	Governing and setting up framework conditions of an NIS/LIS
Meso	Institutional innovation support Programmatic innovation support	Institutional innovation support organisations or public funded initiatives / programmes	Institutions and initiatives are tools to turn innovation policies into practice
Micro	Innovation capacity	Firms, academia, educational institutions, etc.	Main beneficiaries of support measures and main producers of knowledge, innovation, technologies, products

Table 6 Levels and actors within a national/local innovation system

Macro Level: Innovation Policy Level

In macro-dimension, national and local innovation policies directly influence the framework conditions of an innovation system. Laws, decrees and regulations, etc. at that level may often be path breaking, in a positive or a negative way. Public investment in innovation directly relies on decisions made at a policy level. However, such political decisions may only influence the framework conditions for innovation and might not turn innovation into practice.

Meso Level: Institutional Innovation Support Level

Institutions operating at meso level are typically technology transfer centres (for example Science and Technology Institutes), clusters (for example APLs), innovation service providers and funding agencies. They may be considered as the relevant tools to turn any political decision regarding innovation into practice. In developing and emerging countries such institutions are mostly publicly-owned. They mainly aim at fostering stakeholders' competitiveness and capability to innovate and provide in-kind contributions such as training, consultation, conducting applied R&D or products' improvement. These institutions remain a key instrument for improving and encouraging the innovation capabilities of firms, especially in countries where public investment is limited.

Meso Level: Programmatic Innovation Support Level

Programmatic innovation support includes public funding programmes and initiatives which aim at turning innovation policy into practice. This represents the second pillar in improving the innovation capabilities of stakeholders within an innovation system. Such programmes might be managed either by policy makers or by innovation support institutions. Any measures at that level would require significant public investments.

Micro Level: Innovation Capacity Level

The micro level provides an umbrella for the main actors and enablers within an innovation system such as enterprises (large, medium, small, micro), entrepreneurs, universities, public or private R&D institutions, innovators or financial organisations.

Identifying the Determinants of Innovation Systems

The different dimensions may be influenced by some determinants. As far as our research analysis is concerned, these determinants require our special attention since they can be improved with appropriate measures. To sum it up, all four levels of the pattern of determinants affect an innovation system. Although we use the four levels separately, we acknowledge that there are plenty of interdependencies and links between them. However, it might be appropriate to consider these levels separately during the analytical phase. Besides, each one of the determinants may differently influence an innovation system. The ideal way for one country to improve the outcomes of its NIS will not necessarily be the same as for another country. The same applies for the LIS. Furthermore, it is important to point out that within a globalised world all NIS/LIS may be affected by external influences. Therefore, in this analysis we will not consider the external factors that may affect NIS/LIS, since they cannot be controlled by national or local policy makers and actors of an NIS/LIS.

In total, we identified a core set of 30 determinants grouped into three levels to support this analysis. All of them may directly influence the efficiency of an NIS/LIS. By means of different approaches of measuring all determinants may directly be addressed. In the short term, some of them would only require low input whereas others would need longer periods of time for improvement, combined with significant investment. Improving any determinant might generate magnified positive impacts.

We designed a set of three to eleven questions to characterise the 30 determinants properly and assess their stage of development. When applying ANIS for a LIS, some details differ from when applying ANIS for an NIS. These differences however can be considered as marginal.

Expert Opinion Survey (EOS)

The implemented model relies on a wide range of survey data from the Expert Opinion Survey (EOS). The EOS meets the need for up to date and far reaching data, thus, providing valuable qualitative information which is scarce or nonexistent from hard data sources. The 30 determinants are calculated by considering more than 150 variables which are based on the findings of the EOS for each respective country or local environment.

We ask the experts to provide their opinions regarding various aspects of innovation and the innovation environment they operate in. The relevant data which is gathered as a result of such interviews offers a unique insight and qualitative portrait of each country's or region's concept of innovation

and each country's/region's own representation of its situation in comparison to others.

Rating

Through the survey process the interviewees are asked to rate the current conditions of their country's (or region's) innovation environment on a scale of 1 to 4. On the scale, rating 1 corresponds to the worst operating condition or situation. Rating 4 corresponds to the best operating condition or situation. The ratings in between indicate the tendencies to either positive or negative evaluation (see example in figure 22). If a condition is not existent at all, the interviewee shall rate it as zero. If the interviewee does not know anything about the condition, he/she shall answer "I don't know".

18.1	Joint R&D funding					
	is a well established tool to stimulate STI between SME and academia	④	③	②	①	is not recognised as an approach to stimulate STI

⓪ Does not exist.

◯ I don't know.

Figure 22 Example of an EOS question

The Indicator Approach

Based on the findings of the EOS and on the evaluation of the questions we then are in a position to calculate appropriate indicators. A scale with the following indicators was designed:

- Indicator "1" represents the determinant at its worst operating condition or situation, emphasising that it is poorly developed.
- Indicator "2" means that a determinant basically exists and has shown first positive impacts. Nevertheless, there is a strong need to improve its efficiency or functionality.
- Indicator "3" means that a determinant is mature and has shown positive impact on the performance of the Innovation System over a long period of time. Nevertheless, there is still room for further improvement to reach excellent performance.
- Indicator "4" corresponds to the determinant which is at its best operating condition. Although tiny improvements might still be possible, this determinant has proved to be strongly developed and well performing over a long period of time.

Indicator values above 3 usually apply to well develop industrial countries where all determinants are well established and efficient even though some are performing better than the others.

A value between 1.5 and 3 indicates that the determinant already exists and is currently developing.

Values below 1.5 mean that a specific determinant may exist but is not yet operational or requires significant improvement. This usually corresponds to countries and regions that currently have a quite weak innovation system.

Values below 1 and/or a high number of “I don’t know” answers show that obviously items are not existing or very unclear. Further investigation on the reasons therefore might be interesting.

Analysis of Scope of Intervention

In order to be able to evaluate the quality and the stage of maturity of an innovation system it is important to describe the determinants. The maturity level of an innovation system as well as the performance of its actors may be improved by means of policy measures addressing either individual or groups of determinants. As determinants may often be linked to one another, the potential impact might be magnified. Obviously some determinants may easily be improved whereas others might be much more complex.

Therefore, a portfolio analysis is used to compare the required mandatory effort and the potential impact of the determinants which are below average in the analysed innovation system. One scale represents the "efforts needed" in terms of capability to provide public funds, investments in infrastructure and human resources, policy reluctance, structural changes, etc. The other one represents the "expected impact" in terms of improved framework conditions or improved innovation capacity of the actors. As a result of these findings, specific policy measures addressing these determinants can be formulated.

A key issue when elaborating the intervention portfolio and the resulting recommendations is the integration of local stakeholders into a discussion process. The local experts shall be actively involved in the process and thus shall have a high identification with the results of the study. By this, a high local compliance with the results is achieved being the base for a further development and an implementation of the recommendations.

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Created by FUCAPI in 2005, Nepi has as its main objective to contribute to the economic development of the Amazon Region through strengthening of local innovation dynamics. Nepi develops consultancy services to private firms. In addition it carries out studies that intend to insert innovation as an essential item on public policies local agenda. Nepi's researchers are active in formation of skilled people through training activities and teaching in under graduation and graduation courses. Part of these efforts is advising students on innovation management in a *stricto sensu* programme which is focused on the strengthening of bioeconomy in the region. Among the main areas of interests, there are: innovation systems, clusters, knowledge and innovation networks, technological learning and capabilities, entrepreneurship and incubation of firms.

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CIEAM - Founded in 1979, the Industry Centre of Amazonas State represents around 165 associated firms in forums at different governmental levels, discussing processes related with concession and use of fiscal incentives at Manaus Free Trade Zone. Acting in both technical and legal areas, CIEAM aims to improve efficiency and efficacy of industrial sector in Amazonas State.

FAPEAM – Created in 2002, Amazonas State Research Support Foundation has a mission to support scientific research and technological and experimental development in the Amazonas State as well as their applications in the interests of its both economic and social development. Its main activities are related to financing scientific and technological research projects, concession of scholarships to human resources development and financing technical and scientific events.

FUCAPI – Centre of Analysis, Research and Innovation Technology Foundation is a private non-profit organisation created in 1982 purposed to support industrial activity which includes among its activities to provide expert technological services, to develop products and processes, and human resources development in technical areas, including training and formal education in both high school and higher levels.

SEBRAE-AM – Service of Support for Micro and Small Enterprises is a private non-profit institution created in 1972 which has a mission to promote the competitiveness and sustainable development of micro and small firms. Focusing the strengthening of entrepreneurship SEBRAE helps new firms creation and expansion through a diversified set of activities as training, funding access, association incentive, fairs and business meetings promotion. It has a countrywide presence, with representatives in each state of Brazil.

SECT-AM – Science and Technology State of Amazonas Secretary was created in 2003 and has the mission to formulate and manage the Amazonas policy of S&T, for so coordinating efforts from different institutions so that knowledge developed at universities and research centres and labs may be used as effective alternative to promote sustainable, human and jointly responsible development.

SUFRAMA – The Superintendence of the Manaus Free Trade Zone, which was created by a federal Decree Law in 1967, is a Federal Agency linked to the Brazilian Ministry of Development, Industry and Foreign Trade. It is responsible for managing the tax incentives related to the Manaus Free Trade Zone and has as its main objective to promote Western Amazon Region development, contributing to a better integration of this area to the rest of the country.

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