PROJECT FINAL REPORT

Grant Agreement number: 225368

Project acronym: INGINEUS

Project title: Impact of Networks, Globalisation and their INteraction with EU Strategies

Funding scheme: Collaborative project (large-scale integrating project)

Period covered: **from** 1st January 2009 (month 1) **to** 31st December 2011 (month 36)

Name, title and organisation of the scientific representative of the project's coordinator, title and organisation: Alireza Naghavi, Dr, Fondazione Eni Enrico Mattei, Milan, Italy (FEEM)

Tel: +39.051.209.8873

Fax: +39.02.520.36949

E-mail: alireza.naghavi@feem.it

Project website address: www.ingineus.eu

Table of contents

Final publishable summary report

1. Executive summary

Innovation is a key component of productivity and growth for any economy. The recent shift of events in the world economy has brought the internationalisation of innovation activities in centre stage of debates on globalisation. The European commission seeks to fulfil its Europe 2020 goals of achieving smart, sustainable and inclusive growth, by seeking innovation policies that retain, foster and attract innovation.

Results from the INGINEUS investigation suggest that more than half of the 1215 firms polled in the INGINEUS Survey (i) operate across national borders, (ii) or are at least somewhat innovative and (iii) or rely on some form of networks for their offering. Nonetheless, *global innovation networks* is only a new phenomenon and not yet exploited by policy makers and industry representatives as just about one percent of the total number of firms in the survey are highly involved in all three components of GINs (INGINEUS, 2011a).

The globalization of innovation presents challenges and opportunities for both European and Southern countries in establishing a virtuous cycle that could foster and attract new knowledge from abroad. Brain drain, deskilling and job losses are among the main sources of conflict between country-partners engaged in the offshoring of R&D and innovation activities. We expect the geographical expansion of knowledge activities to lead to more competition for highly skilled labour and other strategic resources. Firms and institutions should face the challenge by placing themselves in a position where they could not only attract mobile knowledge assets, but also exploit knowledge assets generated elsewhere. In short, they must build and take part in global networks of innovation, a growing phenomenon that may turn challenges into opportunities.

An important upshot of the project was providing evidence that the widespread fear that R&D offshoring may have detrimental effects on growth and competitiveness is unfounded. Offshoring R&D activities by European firms tend to be complementary to those carried on at home. On this basis we can conclude that offshored R&D is in most cases complementary to R&D activity conducted at home and as such should not have a negative impact on R&D activity and employment in Europe. The findings suggest that policies aiming to discourage offshoring may reduce the competitive standing of EU firms in global markets (INGINEUS, 2011b).

In sum, regional and national policymakers must not only ensure that their locations is an attractive node in firms' global networks, but also present the ability to identify and absorb technologies. Indeed, the globalization of innovation tends to be due to the distributed nature of scientific and technical knowledge, and to allow MNCs to become embedded in regional innovation hubs and be present in some of the most important markets. Given the expansion of knowledge-based economies and the globalization of innovation, INGINEUS underpins the importance of a shift of context to an outward-looking rather than a protectionist perspective in European innovation policy and growth strategy.

2. Description of INGINEUS context and objectives

INGINEUS addressed the impact of globalisation and the rapid growth of selected emerging economies in the world on the competitiveness and strategies of European Union firms, industries and regions. INGINEUS brought together researchers from EU countries (Italy, Denmark, Germany, Estonia, Sweden, Norway and United Kingdom) and from some of the most important emerging economies in the world (notably Brazil, China, India, and South Africa). It focused particularly on the evolution of global production networks into global innovation networks and its impact on knowledge-intensive activities in the European Union.

The project moved beyond traditional studies of the global location of productive activities. It focused on a much more recent trend, namely the global location of innovation or knowledge intensive activities. This global shift has even greater implications for the European Union than the well-known relocation of production to other geographical areas. This is because it refers to the main factor underlying competitiveness, growth performance and employment in the globalised learning economy, i.e. knowledge (Archibugi and Lundvall, 2001; Lundvall and Borrás, 1999).

Competition in traditional, cost-based industries has for some time ceased to be a viable specialization for advanced economies. It is becoming increasingly less so also for more or less rapidly advancing developing economies, thereby raising the premium on knowledge activities (OECD 2007). Indeed, even in sectors previously regarded as cost based, value-added activities have become increasingly knowledge intensive (Narula and Dunning 2000).

The ambition of the Lisbon strategy is that the EU shall become the most competitive knowledge-based economy in the world. In an increasingly globalised economy and with accelerated technological change, the challenge for the EU consists of retaining and attracting knowledge-intensive or innovation-based activities and, in addition, tapping into knowledge generated elsewhere. This is why the understanding of the evolution of global production networks into global innovation networks and its dynamics is crucial.

Similar to global production networks (GPNs), the project conceptualised global innovation networks (GINs) as a function of changing strategies of multinational firms, primarily from developed but increasingly also from advanced developing economies. But as opposed to more simply constituted GPNs, evolving local learning and innovation capabilities are a hallmark of GINs. In fact, in addition to activities in the core advanced economies, GINs have begun to involve those parts of the developing world that are rapidly attracting knowledge intensive activities, thus questioning the future competitiveness of firms, industries and regions in the EU.

The dynamics of these networks have implications for growth and development both in Europe and in its partner countries. These implications were not yet well understood. It was clear, however, that they go to the heart of the Lisbon Agenda of harnessing the knowledge economy for increased global competitiveness. The internationalisation of knowledge intensive activities is both a challenge and an opportunity – a challenge because the geographical expansion of knowledge activities leads to more competition for highly skilled labour and other strategic resources, and an opportunity in that European firms and institutions can position themselves such that they simultaneously exploit knowledge assets generated elsewhere while continuing to attract mobile knowledge assets to Europe. Preparing for the challenges while responding to the opportunities requires an innovation policy that goes beyond the narrow concerns of the EU and ERA and that also reflects the aspirations of the world's most dynamic developing countries which are making great strides in capturing larger shares of global innovation networks. This is why the project

culminated in an assessment of the Impact of Networks, Globalisation, and their INteraction with EU Strategies (INGINEUS).

INGINEUS draws its strength from a research design that conceptually and empirically integrated Northern and Southern perspectives on the determinants of GINs. More specifically, the geographical and sectoral spread allowed the team to probe trends identified in the literature and emerging from our own analysis, while illustrating insights through indepths investigations of specific instances of internationalisation of firms and regions.

The first objective of INGINEUS was to understand the transition of global production networks to global knowledge and innovation networks. In addition to WP1 (administrative) and WP2 (methodological), this involved both an analysis of trends at national and regional level of the extent and scope of the global shift of innovation activities and the micro-level determinants of choices of MNCs – between retaining vertical control over knowledge-based activities as opposed to creating or participating in networks in which these activities are fragmented **(Work Packages 3 to 5)**.

Work Package 3 assessed and measured the shift from global production networks to global innovation networks and its determinants at country level. Particular focus was on key factors that can facilitate the transformation of GPNs into GINs within the national context. It explored the role of the accumulation of competences at country level in attracting R&D from elsewhere or entering into innovation collaborative agreements. **Work Package 4** aimed to understand the changing roles of certain latecomer regions in GIN from low cost producers to innovation hubs coupled with the role of their regional institutional frameworks in fostering (or not) the accumulation of capabilities at regional level. The selected regions were Gauteng and the Western Cape in South Africa; Beijing in China and Bangalore in India. In order to achieve the objectives the data collected through the INGINEUS survey were analyzed and case studies carried on. **Work Package 5** focused on understanding the contribution of fragmentation of production to the creation of Global Innovation Networks (GINs) from a firm perspective. It set out to explore the strategies, structures, behaviours and attitudes of some key Multinational Companies (MNCs) from the selected sectors and countries in relation to: (i) the role played by the stages of the production processes off-shored; (ii) the role of the adoption of ICTs in determining different firms' internationalization modes; (iii) how different innovation strategies interact with the internationalization ones; (iv) their views and needs regarding institutional frameworks.

The second objective of INGINEUS was to understand the capacity of emerging countries to accumulate and use knowledge and capabilities that allow them to participate in global innovation networks. The focus was in particular on the role of human resources and technological capabilities on the one hand and the relationship between subsidiaries of MNCs, local firms and universities on the other hand. More generally, the intention was to shed light on the microeconomic and systemic dimensions of technological learning and upgrading and globalisation **(Work Packages 6 and 7)**.

Work Package 6 aimed to research the link between GINs and skills and competences. The tale was one of (Northern) MNCs that embody certain capabilities while at the same time looking for new ones, and of education and training systems (in the South) that are an essential element of the very absorptive capacities that INGINEUS conceptualized as a local or national building block of GINs. Therefore, the fragmentation of GINs and the different demands on capabilities that the different activities pose were firstly investigated. The evolution of the two-way relationship between foreign direct investment and local human capital in firms in Brazil, India, China and South Africa was then understood to further analyze the role of intermediate skills in the competitiveness of high- and medium-tech industries. **Work Package 7** consisted of three principal analytical components, exploring (i) how (domestic/foreign) ownership affects the propensity to

interact with research units (institutes/universities); (ii) how IPRs shape the configurations of GINs in technological catch-up; (iii) global-local relationships between firms, public labs and higher education institutions in ICT GINs.

The third objective of INGINEUS was to assess the dynamic impact of offshoring of knowledge intensive activities in firms and evaluate the long-run costs and benefits of emerging global innovation networks in a range of industries (differentiated by research intensity and the drivers of technical change), and how their gains are being distributed between European and emerging economies' industries and regions **(Work Packages 8 and 9)**.

Work Package 8 assessed the long-term effects of GINs on EU and other Northern economies and investigated the relationships between different strategies of participation in GINs and the expected impact in northern MNCs. **Work Package 9** provided insights into inter-sectoral differences in drivers, degree and patterns of global innovation network formation. Three different sectors, each representing their own category in the influential Pavitt (1984) taxonomy, were chosen as cases. WP9 provided insights into GIN formation in each of these sectors on their own and, by way of comparative analysis, lifted the analysis to a more general European level perspective to answer to the following research questions: what GIN patterns are forming in the selected sectors, and to what extent are these influenced (driven, constrained) by contextual conditions specific to these sectors?

The fourth objective of INGINEUS was to analyse the institutional frameworks in Europe and in emerging economies that are relevant for the creation and anchorage of GINs in national and regional systems, and to derive specific policy recommendations from this study aimed at improving these institutional frameworks in both the EU and emerging economies **(Work Package 10)**.

Indeed, **Work Package 10** summarized and reflected upon the most relevant dynamics of global innovation networks, their threats and opportunities in view of the international dimension of the Lisbon Strategy; it discussed their implications for the next 10-15 years and analyzed the policy-related institutional aspects that affect the featueres an development of GINs between Europe and the latecomer economies studied.

3. Description of the main S&T result and foregrounds

Here below, the main S&T results achieved are provided for INGINEUS.

3.1. The INGINEUS survey[1]

Results from the INGINEUS survey suggest that Global innovation networks (GINs) are at an early phase of their emergence, and most evidence about the emergence of such networks has been anecdotal. The survey (of 1215 firms in 11 countries) fills an important gap by providing systematic evidence about the phenomenon.

In addition, the survey addresses two blind spots often found in innovation research. First, firms from four developing countries (Brazil, China, India and South Africa) were included. Second, the survey was conducted not only for multinational enterprises, but among all organisations in the

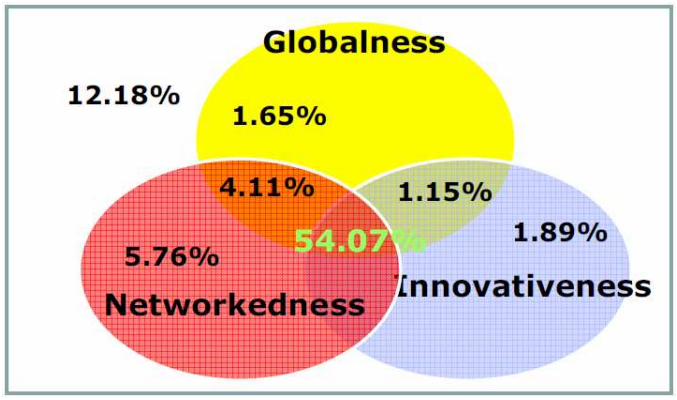
[1] All results from INGINEUS survey are reported in Deliverable 2.2 : Complete standardised data set containing all the information collected in all countries, June 2011, available at http://www.ingineus.eu/getpage.aspx?id=302&sec=300.

relevant industry with 5 or more employees. Because of its greater reach, the survey succeeded in capturing some hitherto under-recorded phenomena.

The levels of "globalness", innovativeness and "networkedness" were calculated for each firm. Various metrics were used for each measure, e.g. **globalness** was measured by looking at the percentage of total sales derived from export and the largest markets, the geographical location of partners with whom firms collaborate for innovation; the location of the different functions of the firm (by the unit, by geographically dispersed subsidiaries or outsourced) and the location of firms' outsourced or offshored production or innovation activities (if they do use outsourcing). The **innovation** measure follows the Oslo manual guidelines, and **networkedness** was based on the following questions: How different functions of the firm are performed (by the unit in location, by subsidiaries or outsourced); with whom outside the firm it has been collaborating for the development of its most important recent innovation and whether a firm has developed formal/informal linkages (e.g. research relationships) with a variety of external organizations, e.g. universities, research institutes, government etc.

Highly reliable composite metrics were developed which enabled us to categorise firms as highly, somewhat or not at all global / innovative / networked.

Figure 1: Globalness, Innovativeness and Networkedness

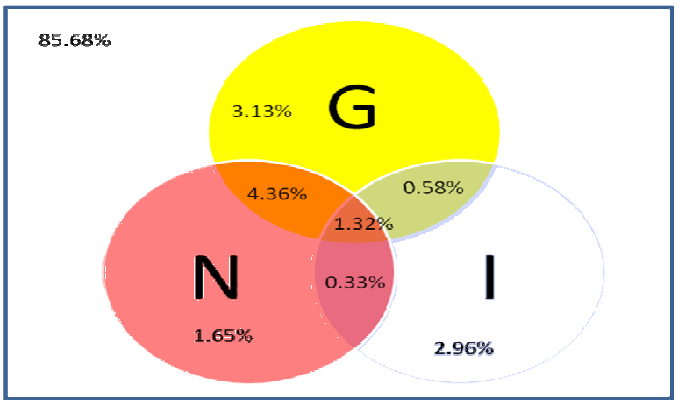


Source: INGINEUS, 2011a

Figure 1 shows that more than half of the firms polled (i) operate across national borders, (ii) are at least somewhat innovative and (iii) rely on some form of networks for their offering. Only 12% of the firms in the dataset doesn't present any of the analyzed characteristics. That is, it is not at all global, neither innovative, nor networked. The next largest groups are represented by firms definable as only networkers (5.76%) and those resulting global networkers (4.11%).

We repeated the same experiment narrowing the definitions of Globalness, Innovativeness and Networkedness. In this second phase, we considered **Global** only those actors carrying on operations across all continents, not just across Europe, Japan and United and States; **Innovation** new to the world rather than new to the firm; a **Network** only if firms resulted engaged in both formal and informal relationships with a range of partners to create innovations.

Figure 2: Global Innovation Networks



Source: INGINEUS, 2011a

As indicated in Figure 2, when stricter criteria are applied, only about 15% of firms demonstrate a high level of globalness, innovativeness and/or networkedness. This is consistent with the fact that GINs are an emerging phenomenon.

The 3.13% of **Global asset exploiters** and 4.36% of **Global Networkers** have a similar distribution in terms of size (large firms) and firm type – mainly the subsidiaries and headquarters of multinational corporations (MNCs). Among the Global asset exploiters, European locations are relatively well represented and firms seem to follow a fairly traditional model of market-seeking expansion.

In contrast, Global Networkers is the single category where developing country firms are most prevalent – almost 7% of developing country respondents fall in this category. The 1.65% of **Networkers** are also large firms, also predominantly subsidiaries and headquarters of MNCs, but firms from developing countries are less often found here.

The main dimension of difference between the Networkers and Global networkers is the scope of the network. Developing country firms are much more global, and high levels of globalness and networkedness co-occur, but not innovativeness. This pattern is consistent with previous evidence about the relatively lower innovativeness of developing country firms. We suggest that the weaker institutional context in less developed countries is an important explanatory factor in their strong drive for global networking.

In contrast, the 2.96% of **Innovators** are more often from Europe than any other category. Innovators are more often small (less than 50 employees) standalone firms. It seems that these players are able to draw on an appropriate regional institutional infrastructure to generate new to the world product and/or service innovations. Although these firms have the potential to play a particularly important role in an economy, Innovators have a low proportion of exports and few international clients. This raises the question of whether firms are capturing adequate economic value from their innovations.

Fifteen firms are highly global, innovative and networked: two in agroprocessing and the rest in ICT. Most range in size from 50 to more than 1000 employees. This is smaller than previous literature would suggest, and suggests that the complexity of managing a GIN suggests an optimal point for the number of employees. Firms with a global footprint (Global asset exploiters and Global Networkers) that are only somewhat innovative are generally large firms with 1000+ employees, and firms that are innovative but with a limited global footprint tend to be small (around

50 employees). High-level GINs have a considerable footprint, but have clearly not internalised all activities.

The location of the High-level Balanced GINs is somewhat surprising. Apart from a Norwegian firm, the only European participation in this list is through two emerging MNCs with dual headquarters, both in their country of origin and in a European country. Five of the fifteen firms them are the subsidiaries of advanced (and in fact, US) MNCs in India, as is the single Chinese High-level Balanced form GIN. An additional five of the High-level Balanced GINs are subsidiaries or headquarters of emerging MNCs, and four more are stand-alone firms.

3.2 The transition of Global Production Networks (GPNs) to Global Innovation Networks (GINs)

3.2.1 Country-level analysis[2]

The country-level input-output analysis on the drivers and determinants of global R&D outsourcing found that seven of the eight countries on the technology frontier (Norway, Sweden, Denmark, US, Japan, Germany, UK) appear mainly as net exporters of embodied technology and that the four countries below the frontier (Brazil, China, Estonia and South Africa) are net importers of embodied technology. Italy was the main exception to the rule, but this was relative to the other countries included in the analysis. There is strong evidence that global production networks are evolving into GINs in China as this country appears to have become less dependent on imported technology and it may have increased their contribution of embodied technology into these networks during the first half of the 2000s. By contrast, there is strong evidence that Brazil and South Africa have become more dependent on technology they import from the eight countries on the frontier (INGINEUS, 2010a).

The research on the evolution of national innovation systems and their relevance for the emergence of GINs found that national innovation systems remain important for the development of GINs. National innovation systems were seen as a network of institutions that facilitated interactive learning. Knowledge sharing and collaborative learning are rather prevalent within the European countries analysed and between Europe and the United States. The BICS countries have much less access to these networks, but there are signs in all of the countries, especially China and India, that their global production networks are gradually including knowledge transfer agreements indicative of an innovation network. These relationships include joint ventures and R&D agreements, technology licensing and exchange agreements, knowledge seeking foreign direct investment, outsourcing, research associations and knowledge banks, government and inter-governmental joint research programs, and other networks, including various informal networks. The national innovation system becomes important in that it sets the rules of the game for each node within the innovation network, and for the actors entering into a relationship (INGINEUS, 2010b).

Another very important result obtained from the case studies was the identification of two different types of GINs. One centers on the large multinational corporation, which consider their market to be global and attempt to coordinate production, marketing and R&D activities from one central

[2] Country level analysis was conducted within INGINEUS Work Package 3 and led by Mark Knell (NIFU-STEP).

location. The second type involves many different actors, some tied together through ownership, and others through an agreement or alliance, which evolves in a self-organizing way.

3.2.2 Regional-level analysis[3]

The regional-level analysis first distinguished between different forms of GINs: from the global exploitation of innovation, global research collaboration, global sourcing and global generation of innovation. The results of INGINEUS survey shows that there are significant differences across regions with regards to three out of four forms of globalization of innovation: global exploitation of innovation, global research collaboration and global sourcing. In general, firms located in regions that are neither too strong nor to weak participate more often of GINs than firms in strong or weak regions. Firms located in highly dynamic regions seem to be more engaged in intra-firm networks rather that extra-firm. Transactions take place more often between different units of the same organization rather than with external firms or knowledge providers.

Strong regions, like Stockholm, Beijing or Bangalore are characterized by a large presence of MNCs and in general large corporations, surrounded by a network of small and medium enterprises (SMEs). They host a number of research institutes, providing qualified human capital and research to the productive system. Although innovation is higher in these regions, collaboration for innovation is not as high as in intermediate regions, despite the high density of their institutional environment. Our results seem to confirm that research is rather internal to the firm than external (Cooke et al, 2007) and more confined to the domestic arena rather than the regional or international one (Tödtling et al, forthcoming 2011).

Regions that are neither too strong nor too weak, like Shenzhen, Western Cape or Malmö network with a variety of actors for innovation, at all three geographical levels (regional, domestic and international). Firms from these regions are more integrated in global flows of innovation, particularly the global exploitation of innovation, global sourcing of technology and global research collaboration.

Finally, marginal regions like Easter Cape or Jönkoping are dominated by small firms and with limited research capabilities. Interactions take place within the value chain, with suppliers and clients for example. It is in these regions where we find that interactions with regional suppliers are higher. It is also in these regions where we find also collaboration with international clients. The picture that emerges is of firms that collaborate regionally with suppliers and internationally with clients.

Following this, we may expect that firms located in intermediate regions may be more prone to participate in global innovative networks (GIN). Firms in marginal regions may have linkages with global clients but they are not so innovative and not so networked (gin). Finally, firms in strong regions, may be more innovative, but they are not so global (at least not with regards collaboration for innovation) and not as networked as firms in intermediate regions (gIn).

It is interesting to link these findings with the institutional thickness of the different regions. What these results seem to suggest is that, contrary to what we expected, GINs may emerge in regions which are neither institutionally too thick or too thin. Regions that are institutionally thick are better networked domestically than internationally. They may have reached some form of institutional

[3] Regional level analysis was conducted within INGINEUS Work Package 4 and led by Cristina Chaminade (ULUND).

congestion that hampers instead of promoting the kind of networking that characterizes less institutionalized regions. Regions that are too thin institutionally may force firms to collaborate with international clients or suppliers, thus supporting more the emergence of global value chains rather than networks.

It is regions that are neither too thick nor too thin institutionally - that are more supportive for the emergence and participation of GINs. This could also explain why most of the firms that are truly innovative, networked and global are located in non-european regions (institutionally less thick), rather than in European ones (INGINEUS, 2011a). The results are summarized in Table 1.

Table 1: Regional innovation systems and institutional thickness

Institutional Thickness	Level of Internationalisation	Why
Tier 1: Thick (Stockholm, Beijing, Bangalore)	Low	Have capability but not need
Tier 2: Medium (Shenzhen, Western Cape, Malmö)	High	Have capability and need
Tier 3: Thin (Pune, Eastern Cape, Jönkoping)	Low	Have need but not capability

Source: INGINEUS, 2011c

The cases analysed confirmed these results in emerging economies, although show differences in the propensity to go international that are more national than regional. In general, firms from China tend to target more domestic markets while firms from India tend to target more international markets. The observed regional differences are also robust even when differences in industries are considered. Interregional differences overrun the inter-industrial differences.

3.2.3 Firm-level analysis[4]

The recent surge in the offshoring of R&D to emerging economies as well as the rapid growth in global R&D collaborations has changed the characteristics of internationalization of R&D. Interviews conducted in WP5 attempt to provide a better understanding of the phenomena by collecting new evidence from the perspective of both a MNC headquarter (HQ) and their R&D affiliates (subsidiary/joint venture). The cases provide a rationale for locating in specific regions and present various R&D strategies pursued across different sectors.

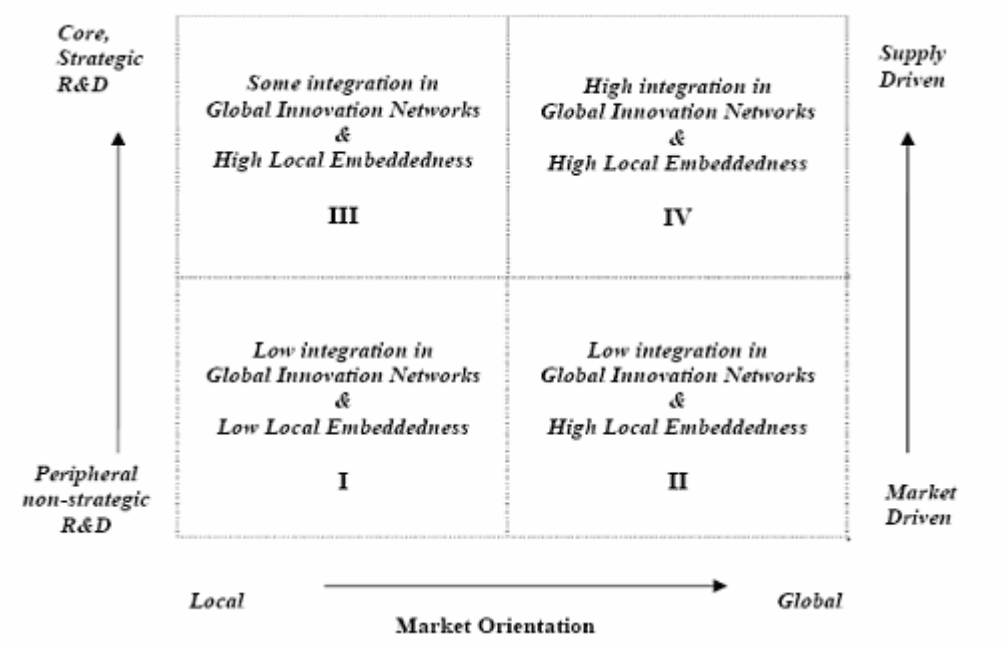
Evidence showed that MNCs' R&D internationalization is driven by various pull and push factors that are external as well as internal (within the MNCs). The external location specific advantages include the presence of specialized suppliers, the technical expertise in the region, and the unique knowledge inflow from the market that is crucial for greater responsiveness. The industry characteristics that explain the dispersion of the MNCs' innovation processes were the extent of

[4]Firm level analysis was conducted within INGINEUS Work Package 5 and led by Nick von Tunzelmann and Vandana Ujjual (UoS).

fragmentation of the value chain, vertical specialization, or the extent of advanced technology used to ensure flexibility in the innovation process. R&D internationalization is also driven by the internal factors such as, the need to increase R&D productivity, and the need to ensure greater returns from R&D investments in order to stay competitive.

Figure 3 presents the conceptual framework developed to understand the strategies of R&D offshoring of both Northern and Southern firms. The first point to note is that the extent of integration in the MNCs' global innovation network and the extent of local embeddedness are quite low if the local subsidiary undertakes peripheral and non-strategic routine type of R&D, mainly catering for the local market (cell 1). The figure also shows that the extent of integration in the MNCs' global innovation network and the extent of local embeddedness increases when the level of innovation capabilities of the R&D subsidiary is high and it has a global market orientation (cell IV). However, a greater integration in the global innovation network does not always coincide with the greater local embeddedness, as is the case in cells II and III. The precise position of the R&D subsidiary in this diagram is influenced by the host region's supply factors such as the local technical/scientific skills and the competence of the supplier and science base. The relevance of market factors such as the local demand for low cost products and the flexibility in operations to meet those demands are also important, as are the internal demands from MNCs' various business units. The host government incentives and national priority on undertaking certain kinds of technology development also have a role to play.

Figure 3: Innovation Strategies at the R&D centres in host locations – a conceptual framework



Source: INGINEUS, 2011d

Drawing on the insights gathered from the case studies on the MNCs' innovation activities overseas, we can distinguish seven innovation strategies by analyzing the level of innovation and the degree of market orientation within a host institutional context. These innovation strategies fit on a continuum which displays increasing innovation capability and greater integration into MNCs' global innovation networks and local embeddedness. Strategies that involve the highest level of

core and strategic R&D are not featured at the emerging market R&D facilities. Strategies present in emerging markets range from adaptive R&D with the aim of satisfying local market needs at the bottom-left of the figure to specialized functions and technologies at the top-right. Despite the different ways in which these strategies have evolved, a trend towards greater integration into the parent GIN and a greater degree of local embeddedness is clearly apparent (INGINEUS, 2011d).

3.3 Offshoring innovation[5]

3.3.1 Strategy of firms

The decision to offshore R&D activity is driven by (i) access to emerging market (Demand) or (ii) access to the local pool of skills (Supply). The **demand factors** can be related to expanding market size or absorbing knowledge from local markets and hence developing new products to increase sales. The **supply factors** can be related to access to local resources at a lower cost or to access to resources which are not available in home country at all including local networks and knowledge hubs. **Demand factors** are relatively more important when MNCs use local resources to: (a) adapt products developed in advanced countries (North) to local needs through cheaper design implementations that are different from that in the North (b) develop completely new products in emerging countries (South) to be sold in these markets only. **Supply factors** are relatively more important when MNCs: (c) develop completely new products in South locations which are also rolled out globally.

We submit that the cases (a) and (b) give rise to "**R&D complementarity**", in which offshored R&D activity results in manufacturing of products which are primarily sold in the South and therefore cause no direct competition between these products and products manufactured in the North. In such cases, some R&D activity needs to be located in the South because market-specific knowledge is required to successfully market the products. A higher level of R&D investments in the South generates sales and profits which also enable more core R&D in the North. New products developed in the North again stimulate R&D investments to adapt these products to the demand in the South. Hence, the complementarity between products manufactured in the North and the South is reflected in the complementarity in R&D investments in the North and the South, which reinforce each other. Overall, stimulating offshoring R&D in such case may result in greater profits for MNCs. At the macroeconomic level the production and employment by these firms should increase in both regions.

Case (c) should give rise to "**R&D substitutability**", since offshored R&D activity results in manufacturing of products which are sold in both the South and the North. The products manufactured in the South are substitutes and directly compete with products manufactured in the North. In such cases, the decision to locate R&D activity in the South is driven to a greater extent by access to skills and lower costs rather than by market-specific knowledge. A higher level of R&D investments in the South generates sales and profits in both the North and the South but due to competition profits may be lost on other production based in the North. In result, R&D investments may be reduced in the North. Hence, the substitutability between products manufactured in the North and the South is reflected in substitution between R&D investments in

[5] Research on the long-run impact of R&D offshoring was conducted within WP8 and led by Davide Castellani (LdA).

the North and the South. Overall, the decision to offshore R&D is driven by greater profits of MNCs but at the macroeconomic level there may be reduction in production and employment in the North.

3.3.2 Impact on EU firms

To address the long-run effects of the offshoring of innovation for the EU economy, INGINEUS conducted both case studies and econometric analyses at the firm level. An econometric investigation at the sectoral and regional level was also carried out in order to achieve a more comprehensive understanding of the aggregate effects of the offshoring of innovation on the EU.

Based on the case studies on R&D offshoring strategies of 18 EU-based MNCs in ICT, automotive and agro-food industries[6], it was assessed whether offshored R&D complement or substitute R&D at home. We gather that these industries differ with respect to dependence between R&D at home and host countries. In the case of the ICT industry both substitutability and complementarity between R&D in the North and the South occur. The strategic R&D that requires specialized know-how and high investments are in general centralized at their HQ or in other European locations outside the HQ. The applied research and application, and engineering are instead dispersed and located near their important markets. However, to an increasing extent the offshore locations develop products which are rolled out globally. We describe this as complementarity because some relocation of R&D takes place. In the case of automotive and agro-food industries we observe a greater degree of substitutability rather than complementarity. The offshore locations primarily focus on adaptation of products to local needs and the relocation of R&D from Europe to other markets is rather limited. Therefore, the case study evidence supports the hypothesis that offshoring of R&D should not lead to a 'hollowing-out' of the EU knowledge base and a reduction in employment, but can rather concur with other factors in leading to long term growth (INGINEUS, 2011e).

To deepen our understanding, a specific case study on the Fiat-Chrysler merger in the automotive industry was also performed. The merger acts as a natural experiment, which allows us to focus on how the group global economic activities, from R&D and product development to final assembly, are reallocated as a result of the merger. Furthermore, we were able to identify both the direct consequences on the geography of production of the Fiat Group and a framework of territorial competitiveness analysis. To accomplish the first task, we have been able to test the existing academic literature on the localization of such activities to the pre and post-merger R&D and production activities. Thanks also to the cooperation of Fiat top managers in Turin, we are able to assess and describe how the localization of Fiat-Chrysler activities is going to be affected by the merger. Using a detailed survey administered to Fiat and Chrysler plants we gather specific quantitative information concerning different production issues (total factor productivity, working environment, role of unions, etc.). According to the observed evidence, we are able to identify the most important drivers of territorial competitiveness that can attract and enhance investments. In this way, the new patterns of research and production will be closely related to the territorial starting conditions. A more generalized output of the Fiat-Chrysler case study is an aggregate overview of the current geography of manufacturing activities. Given the rising importance of these

[6] INGINEUS, 2011d.

issues in a "restyled" economic scenario, we contribute to the heated academic debate with a deep analysis of the most recent trends in the localization of global value chains.

An econometric analysis on 365 firms from US, EU and Japan was performed to study the relationship between the extent and geographic spread of innovative activities abroad and the market value of those firms. The study measured the extent of offshored innovative activities by means of the number of patents granted to foreign affiliates of the sample companies and the spread of such activities using the number of countries where a firm has been granted such patents. The measure of firm market value used is the Tobin Q. The results are consistent with the idea that better performing firms are more likely to offshore innovation, but this does not seem to affect significantly their profitability. In other words, R&D offshoring does not cause any significant hollowing-out of MNCs' knowledge base and profit potential.

The previous results were based on a relatively small number of large firms (accounting for a large share of R&D in the EU and elsewhere), so they may fail to provide evidence on the effects at a more aggregate level. Thus, given the relevance of regional policy within the EU, an econometric analysis at the regional level (more precisely, at the NUTS2 level) was carried out. We believe that at this level of analysis we can gather not only the benefits or costs accruing to the firms involved in R&D offshoring, but also on other firms, such as their suppliers and competitors, which could benefit from the (positive or negative) externality. To this end we collected, exploiting the fDi Market dataset, information on the number of cross-border investments (both within and outside Europe) of MNCs based in each of the NUTS2 regions and those from foreign MNC incoming in the region. We then related this measure of inward and outward FDI to the productivity growth of each region, controlling for a number of country and regional characteristics. Our results suggest that offshoring regions experiment higher productivity growth, although this positive effect fades out when the extent of offshoring is too large (INGINEUS, 2011e). These findings support the results obtained from the theory derived in Naghavi and Ottaviano (2010). Conversely, incoming MNCs contribute to boost a region's productivity, but only when the number of investments is large enough. Exploiting the information on the type of activity carried out by MNCs abroad, we were able to measure the extent of R&D offshoring by EU MNCs in each NUTS 2 region and find that this is positively and significantly associated with regional productivity growth.

Finally, using novel and comparable data for nine EU15 members over the last decade at the sectoral level for 20 industries, which span both the manufacturing and the services sector, we have also estimated the effect of service offshoring in general, and offshoring of R&D in particular, on employment. Following previous works, we measure service offshoring as the share of imported private services in the industry's total purchases of intermediate inputs. The results show that the effects are very small and, if anything, weakly positive. The aggregate results are almost entirely driven by offshoring of business services, the largest category in Europe; financial, computer, and R&D service offshoring have instead negligible impacts on the employment level. Finally, we do not find negative effects on any groups of workers; rather, our results suggest imported services to complement with domestic workers with higher skills. The analysis of the effects on labour demand elasticity, reveals that service offshoring contributes to making labour demand more elastic, but the economic magnitude of the effect is found to be small also in this case. However, the difference in labour market regulations explain some differences across countries. In countries with weak regulations, in fact, labour demand may be adjusted more flexibly by firms, and the effect of service offshoring may end up being larger as a result. Consistent with this argument, we find that service offshoring raises labour demand elasticity only in countries with weak regulations. Using the available information on workers' skills, we also find that in these countries the effect is almost

entirely borne by unskilled workers (INGINEUS, 2011e). The results of Work Package 8 are summarized in Table 2.

Table 2: Summary of empirical results in WP8

Partner	Level of analysis	Sector	Method	R&D offshoring measure	Outcome variable	Result
FEEM (based on WP5 Report written by UoS)	Large EU MNC	ICT, Auto, Agro-food	Case studies	R&D abroad	R&D at home	• Limited evidence of substitution • Some evidence of complementarity
UoS	Large EU, US and Japan MNC	All manufacturing	Panel data econom trics	Number and geographic spread of patents granted to the affiliates of MNC abroad	Tobin Q	• Evidence that more profitable firms offshore more innovation • No evidence of negative effect of offshoring of innovation on firm profitability
LdA	EU NUTS2 regions	All economy	Panel data econometrics	Number of investment projects in R&D to and from each regions	Productivity growth	• Positive and significant effect of the extent of R&D offshoring on home region productivity growth
LdA	EU15 sectors (NACE)	All economy	Panel data econometric	Import of R&D services	Employment	• R&D exerts small, and possibly weakly positive, effects on the level of labour demand

3.3.3 Policy-relevant conclusions

The case studies help analyze the relationship between the activities which are offshored and those which are retained in the home country. We refer to this relationship as complementarity or substitutability between R&D activities in different geographic locations and draw conclusions on the effects of different strategies on production and job creation. Detailed interview conducted by various teams in INGINEUS provide insights into the way firms in different industries internationalize their R&D activities and on how these feed back into R&D activities at home.

We can conclude that there are some industries for which we may say that R&D offshoring has a negative impact on R&D activity and employment in home country. In other cases the impact may be neutral or positive. Next, taking a macroeconomic picture as a summation of all these industry

we can conclude whether we get closer or further away from the objectives set out in Europe 2020 with respect to R&D expenditure and employment.

In summary, as of 2010, European companies offshore a relatively small share of their R&D activities; ca. 4% to India and China and ca. 5% to other developing countries according to the Commission's "Survey on R&D Investment Business Trends". Despite advances of globalization and compared to the market size, a relatively low share of R&D activities is carried out by the European firms in China, India and other developing countries. This trend is unlikely to change in the nearest future.

The industries analyzed to some extent differ with respect to dependence between R&D at home and host countries. In the case of agro-food and automotive industries the main driver of offshored R&D is access to local markets. The core R&D activities are located at the HQ in the North and R&D activities in the South have the function of adapting these products to local needs. In the case of automotive industry some new products developed in the South are eventually distributed globally. On the other hand, in the case of ICT sector we can see both substitution and complementarity. The location of R&D is generally driven by cost factors but being located close to the market also matters. Some products developed in the South are sold both in local and global markets.

On this basis we can conclude that offshored R&D is in most cases complementary to R&D activity conducted at home and as such should not affect negative R&D activity and employment at home. We can conclude that policies aiming to discourage offshoring may reduce the competitive standing of EU firms in global market (INGINEUS, 2011e).

3.4. Emerging economies' evolving capabilities and growing role in GINs

3.4.1 The role of competence building in firms[7]

The case studies on the role of human capital in host countries for Northern and Southern firms provide evidence of factors shaping the emergence and evolution of GINs. Sectoral differences were evident, explained in part by different levels of technological intensity, different levels of dependence on tacit and codified knowledge, and differing demand for incremental development, adaptive development, new product development, and basic research. A key difference to emerge from analysis of the case studies is the role of tacit knowledge, which is more significant in the automotive sector, and less significant in the ICT sector. The difficulties involved in tacit knowledge transfer in the automotive sector have slowed the building of automotive GINs in emerging economies relative to the ICT sector (INGINEUS, 2011e).

The key factors influencing the fragmentation of GINs in all cases thus were reported to be pull factors from developing countries, rather than push factors from the home country (Tables 3 and 4). All the firms interviewed in Europe reported that they could find the skills they needed in their home market, with the exception of certain domain competencies, for which they scan globally.

[7] Research on the role of competence building in firms was conducted within WP6 and led by Jo Lorentzen and Glenda Kruss (HSRC).

Emerging economies are increasingly the sites of large pools of talent. The massification of higher education in India, Brazil China and South Africa since the 1990s has increased the global pool of talent and available workforce. China and India are very large countries, where even a small proportion of the population passing through the education and training system amounts to a significant cohort of skills. In addition, there is evidence of rapidly growing R&D output. A comparison of total publications measured by the Thompson Reuters' index in 2002 and 2008 suggests that the four developing countries have been increasing their scientific output rapidly.

In an environment of great inequality, it is possible for pockets of excellence to exist within a generally weak system. Opportunities for GINs to emerge, attracted by skilled human capital in the South are especially strong in large urban areas of China, such as Shanghai, Hong Kong and Beijing. It thus appears that in the search for skills, firms are seeking pockets of excellence that emerge from the challenging environment of rapidly expanding education systems in emerging countries.

The profiles of Foreign Direct Investment in the emerging countries contrast dynamics in China and India, on the one hand, and Brazil and South Africa, on the other. China and India offer huge internal markets with the prospect of continued rapid growth. This is highly attractive for European firms facing stagnant domestic markets. Brazil and South Africa have smaller populations, smaller markets, and lower growth rates. However, they both act as economic gateways to their respective regions, which incentivises firms to invest, and also to undertake adaptive innovation for the regions. Despite this the INGINEUS survey suggests that few firms in Europe have drawn on human capital in these two countries to create GINs, and most firms continue to focus on production only.

The case studies confirm the postulation that (Northern) MNCs embody certain capabilities, while at the same time looking for new ones, and that education and training systems are an essential element of the absorptive capacities that enable the formation of GINs. A complex set of micro-determinants of the relationship between competences and capabilities, and GIN formation were identified through comparative analysis (Tables 3 and 4). Table 4 illustrates the emergence of GINs as southern MNCs seek to access missing capabilities in the North.

Table 3: Determinants of North-South GIN formation

Firm	Countries	Key micro-determinants (pull factors)
ICT3	Sweden/Estonia	Availability of specialized human capital, Geographical proximity, Low cultural barriers
Auto1	Germany/South Africa	Regional gateway, Long logistical pipeline, Demand for local product development and adaptation, (management constraints on innovation activity at the subsidiary)
Auto9	Germany/South Africa	Regional gateway, Demand for local product adaptation, Regional commonalities with Brazil
Auto4	Italy/Brazil	Regional gateway, Demand for local product development and adaptation
Auto3	Italy/Brazil	Regional gateway, Demand for local product development and adaptation, Policy incentives
Auto1	Germany/India	Large domestic market and growth potential, Large available human capital pool at lower cost, (tacit knowledge barriers, cultural barriers)
Auto2	Germany/India	Large domestic market and growth potential, Large available

		human capital pool at lower cost, (tacit knowledge barriers, cultural barriers)
Auto9	Germany/India	Large domestic market and growth potential, Large available human capital pool at lower cost, (tacit knowledge barriers, cultural barriers)
Agro1	Denmark/South Africa	Regional gateway, Local demand for adaptation, Regional commonalities (with Brazil), Tacit knowledge acquisition, Specialised knowledge acquisition, Local network acquisition
ICT1	Sweden/China/India	Large domestic market and growth potential, Large available human capital pool at lower cost, innovation management structures
ICT2	Sweden/China/India	Large domestic market and growth potential, Large available human capital pool at lower cost
ICT2	Sweden/South Africa	Regional gateway, Demand for local product development and adaptation

Source: INGINEUS, 2011e

Table 4: Determinants of South-North GIN formation

Firm	Countries	Key micro-determinants (push factors)
Auto10	South Africa/UK/USA	Local skills shortages, proximity to customers
Auto11	South Africa/Australia/New Zealand	Proximity to customers

Source: INGINEUS, 2011e

The key micro-determinants that emerged from the comparative analysis of case studies across countries and sectors thus are:

- *Market:* size, growth potential, local demand for adaptation, local demand for new product development
- *Human capital availability*: scale, scope, technology-specific competencies and capabilities,
- Strength of the National System of Innovation, specialized knowledge assets, tacit knowledge assets, network assets
- *Sector*: role of tacit knowledge versus codified knowledge, sector-specific skills demands, value chain structures, sectoral innovation drivers
- *Geography*: geographical proximity, regional gateways, logistics, regional commonalities
- *Culture and tacit knowledge*: cultural/linguistic commonality, ease of tacit knowledge transfer
- *Infrastructure*: logistics, ICT
- *Policy*: IPR regimes, policy incentives
- *Management*: innovation management structures, strength of internalized knowledge networks, strength of value chain knowledge networks.

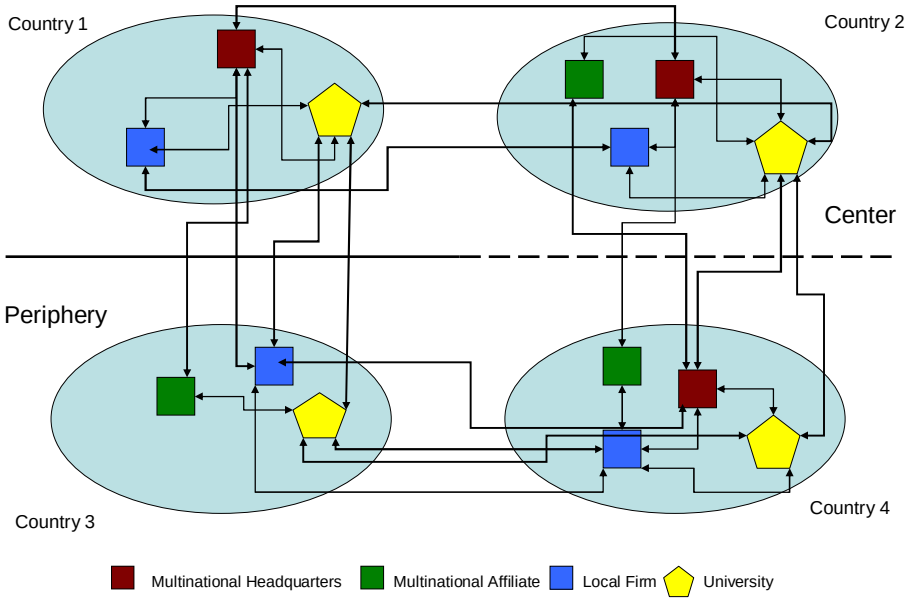
3.4.2 The role of institutional frameworks and local-global interactions[8]

Global Interactions between firms and Universities have not one, but two main drivers: transnational corporations (TNCs) and national systems of innovation (NSIs).The combination of these two drivers leads to a complex picture, where the nature of NSIs matters for the formation of networks, their main characteristics and the nature and scope of the international hierarchies established.

A tentative framework to synthesise these insights is suggested in Figure 4. Firms - local and TNCs - universities and their links, are reflected in a hierarchical world, divided between a center and a periphery, and the implicit social and political forces that shape NSIs defining the major countries' characteristics and possibilities within a global innovation system in the making.

The division between centre and periphery has two features: the first is portrayed as a continuous line, the other as a discontinuous line. The difference is intended to express graphically the possibility of catch up – the emergence of a country that successfully overcomes underdevelopment. This framework would yield four main types of interaction, with variations depending on their location in the centre or periphery, which necessarily go beyond GINs, both backwards and forwards: (1) LOCAL firms interacting with local and/or foreign universities; (2) TNCs interacting only with their LOCAL home based universities; (3) TNCs interacting both with LOCAL home based universities and FOREIGN universities in a host country/ies; (4) INTERNATIONAL consortia between firms and networks of universities (INGINEUS, 2011f).

Figure 4: Global interactions between firms and universities - A tentative framework



Source: INGINEUS, 2011f

[8] Research on the role of institutional frameworks and local-global interaction in the emerging countries was conducted within WP7 and led by Eduardo Albuquerque and Gustavo Britto (CEDEPLAR).

An analysis of selected science and technology indicators was performed to identify how interactions between firms and universities differ across the world and to locate the very specific position of South Africa and Brazil in this regard. It revealed that, improvements in the size, diversity and quality of NSIs should impact on the process of formation of home-based TNCs in the periphery. In addition, the nature of those home-based TNCs may open space – through an active insertion in the international division of labour – for a less subordinate role in GINs and a more positive inclusion in global interactions between firms and universities. The NSIs' position within the international division of labour also determines the nature of the country's TNCs, which, in turn, shapes one important feature of the country's involvement in existing GINs. Therefore, we can affirm that immature NSIs will have immature (or incomplete) GINs. The limits of the NSIs will be reflected in the sectors and nature of these GINs.

This is followed by an investigation on the existence of different profiles of companies and their interactions with local and foreign universities in eight countries researched by the INGINEUS Project: South Africa, Germany, Brazil, China, Denmark, Estonia, Norway and Sweden. The statistical technique of Multiple Correspondence Analysis (MCA) was used to analyze the data related to interactions with universities showing a clear differentiation of countries and sectors. For the agro-processing sector including South Africa, there are two well-defined profiles, which cluster South Africa and Denmark in opposite quadrants. For the auto sector including Brazil, there is also a clear delimitation showing Germany (headquarter of TNC, internal R&D and intense interactions with universities) in one quadrant, Brazil (host country of TNCs, low R&D and low level of interactions with universities) in the opposite one, and Sweden as having a different profile with stand alone TNCs. The analysis of the INGINEUS survey data stresses therefore the dependence of innovation networks on the nature of NSIs and the presence and spread of home-based TNCs.

China tends to be different in the sense that the internationalization of the multinational companies' most important activities, regarding production and R&D, stands as a characteristic mostly related to it, while the economy has not displayed characteristics connected to the university-company interaction. The analysis developed therefore point to the fact that the characteristics connected to the university-company interaction generates patterns strongly aligned to the centre-periphery dichotomy. Even though China is seen as a rising economy in a global context for being strongly associated with the large multinational corporations production activities expansion, when it comes to the interactions between companies and universities both local and foreign, characteristics regarding the GINs are associated with Germany, which display the most advanced innovation system amongst the ones assessed.

A comparison of the INGINEUS findings collected from other surveys reveals interesting insights. Analysis of data from Brazilian and South African Innovation Surveys for instance help to differentiate the innovative activities of domestic and foreign firms, and to understand how capital ownership matters for the shape and scope of interactions between firms and universities. The surveys suggest that foreign firms rely strongly on internal networks as source of technology compared to domestic firms, which rely on interactions with local universities. However, since foreign firms are proportionally more innovative than domestic firms, they also tend to have links with local universities. Data from a Brazilian Survey on interaction between firms and universities showed that although there are some differences in patterns of cooperation of national companies (NCs) and multinational companies (MNCs), the interactions of these firms and universities/research institutes are usually quite similar. The main difference found is related to the reasons for collaboration. In addition, the use of the Multiple Correspondence Analysis method suggested that, for the variables analyzed in this study, it is not possible to distinguish patterns of

interaction between universities and firms based on the origin of their capital. These results stress again the importance of the NSI (general environment) to shape the nature and the intensity of interactions between domestic and foreign firms and local universities. A conjecture is that the foreign firms adapt themselves to the general conditions of a NSI, which leads to a conclusion that improvements in a NSI affects both domestic and foreign firms.

Case studies on subsidiaries of agro-processing TNC in South Africa and auto TNC in Brazil further show a clear division of labour between R&D departments in the home country and in the host country, with well-defined hierarchies. This hierarchical relationship is however not static. Over time, there have been improvements with the network between TNC headquarters and subsidiaries and their connection with universities. Once a team in charge of local R&D activities has been formed, a new process with its own dynamics is created. These dynamic effects are also present in the relationship with universities, since there may be R&D researchers and engineers with formal connections to local universities, who naturally establish ties between local universities and local R&D department. There will be also informal ties, also, since engineers and researchers from the local subsidiary may attend graduate courses at the local universities and use problems of the R&D department as the subject of their dissertations. These informal interactions may also develop over time.

The tentative taxonomy suggested along with the fieldwork of the project INGINEUS have helped us to evaluate one central question: whether GINs in emerging countries are a path for improvement within the international division of labour or they block the development of globally integrated national innovation systems. Our answer is in line with a recent evaluation from Ernst (2009): GINs may be a “mixed blessing”, even a “poisoned chalice”. On the one hand, the preservation of hierarchies is a barrier to more advanced technology-rich international interactions. On the other hand, existing GINs may, under certain conditions, trigger processes, which can lead to technological upgrade of peripheral countries. However, as Ernst (2009) emphasizes, public policies matter for the positive development of GINs. In our theoretical framework, this is one feature of the NSIs determining the nature of GINs (INGINEUS, 2011f).

Finally, with respect to institutional environment a theoretical and empirical investigation of the role of the interaction between skilled migration and intellectual property rights (IPRs) protection in Southern countries revealed that although emigration from the South may directly result in the well-known concept of brain drain, it also causes a brain gain effect, the extent of which depends on the level of IPRs protection in the sending country. We argue this to come from a diaspora channel through which the knowledge acquired by emigrants abroad can flow back to the South and enhance the skills of the remaining workers there. In short, by increasing the size of the innovation sector and the skill-intensity of emigration, IPRs protection magnifies diaspora gains making it possible to transform brain drain into brain gain (Naghavi and Strozzi, 2011).

3.5 Outlook for industries in the EU and emerging economies[9]

From the investigation of industries, it emerged that overall (i) there are modest GINs, (ii) there are sector variations and (iii) sub-sector technologies define the types of actor engaged internationally.

[9] Research on the potential implications of offshored knowledge based activities on selected industrial sectors was conducted within WP9 and led by Heidi W. Aslesen.

Based on the survey findings it is not possible to affirm that the selected sectors in the North have a *global* reach on innovation collaboration. Indeed, evidence suggests that:

- The ICT and agro-processing sector in the South have a more global reach on innovation collaboration
- The ICT sector in the South has North America as dominant partner
- The agro-processing sector in the South has Europe, Asia, Australia and Africa as innovation partners
- Sectors relate to different knowledge hubs. Sectors in Europe relate to 'regional hubs' compared to 'South'.

In general, there are sector differences in barriers to international collaboration, and there are differences between North and South in the same sector with regards to type of barriers that are perceived. Industrial sectors in the North emphasise harmonising tools, structures and processes a barrier for international collaboration together with the barriers seen by managing globally dispersed projects. The same sectors in the South emphasise barriers linked to changing current locations of operations and barriers linked to overcoming organisational barriers and gaining management acceptance.

The propensity of GIN seem to grow out of dense national links (well functioning clusters or RIS) and/or from comparative advantages arising from local resources.

All sectors are regionally and locally embedded in formal innovation linkages. The knowledge and capacity building aspect of these geographical levels are important – there might be certain linkages/factors that need to be strengthened in sectors at the regional/national level (INGINEUS, 2011g).

Here below a more detailed description of the results by sector of analysis:

Automotive sector

In the auto industry the number of mergers of system suppliers and component suppliers are increasing and this may lay the basis for GINs. A shift in the global organization of the industry suggests challenges for different parts of the industry. The relevance of innovation activity for GIN creation seems clear—more efficient actors in the value-chain might be expected to be more involved internationally. Results from the survey are that the Brazilian population is more specialized in manufacturing: while the European firms both small and large are generally more innovative. This may be a factor of the market or other contextual factors that are not observed. The literature however does suggest the danger of 'hollowing-out' of the competencies of the domestic companies. This challenge and the importance of maintaining a certain level of 'absorptive capacity' over time, suggest the importance of promoting RD&I activities in house, as the survey shows a relationship between R&D activity in house and the propensity to engage in international activities.

The immanent reorganization of the industry is raised as a special area of concern in the industry in Europe. On the one hand, this involves the ongoing efforts to adapt and integrate lower carbon technologies into cars; on the other, it involves adapting the market to emerging markets. Several layers of supports (EU, national, and state) target different areas of this wide-ranging sector in Europe, suggesting that a need for policy coordination between the different levels is important. It also suggests the importance that the policy measures help the industry address emerging

challenges. The country reports and the overall study point out that there are GIN patterns that emerge in this sector. However more comparative study into the innovative networks of this sector is needed before more conclusive policy implications can be drawn.

ICT sector

The study of ICT firms in the North (defined here as Norway, Sweden and Estonia) show that they are small, innovative stand-alone companies heavily embedded in regional or national user-producer relationships – often with lead users in other sectors representing important regional or national clusters. The firms are domestically owned, with high internally oriented innovation activity. The most knowledge intensive activities and the integration and coordination of activities are rooted in dynamic regions of these small open economies.

Certain kinds of transaction intensive services have become commoditized explaining the general rise in offshoring of lower end software services to southern countries by both small firms and firms that have not internationalized earlier. Nonetheless, very few Northern firms offshore innovation or production, when they do, qualified human capital and specialized knowledge is the motivation, supporting research showing a shift from offshoring being driven by labour costs, to offshoring being a strategy to search for talent. The global search for new talent can be looked upon as signs that more advanced services are being offshored, however, our data do not support that the majority of firms offshore knowledge intensive activities. Many of the ICT firms are small and have limited resources, information systems and web-based collaborative technologies can help in coordinating globally dispersed high-value activities. The challenges of actually identifying relevant knowledge on a global scale are important barriers for small domestically oriented firms. In order to be attractive partners in GIN there is a need for greater specialisation and gradual upgrading of the value chain relationships, process that needs to be carried out at the regional level. The main conclusion is that integration into GINs remains modest among the Northern countries. This is especially so for indigenous firms, suggesting that MNCs can not only be gateways for export and import relations, but also for more knowledge intensive linkages leading to potential GIN.

The average ICT company in the South (China and India) is also a small, stand-alone company showing low shares of R&D and innovation. There is a need to develop more innovation oriented expertise in the indigenous ICT firms in the South, as they are the least nationally and internationally embedded in innovation networks. The ICT sectors have emerged as an export industry and the nature of ICT activities first initiated was driven by exogenous factors/demand. The survey results show that North America is twice as important as Western Europe as an export market and as destinations for innovation collaboration. There are examples of firms and sub activities of ICT moving into emerging value adding innovation partnerships – mostly through MNC subsidiaries or MNC HQs. The ICT sector and services in general shows low capital intensity and electronic form of delivery meaning that services offshoring can grow and relocate faster and as such enter straight into GIN. Both countries show great advances in sub-fields of the ICT sector, and clusters have developed in these countries based on functions. Offshoring knowledge intensive activities to countries with weak local institutional settings and weak intellectual property regimes comes with a risk, the problem of weak local institutional settings giving weak intellectual property regimes is difficult to remove in short-term in developing countries. Active policy directed towards attracting in and helping firms out, together with the cluster initiatives and building of regionally concentrated hubs, together with educational policy are important for developing these sectors and in order to rise prospective GINs.

Agro-processing sector in Denmark and South Africa

Agro-processing is a sector that span from biopharma, preservation techniques, traditional knowledge, agricultural techniques, production and distribution, sales etc. This suggests potential for GIN across geographical areas with distinct comparative advantages. Based on the reports, we cannot characterize the agro-processing sector as heavily embedded in GINs. However, firms have to be very globally connected and innovative, partly because of international food and health regulations, and partly because of the perishability of the product. MNCs or small providers servicing MNCs are the main drivers of GINs in this industry, suggesting that GINs in this industry are evolving as part of an expansion from first exporting, then global production, and slowly, global innovation. A strong degree of sector embeddedness is registered in Denmark's sectoral innovation system. Few companies engage in true GINs. Those that do, tend to be the large biotech related companies. Research and innovation policy has played a much more active role in the northern case. In Denmark, policy has explicitly prioritized increased innovation and research in this sector with the overall policy aim to lead innovation in the field while also increasing the competitiveness of the sector internationally. One challenge it faces however is the limited supply of highly trained personnel domestically. It is thus trying to attract skill from abroad.

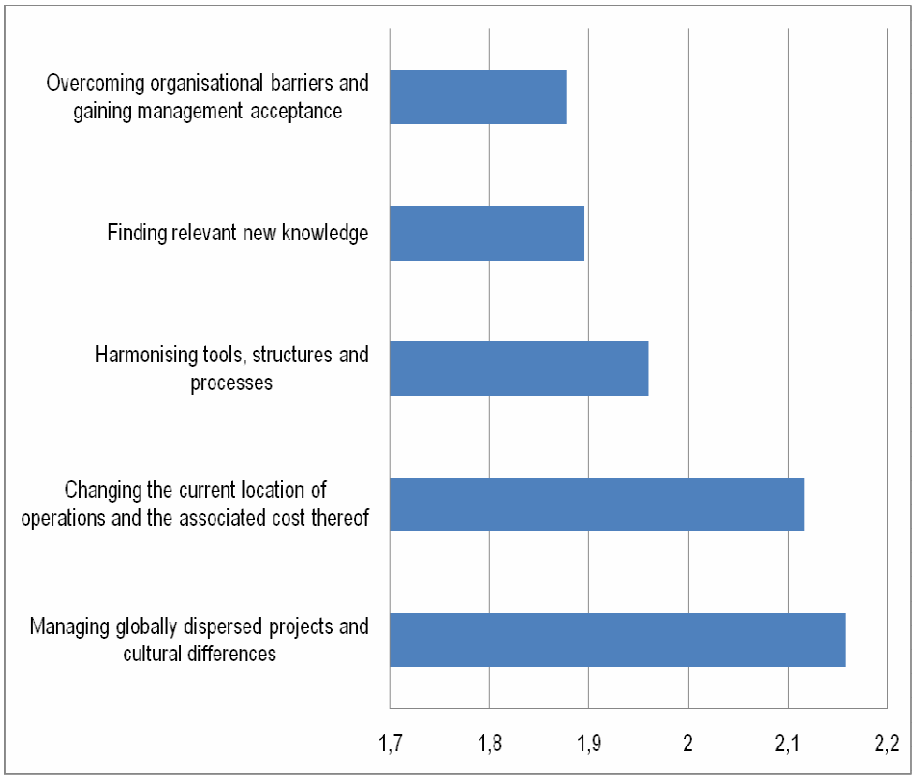
In general Africa is an attractive and fertile source of agro-food products. The South African agro-processing sector is tied firstly to a specific sub- national region (because of climactic requirements) and secondly, is a relatively inward-looking industry, with the proportion of firms exporting or engaging in innovation being below the national average. A general consensus in the industry is that the single most useful policy intervention would be to strengthen the basic education system, widening the pipeline of skilled candidates. The South African case also focuses on accessing outside markets for domestic products. A number of challenges are identified in the report also in this regard. It is noted here that some EU standards can act as a barrier to South African imports especially if they do not address certain specificities (i.e. the case of traditional plants). A desire to increase integration of the local offices of MNC is detected.

3.6 GINs and EU innovation policy implications[10]

As European firms have become increasingly involved in GINs during the past decade, they are starting to come to terms with the barriers and challenges that innovation collaborations in a global scale are posing to them. Willing to reap the opportunities offered by the rapidly growing emerging markets like China, India or Brazil; and by the creation of new global market niches by 'new to the world' technologies; European firms have been actively creating global networks of innovation that can give them advantage in a rapidly changing technological and market context. Yet, GINs are not exempt from problems and challenges. These problems might be different according to the industrial sector, the features of the host country, or the type of knowledge involved in the network. Whereas the barriers and challenges can be many, our INGINEUS survey identified the barriers that are most commonly mentioned in the theoretical literature, and asked a sample of European firms engaged in GINs their views on them. The results exhibited in the figure below are very explicit.

[10]The policy-related institutional aspects that affect the features and development of GINs between Europe and latecomer economies were addressed by WP10, led by Susana Borrás (CBS).

Figure 5: Barriers and challenges that European firms encounter when collaborating with other firms or organizations abroad.



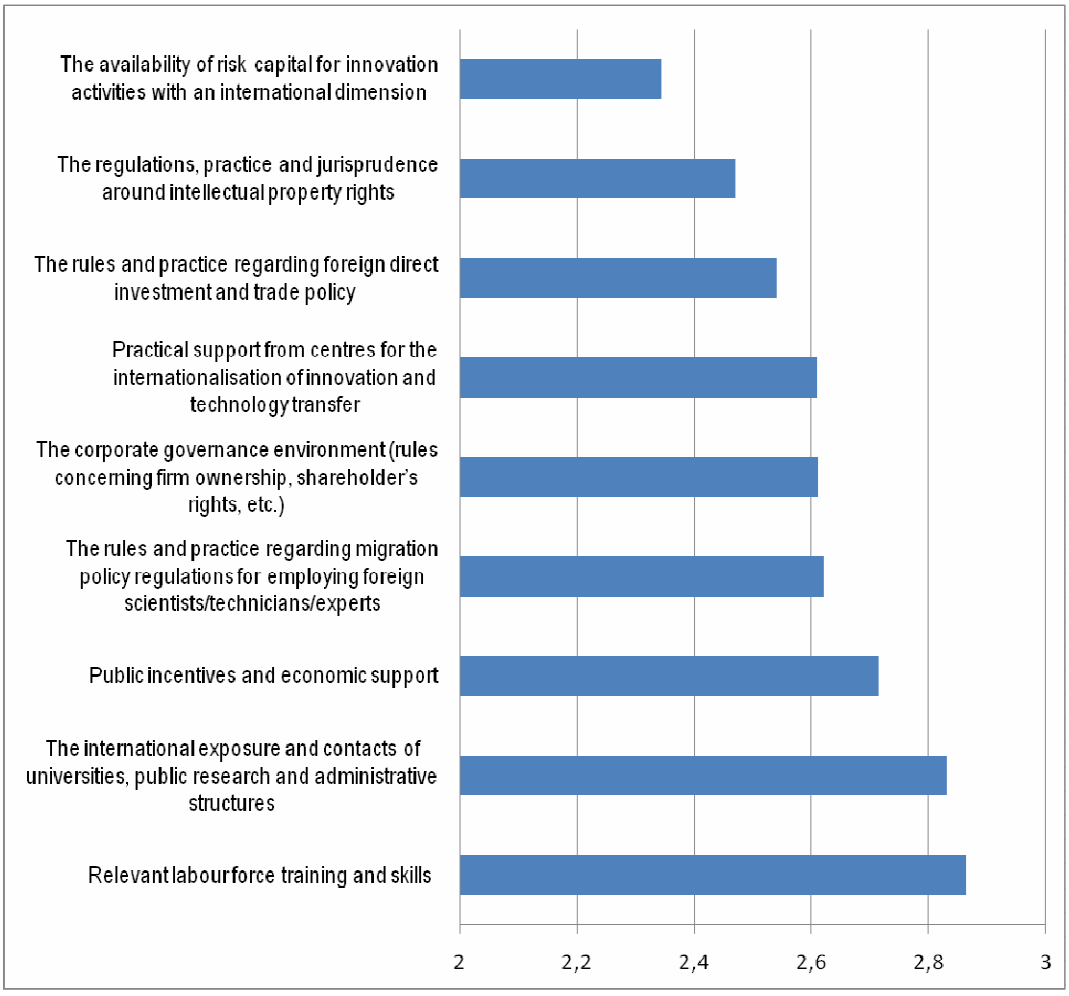
Legend: 1=small barrier - 4= extreme barrier.
N=495. All respondents are European companies.
Source: Borrás and Haakonsson 2011, based on INGINEUS survey

The European firms were asked to indicate the extent to which the following factors represented a challenge or barrier for them when developing a new good or a new service in collaboration with firms, universities or other organisations located abroad. It is worth noting that, among the firms which answered this particular question in the survey only 18% of them explicitly mentions that they are not facing any barriers or challenges when engaging in innovation-related collaborations with foreign firms. However, among the respondents who see some sort of barriers, these barriers are on average of low-medium level. Figure 6 indicates Having said that, however, these results have to be taken with considerable caution because the response ratio of this question in our survey was not high.

It is worth reminding that GINs are embedded in the institutional frameworks in which they operate. These institutional frameworks are important because they influence where MNCs decide to invest their R&D activities, and influence which entry mode they might use to do that. Furthermore, institutional frameworks influence the local absorptive capacities and the capability of the host economy to learn from foreign technology and to use it for upgrading their economies. And finally, institutional frameworks are very important in terms of the interaction between foreign knowledge and domestic capabilities over time. Institutional frameworks are those sets of rules and of specific innovation-related capabilities in a territory that shape the way in which (and where) innovative firms establish and unfold their innovation collaborations. For that reason, institutional frameworks can be largely associated to the set of policy-related factors where firms' innovative activities are

embedded. When asked about their own experiences during the past three years regarding the policy-related factors in the internationalization of their innovation activities, our sample of firms seemed to be generally positive. In Figure 6, most of the factors score above the 2,5 threshold in a scale from 1 to 4. This means that firms have a medium-level positive view on the policy-related factors in relation to their internationalization of innovation. In particular, the three factors that were most positive for firms' internationalization of innovation activities are by this order, firstly, the availability of relevant labour force training and skills; second, the international exposure and contacts of universities, public research and administrative structure; and third, the availability of public incentives and economic support. In fact, these survey findings seem to support the hypothesis that GINs might have a mutual 'mobilization effect' of local and national networks in terms of knowledge sources and national networks own internationalization (Borrás and Haakonsson 2011).

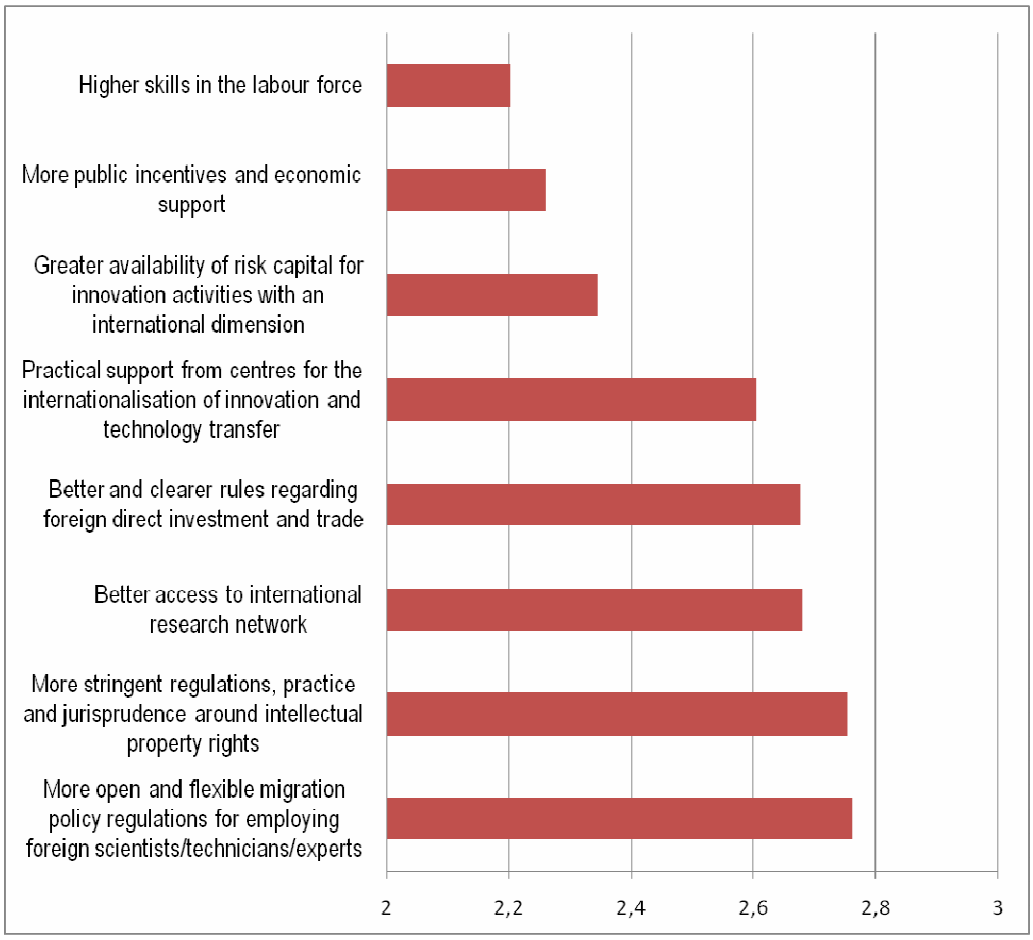
Figure 6: Policy-related factors in the internationalization of innovation activities *during the past 3 years*



Legend: Average responses of the following scale:
1= highly negative factor
4= highly positive factor
N=495. All respondents are European companies
Source: Borrás and Haakonsson 2011, based on INGINEUS survey

The INGINEUS survey put another question about policy-related factors. European firms were asked about their views on the future. More concretely the question in the survey reads: "Considering your future innovation activities, please assess the need for improving the following factors". The findings are shown in Figure 7 below.

Figure 7: Firms' needs for policy-related factors in relation *to their future innovation activities*.



Legend: Average responses of the following scale:
1= highly negative
4= highly positive
N=495. All respondents are European companies
Source: Borrás and Haakonsson 2011, based on INGINEUS survey

Figure 7 provides very relevant results. First of all, just like in the previous figure, most of the factors score above the 2,5 threshold. This means that firms have a medium level of positive expectations for policy needs in the future. It is worth pointing at the fact that the factors that are most positive or negative in the past and future are different. From the point of view of their needs for the future, it seems that European firms would like to have more open and flexible migration regulations for employing foreign scientists and technicians, as well as more stringent regulations, practice and jurisprudence around intellectual property rights. Other policy-related factors that firms consider that need improvement for the future are: better access to international research networks, and better and clearer rules for foreign direct investment and trade.

4. Potential impact, main dissemination activities and exploitation of results

4.1 Potential impact of the INGINEUS project

The evidence from our survey suggests that it would be wrong to regard GINs as the domain primarily of the most advanced MNCs of the developed world. In fact, the emergence of GINs critically suggests that there the capabilities of a firm and the capabilities of its host location are being disconnected to a greater extent than ever before.

As firms are increasingly able to "cherry pick" the locations from where they source their needed capabilities, they are likely to locate only in the most attractive locations for a given activity. This is likely to spur virtuous (for munificent) and vicious (for weak) cycles for locations. For policymakers, it is critically important that they ensure that locations are attractive nodes in firms' global networks.

Another important finding from this research is that another innovative type of firm is emerging alongside the multinational corporation. Those firms are relatively small, but by relying heavily on relationships with partners from across the world, they are able to create substantial innovations. Tracking these firms is hard, firstly because existing data sets are biased towards larger firms, and secondly because there is not yet a clear way of easily differentiating between these globally connected smaller innovative firms, and their non-innovative counterparts. But these firms seem to be important engines of economic growth, and need to be better understood.

WP3 was mainly designed to feed into other work packages as background information that would be used to develop policy proposals that encourage the development of GINs. While the focus of the report is on outcomes and not policy conclusions, it lends support to the idea that the national innovation system is a network of innovators and that while innovation is a highly localized phenomenon, the creation and diffusion of ideas and knowledge often involved global networks. National policies can improve global networking among the actors and institutions in the national innovation system by enhancing the innovative capacity of firms, particularly their ability to identify and absorb technologies.[11]

The results of WP4 have important implications for EU regional innovation policy, as regards to the objectives of retaining knowledge, attracting new knowledge and tapping into international pools of knowledge.

Regarding the retention of knowledge, it is clear from our analysis that firms located in strong regions tend to maintain their innovation activities in those strong regions instead of locating R&D abroad. The scarcity of qualified human resources can be a motivation factor for re-locating R&D activities abroad, but more often than not the main motivation is the access to

[11] An edited version of the report has the potential impact by appearing as a book. The report provides is a comparative analysis of the countries that are discussed in more detail in the individual country chapters. The book as a whole tells a story about how the individual innovation systems are tied together through an evolving global network of innovators. Plans are to publish an edited version of deliverable D3.2 as a book, to be edited by Mark Knell. NIFU-STEP is currently in negotiation with Edward Elgar publishing.

larger markets. This means that with few exceptions, the kind of R&D that is developed in emerging economies is more development that research. Core research continues in Europe, at least in strong regions.

As for the attraction of new knowledge, emerging multinationals are driven by a necessity to access knowledge resources and knowledge infrastructure that they do not have in their home country. They will target strong dynamic regions in Europe, which are also where the most innovative firms are.

Finally, as for tapping into international pools of knowledge, it is firms located in intermediate regions or marginal regions that **need** to tap into the new pools of knowledge, as their institutional environment is not so strong. It is those firms that need most support to access GINs in the form of international copyright agreements or standards.

The research undertaken for WP5 has important implications for the EU MNCs and for organisations involved in the creation, use and diffusion of innovation. It has become evident that new and complimentary knowledge is increasingly being sourced from emerging markets, residing within various informal and formal institutions in the host NIS. In order to undertake R&D on emerging markets products and technology, the institutional strengths at home locations and the existing research facilities in the Europe and the US are increasingly found to be unsuitable and out of touch with the specific knowledge requirements and the essential market feedback. In the R&D facilities in emerging markets, such research can be undertaken in close interaction with the market and can facilitate frequent exchanges with the key stake holders involved in the development of the technology and innovative solutions.

In recent years the MNCs have focussed on developing low cost products in emerging markets as a competitive strategy rather than competing with the expensive and ill adapted European products. The attractiveness of vast and untapped market potential combined with the presence of essential elements in the host innovation system conductive for undertaking R&D have encouraged MNCs to do applied R&D to find new technology applications and to create new market opportunities. The presence of large international suppliers and customers, premier research institutes with world-wide recognition, presence of low cost service providers, system integrators, contract research organisations, as well as the presence of specialised technology and service providers in the region have been the main factors. Moreover, the government in these countries has recently prioritised key emerging technology areas as a means to increase the competitiveness of national industries.

This provides the EU MNCs, an opportunity to contribute not just in technology development by benefiting from the public funding and support, but also in establishing appropriate industry regulations and technology standards and in strengthening the institutional framework for undertaking innovative activities in general. The latter is imperative for MNCs pursuing an emerging market innovation strategy as a means to have the competitive edge and to succeed in a toughening global competition.

Emerging economies offer opportunities for firms in developed countries to expand through the emergence and evolution of GINs. Firms extending into emerging markets can benefit from new knowledge networks, and the ability to access different customer demands and inputs from emerging market suppliers and competitors. Most of the benefits accrue from being able to tap into large and growing emerging markets. Rapid urbanisation and the massification of education in emerging markets has also increased access to low cost labour, including pockets of highly qualified knowledge workers at the intermediate and high skills

levels. There are however limits in the BICS countries to accumulate knowledge and capabilities. Tacit knowledge transfer is a slow and difficult process and highlights the importance of maintaining many core innovative activities in developed countries. WP6 demonstrates the importance of both maintaining innovative activities in developed countries, and expanding innovative activities to the BICS countries.

The development of global innovation networks, the present phase of internationalization of R&D, the processes of NSI formation and improvement may provide India, South Africa and Brazil with new avenues to escape subordinate roles in global innovation networks. Recall the four types of university-firm interactions: (1) LOCAL firms interacting with local and/or foreign universities; (2) TNCs interacting only with their LOCAL home based universities; (3) TNCs interacting both with LOCAL home based universities and FOREIGN universities in a host country/ies; (4) INTERNATIONAL consortia between firms and networks of universities. India, South Africa and Brazil may use other types of insertion in global interactions between firms and universities, beyond type 4. Type 2 can be a starting point to the creation of TNCs, type 3 may be a wise way to take advantage of broadly built networks. And, type 4 is a rich way to take advantage of the relatively more developed scientific international role of countries like India, South Africa and Brazil (and this is a feature that they share with Mexico and other immature NSIs that are in the intermediate group of Ribeiro et al, 2006). Finally, the creation of "non-hierarchical networks" could be an experiment in the way to a formation of a truly global innovation system.

Empirical and theoretical investigation on the role of institutional environment in the South has revealed a significant interaction between skilled migration and intellectual property rights (IPRs) protection in Southern countries. A diaspora channel makes it possible for knowledge acquired by emigrants abroad to flow back to the South and enhance the skills of the remaining workers there. By increasing the size of the innovation sector and the skill-intensity of emigration, IPRs protection magnifies diaspora gains making it possible to transform brain drain into brain gain (Naghavi and Strozzi, 2011). Following this study and its findings, WIPO is planning to launch a research agenda on the relationship between intellectual property and "South-North" mobility of talent (in both directions) and on the use of political instruments like IPRs to reverse the brain drain phenomenon into a win-win game.

The results from WP8 suggest that the widespread fear that R&D offshoring may have detrimental effects on EU growth and competitiveness are largely unfounded. Our evidence does not provide any conclusive evidence that carrying out innovative activities abroad reduces R&D at home, or that depletes a firm market value or a region productivity growth. If any, the studies carried out for this WP draw a picture where offshored R&D if often complementary to R&D activity at home, and this in turn allows the EU regions where offshoring MNCs are based to achieve higher productivity growth. In WP10 we discuss the implication for policy of these and results from this project. Let us just stress here that our evidence suggest that measures aimed at providing disincentive to offshoring firms may actually end up reducing EU long-term competitiveness, by limiting the opportunities of technological upgrading and productivity growth achieved through the integration in international innovation networks.

Based on results focusing on barriers to international collaboration, we can expect a slower GIN evolution in sectors dominated by complex engineering knowledge and advanced production equipment.

Knowledge and capacity building aspects of these geographical levels are important – there might be certain linkages/factors that need to be strengthened at regional/national level. There is a need to address what kinds of initiatives actually link global collaborative efforts.
The results from WP9 suggest that working for the development of Global standards is important in all sectors. Specifically, (i) the incoherence in standards works as a barrier; (ii) their development could provide a level playing field also for new products; (iii) Global standards work as motivations for innovation and as a barrier for market access.
The studies carried out for WP 9 revealed that there are examples of indigenous firms that use MNC affiliates to enter foreign locations with products linking up small stand alone companies with MNCs.

WP10 is the policy-related work package of INGINEUS project. The policy briefs have been published and posted in the web site, and the preliminary findings during this process (2nd half of the project) have been presented in several academic contexts (see below). Whereas it is still too early to see the long term impact, we are very satisfied to see the following immediate impact:

- The notion of "global innovation networks" has been explicitly mentioned in the 80 pages governmental program of the new government in Denmark, who took power in early October. The government aims at positioning Danish firms in strong global innovation networks and will develop a series of internationalization policy initiatives to achieve this political goal.
- The importance and policy impact of global innovation networks have been reflected in the discussions regarding the future direction of research and research policy in Denmark (Conference on the future of research and innovation held in November 2011, Copenhagen).
- The Copenhagen business school disseminated its suggestions for economic growth, where a lot of emphasis is placed on the importance of global innovation networks.

Whereas these are the immediate impact of the WP10 during the second and final period of this reporting and the life-span of INGINEUS, we expect that the medium-term will bring more impact. We are convinced the notion global innovation networks is just starting to be understood by policy-makers and the representatives of the industry.

4.2 Main dissemination activities and exploitation of results

During its lifetime INGINEUS set out different dissemination activities aimed at promoting its research and at reaching the widest and most varied audience possible.

The first dissemination tool created by the project is the **flyer**. The flyer summarises in a captivating jargon the objectives, methodology and expected outputs of the project. It reports a selection of quotations on innovation and globalisation that help set the framework of the research issues, and provides a graphical explanation of INGINEUS building blocks. The flyer can be downloaded free of charge from the homepage of the project web site (www.ingineus.eu).

Second, INGINEUS has produced a series of **Policy Briefs** aimed at leadership of the Copenhagen Business School (CBS) and are listed here below:

- Policy Brief no1 on "Global Innovation Networks: Where is Europe?", September 2009 (month 9)
- Policy Brief no.2 on "European firms' reasons for taking part in Global Innovation Networks", June 2010 (month 18)
- Policy Brief no.3 on "Challenges and barriers of European firms in GINs", March 2011 (month 27)
- Policy Brief no.4 on "Global Innovation Networks: evidence & policy challenges", December 2011 (month 36)

The INGINEUS Policy Briefs are published on the web site of the European Commission FP7 Socio-economic Sciences and the Humanities (SSH, http://ec.europa.eu/research/social-sciences/ index_en.html). They are also available free of charge on the INGINEUS web site, in the section dedicated to "policy foresight".

In terms of dissemination, during the first part of the project life time INGINEUS has established contacts with projects dealing with similar topics and has created synergies with other initiatives, including the **Coalition Theory Network** and the **EuroIndia** newsletters, the **PLATON+** fact sheets and the **SCOOP** initiatives. It has also contributed to the discussions taking place in the **Danish government** concerning future policy directions for economic growth, exploring possible collaboration between the project and Danish think-tanks and research institutes.

In the second half of the project life time, INGINEUS has participated widely in **Seminars, Workshops and Conferences** held within and outside Europe. These events have been an opportunity to create synergies for future collaborations and for reinforcing existing links with other projects and initiatives worldwide.

A successful connection has been established with GLOBELICS, the global network for the economics of learning, innovation, and competence building systems (www.globelics.org) that applies the concept of 'learning, innovation, and competence building system' (Lics) as its analytical framework. In particular:

- INGINEUS presented its research in the **7th GLOBELICS International Conference** on "Inclusive growth, innovation and technological change: education, social capital and sustainable development", held on 6-8 October 2009 in Dakar, Senegal
- INGINEUS organised a panel session on "Global Innovation Networks" at the **8th GLOBELICS International Conference** on "Making Innovation work for society: linking, leveraging and learning" held on 1-3 November 2010 in Kuala Lumpur, Malaysia
- INGINEUS organised three parallel sessions and a semi-plenary session in the **9th GLOBELICS International Conference on "Creativity, Innovation and Economic Development"** held on 15-17 November 2011 in Buenos Aires, Argentina:
  - INGINEUS parallel session 1 on "Universities as knowledge producers for economic development"
  - INGINEUS parallel session 2 on "What do we know about building sustainable national, regional and sectoral innovation systems? Theory and evidence"
  - INGINEUS parallel session 3 on "Privatization of knowledge, Intellectual Property Right (IPR) and development"

– INGINEUS semi-plenary session on "Global Innovation Networks in the memory of Jo Lorentzen"

INGINEUS has also interacted with the FP7-SSH-2007-1 project **GlobInn** on "The changing nature of internationalization of innovation in Europe: impact on firms and the implications for innovation policy in the EU" (http://globinn.freeman-centre.ac.uk). The two projects established a synergetic approach that has highly contributed to the development of the research undertaken by INGINEUS, particularly as concerns its WP5 on "Understanding strategies of R&D offshoring by Northern and Southern firms". This was possible thanks to the fact that the University of Sussex (UoS) is a partner in INGINEUS and the coordinator of the GlobInn project.

INGINEUS has also presented its research to the **European Union**, interacting with EU policy-makers and stakeholders. The results of INGINEUS were presented at two **EC meetings**:

- the EC meeting on "The results of EU research projects in the field of Socio-economic Sciences, FP6 and FP7", held in Brussels (Belgium) on 28 January 2010 (month 13)
- the EC meting on "Europe 2020 - Innovation insights from European research in socio-economic sciences" held in Brussels (Belgium) on 1 June 2010 (month 18).

Further, the INGINEUS **Final Conference on "Globalisation of Innovation"** was held at the European Commission Brussels, Belgium, on 9 December 2011. It aimed specifically at presenting the project results to a selected audience of stakeholders and policy makers in the field. The announcement of the Final Conference was circulated widely and posted on the INGINEUS web site as well as on the web site of the European Commission.

INGINEUS has also communicated its activities through **press releases** ("Europa mangler team spirit" in Berlingske Magasin, CBS, March 2011) **publications in magazines** and **video presentations** ("Global Innovation Networks", video produced and edited by Susana Borrás and Henrike Strube, CBS, February 2011).

At the time of writing INGINEUS is working on the **publication of a special issue for the journal "Research Policy"**, which collates several papers produced by the INGINEUS team:

The provisional (and still under review) content of the special issue is as follows:

- Editorial, Susana Borrás, Copenhagen Business School (CBS, Denmark) and Helena Barnard, University of Pretoria (UP, South Africa)
- Global Innovation Networks: their nature, driving factors and effects on innovation systems, Susana Borras, Copenhagen Business School (CBS, Denmark) and Jo Lorentzen, Human Sciences Research Council (HSRC, South Africa)
- Global Innovation Networks: towards a taxonomy, Helena Barnard, University of Pretoria (UP, South Africa) and Cristina Chaminade, University of Lund (ULUND, Sweden)
- Structural determinants of Global Innovation Networks, Heidi W. Alesen, Bernd Ebergsberger and Sverre Herstad, Norsk Institutt for Studier av Innovasjon, Forskning og Utdanning (NIFU STEP, Norway)

- Institutional voids as a trigger for the emergence of born global production and innovation networks, Helena Barnard, University of Pretoria (UP, South Africa), Tarmo Kalvet and Marek Tiits, Institute of Baltic Studies (IBS, Estonia)
- Do regions make a difference? Exploring the role of different regional innovation systems in global innovation networks in the ICT industry, Cristina Chaminade and Monica Plechero, University of Lund (ULUND, Sweden)
- R&D Offshoring and the productivity growth of European regions, Davide Castellani and Fabio Pieri, Centro Studi Luca d'Agliano (LdA, Italy) and University of Perugia, Italy
- The impact of Global Innovation Networks on national systems: the case of the Danish food industry, Susana Borrás & Stine Haakonsson, Copenhagen Business School (CBS, Denmark)
- Global Innovation Networks and university-firm interactions: an exploratory survey analysis, Eduardo Albuquerque and Gustavo Britto, Fundação de Desenvolvimento da Pesquisa (FUNDEP, Brazil) and Glenda Kruss, Human Sciences Research Council (HSRC, South Africa)

The complete dissemination list is provided separately.

4.3 The address of the project public website as well as relevant contact details

Project web site: www.ingineus.eu **Project logo:**

Contact details

Fundação de Desenvolvimento da Pesquisa (FUNDEP), Brazil
Team leaders: Eduardo Albuquerque (e-mail: albuquer@cedeplar.ufmg.br) and Gustavo Britto (e-mail: gustavo@cedeplar.ufmg.br)

Graduate University of the Chinese Academy of Science (GUCAS), Popular Republic of China
Team leader: Liu Xielin (e-mail: liuxielin@gucas.ac.cn)

Copenhagen Business School (CBS), Denmark.
Team leader: Susana Borrás (e-mail: sb.cbp@cbs.dk)

Institute for Baltic Studies (IBS), Estonia.
Team leader: Marek Tiits (e-mail: marek@ibs.ee)

German Development Institute (DIE), Germany.
Team leader: Andreas Stamm (e-mail: Andreas.Stamm@DIE-GDI.de)

Centre for Development Studies (CDS), India.
Team leader: K. J. Joseph (e-mail: kjjoseph@cds.ac.in)

International Institute of Information Technology (IIIT-B), India.
Team leader: Balaji Parthasarathy (e-mail: pbalaji@iiitb.ac.in)

Centro Studi Luca d'Agliano (LdA), Italy.
Team leader: Davide Castellani (e-mail: davide.castellani@unipg.it)

Norsk Institutt for Studier av Innovasjon, Forskning og Utdanning (NIFU STEP), Norway.
Team leaders: Mark Knell (e-mail: mark.knell@nifustep.no) and Heidi Wiig Aslesen (e-mail: Heidi.W.Aslesen@bi.no)

Human Sciences Research Council (HSRC), South Africa.
Team leader: Glenda Kruss (e-mail: GKruss@hsrc.ac.za)

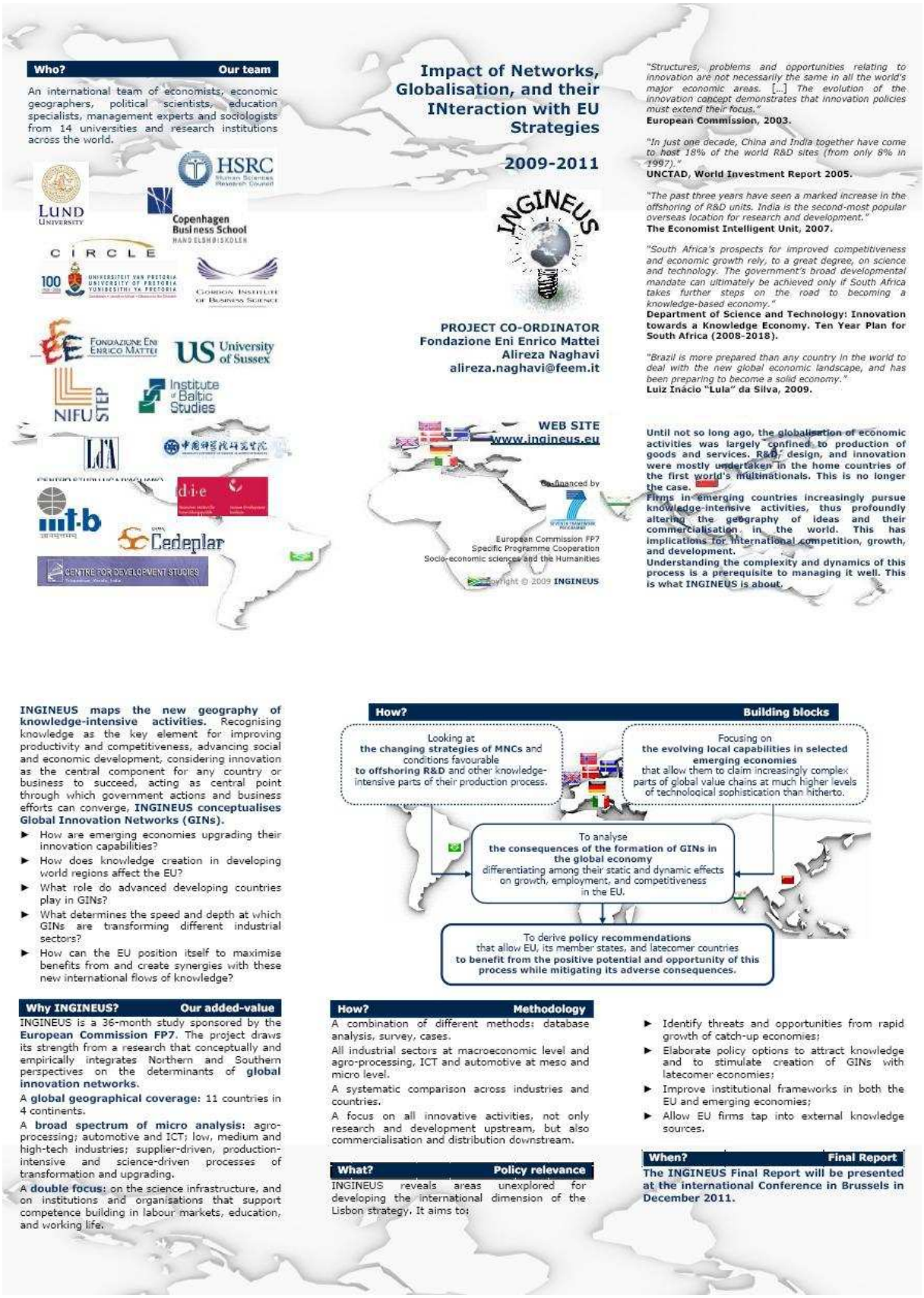
University of Pretoria (UP), South Africa.
Team leader: Helena Barnard (e-mail: barnardh@gibs.co.za)

University of Lund (ULUND), Sweden.
Team leader: Cristina Chaminade (e-mail: cristina.chaminade@circle.lu.se)

University of Sussex (UoS), UK.

Team leaders: Nick Von Tunzelmann (e-mail: G.N.Von-Tunzelmann@sussex.ac.uk) and Vandana Ujjual (e-mail: V.Ujjual@sussex.ac.uk)

Project flyer



References

PART 1

INGINEUS (2011a) Deliverable 10.1: Comprehensive research paper on "Global Innovation Networks: challenges and opportunities for policy", December 2011, *forthcoming* at http://www.ingineus.eu/getpage.aspx?id=302&sec=300

INGINEUS (2011b) Deliverable 8.1: The long-run impact of GINs in Northern countries, December 2011, *forthcoming* at http://www.ingineus.eu/getpage.aspx?id=302&sec=300

PART 2

Archibugi, D. and Lundvall, B.-Å. (2001), The Globalising Learning Economy, Oxford University Press, (eds.) 2001.

Lundvall, B.-Å. and Borrás, S. (1999), The Globalising Learning Economy: Implications for Innovation Policy, Brussels, DG XII, 1999

Narula, R. and Dunning, J. (2000), Industrial development, globalisation and multinational enterprises: New realities for developing countries, *Oxford Development Studies*, 28 (2)

Pavitt, K. (1984), Sectoral patterns of technical change: towards a taxonomy and a theory, *Research Policy* 13: 343–373

OECD (2007), Staying Competitive in the Global Economy: Moving up the Value Chain, OECD, June 2007.

PART 3

Borrás, S. and Haakonsson S. (2011), INGINEUS Policy Brief n.4, "GINs: Evidence and Policy Challenge", December 2011, *forthcoming* at http://www.ingineus.eu/getpage.aspx?id=421&sec=17

Cooke, P., De Laurentis, C., Tödtling, F., Trippl, M. (2007), Regional Knowledge Economies: Markets, Clusters and Innovation, Edward Elgar Publishing, 2007.

Ernst, D. (2009), A New Geography of Knowledge in the Electronics Industry? Asia's Role in Global Innovation Networks, in Policy Studies #54, August 2009, East-West Center, Honolulu, USA

INGINEUS (2010a) Deliverable 3.1:"Modelling global innovation networks using input-output analysis", June 2010 available at: http://www.ingineus.eu/UserFiles/INGINEUS_D3.1.pdf

INGINEUS (2010b) Deliverable 3.2:"National Innovation systems and global innovation networks", June 2010 available at: http://www.ingineus.eu/UserFiles/INGINEUS_D3.2_part1.pdf

INGINEUS (2011a) Deliverable 10.1: Comprehensive research paper on "Global Innovation Networks:
challenges and opportunities for policy", December 2011, *forthcoming* at http://www.ingineus.eu/getpage.aspx?id=302&sec=300

INGINEUS (2011b) Deliverable 8.1: The long-run impact of GINs in Northern countries, December 2011, *forthcoming* at http://www.ingineus.eu/getpage.aspx?id=302&sec=300

INGINEUS (2011c) Deliverable 4.1: Patterns of knowledge accumulation, institutional frameworks and insertion in GINS in successful sub-national regions, June 2011, available at http://www.ingineus.eu/UserFiles/INGINEUS_D4.1.pdf

INGINEUS (2011d) Deliverable 5.1: "Research paper on "Understanding strategies of R&D offshoring by Northern and Southern firms", June 2011, available at http://www.ingineus.eu/UserFiles/INGINEUS_D5.1_3_.pdf

INGINEUS (2011e) Deliverable 6.1: Fragmentation of GINs and capability building in the automotive, ICT and agro-processing industries, June 2011, available at http://www.ingineus.eu/UserFiles/INGINEUS_D6.1(1)(2).pdf

INGINEUS (2011f) Deliverable 7.1: Firm ownership and university-industry linkages in Brazil and South Africa; local–global linkages between higher education institutions, public labs and firms in ICT; role of IPRs in the anchorage of GINs in emerging economies, June 2011, available at http://www.ingineus.eu/UserFiles/INGINEUS_D7.1(1).pdf

INGINEUS (2011g) Deliverable 9.2: Report summarising the implications per industry for EU countries and emerging economies, December 2011, *forthcoming* at http://www.ingineus.eu/getpage.aspx?id=302&sec=300

Naghavi, A., Strozzi, C. (2011) Intellectual property rights, migration and diaspora. FEEM Working Paper 60/2011.

Naghavi, A., Ottaviano, G. (2010) Outsourcing, complementary innovations, and growth, Industrial and Corporate Change, Volume 19, Number 4, 2010, pp. 1009–1035

Ribeiro, L. C.; Ruiz, R. M.; Bernardes, A. T.; Albuquerque, E. M. (2006). Science in the developing world: running twice as fast? *Computing in Science and Engineering*, v. 8, pp. 81-87, July.

Tödtling, F., L. Lengaver and C. Höglinger (Forthcoming 2011) Does location matter for knowledge sourcing? A study of ICT firms in two regions in Austria. European Planning Studies.

PART 4

Naghavi, A., Strozzi, C. (2011) Intellectual property rights, migration and diaspora. FEEM Working Paper 60/2011.

Ribeiro, L. C.; Ruiz, R. M.; Bernardes, A. T.; Albuquerque, E. M. (2006). Science in the developing world: running twice as fast? *Computing in Science and Engineering*, v. 8, pp. 81-87, July.