

DANISH **R**ESearch **U**NIT FOR **I**NDUSTRIAL **D**YNAMICS

DRUID Working Paper No 01-12

**Innovation Systems and Developing Countries:
Experiences from the SUDESCA Project.**

By

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2001

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Abstract

This report deals with the transfer of knowledge from the North to the South. More specifically it deals with a Danish development aid project which aims at enhancement of research capacity in some Central American countries. First, some difficulties connected to knowledge transfer between North and South are discussed on a general level. It is argued that these difficulties are connected to contradictions in the globalising learning economy: On the one hand short-term economic calculations and speedy processes of decision-making are getting more and more important. On the other hand competition depends more and more on dynamic efficiency rooted in knowledge or knowledge related resources with long term characteristics.

After this some concrete experiences from a specific project aiming at building research capacity about sustainable development strategies - the SUDESCA project – are presented. This project is carried out within a system of innovation approach and it is argued that this concept needs to be adapted in order to be useful in the context of developing countries. It is concluded that the results of projects like this depends on to which extent processes of intercultural learning can be organised and if they can be sustained for longer periods of time

Keywords: Knowledge transfer, development aid, Central America

JEL: F35, O19

ISBN (87-7873-111-9)

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Any government, which sets out to "enhance research capacity" will experience, that this is quite difficult. It is not at all self-evident how to cope with such a task. How should the needs to strengthen secondary education be balanced against university education? Should education of researchers (PhD D-programs) be especially targeted, or is it better to increase the funding of concrete research projects? Should private sector research be given priority over public sector research, for example university research, or should one concentrate on bridging between the sectors through, for example, science parks, or concentrate on technology diffusion through technology service systems and so on? Furthermore, having decided upon the implementation of a specific plan, how should the results be measured and evaluated: Numbers of papers published in international, refereed, scientific journals? Number of patents? Productivity growth? Or should the results just be judged by a special review committee?

A moment's consideration, inevitably, reveals the complexity of enhancing research capacity, also in a high-income country with an already well-developed education and research infrastructure. These difficulties, however, fade when compared to the complexities and problems encountered, when a high-income country through a development aid program or otherwise sets out to enhance research capacity in a developing country.¹ One reason for this is that it involves "transfer of knowledge" from one context to another. This is never easy, but when it involves countries on different levels of development, when the transfer takes place in a context of knowledge asymmetries and when the knowledge in question is complex the difficulties increase immensely. In this paper some concrete experiences from a specific knowledge transfer project will be discussed. We will start, though, with some theoretical considerations.

The importance of knowledge as development factor.

The case for including enhancement of research capacity in development aid is quite strong. Different kinds of learning and competence building are increasingly recognized as fundamental sources of the process of innovation, which drives growth and development. Furthermore, research and utilization of research results are indispensable elements of any knowledge-based economy. There is no strong reason to believe that this is not also the case in developing countries. Even if knowledge creation and utilization is far from being all that matters in development, it is clearly a fundamental part of it.

There has been some hope that the combined effects of globalization and development of information and communication technologies, including the internet, would make the access of relevant knowledge faster and cheaper for developing countries and that this would be a powerful carrier in a process of catching-up development. This, however, does not seem to be the case. Knowledge for development appears not to be

¹ Several European countries comparable to Denmark has such programs, for example Norway, Sweden and Holland (Ministry of Foreign Affairs, DANIDA, 2000).

downloadable. In fact, knowledge related recourses as indicated by R&D activities, patents, publications, etc. are even more unevenly distributed between north and south than income and wealth in general. There are clear signs of an increasing knowledge and technology divide.

Knowledge is produced with increasing speed in the north but the ability of the south to access, adapt and utilize it is still quite limited. It should be a central aspect of development aid to increase this ability and part of such an effort should be to help developing countries to enhance their research capacity. To have a good research capacity increases the capability of a country to utilize knowledge produced elsewhere. It also, of course, increases the capability to produce knowledge directly at home.

Knowledge transfer from North so South.

Some people expect much from knowledge transfer. The World Development Report from 1998/99, which is devoted to the role of knowledge in development, starts with the following promising words:

"Knowledge is like light. Weightless and intangible, it can easily travel the world, enlightening the lives of people everywhere. Yet billions of people still live in the darkness of poverty – unnecessarily."

In spite of the high expectations knowledge transfer between the North and the South is an area with many failures. Not being able to distinguish between information and knowledge may be the reason for the exaggerated expectations. Knowledge is seldom just transferred. The very concept of knowledge transfer is in a way a misnomer. Knowledge is not transferred directly from one person to another. Tacit knowledge cannot be separated from the person or organization in which it exists and can only be learnt through time consuming processes of interactive learning, face-to-face. It certainly does not move like light.

It is of course a bit different with codified knowledge. Codifying knowledge makes it possible to send messages containing information from a person or organization in one country to a person or an organization in another country. This does not mean, however, that knowledge has been transferred. Information may be transferred, but knowledge has to be learnt. At the receiving end of the transfer line persons have to use the information as input in a process of learning, which probably requires other inputs and institutional capacities as well. Codification, if it is at all possible, is not enough for successful knowledge transfer because there are knowledge asymmetries and context dependencies.

Many development aid projects aiming at technology transfer have failed because of knowledge asymmetries: Normally, knowledge does not work in the same way in the South as in the North (Müller, 1999). One major problem has to do with 'contextuality'. The knowledge sender may have good and explicit knowledge about the technology he is trying to transfer, but he has only incomplete and implicit knowledge about how the economic and social context has affected its development and the way it works even in his own country. He has probably not given it much thought. And he has even more

inadequate knowledge about its context dependency in the receiving country. For this reason he is often not able to make sure that the receiver succeeds in utilizing the technology efficiently. It is not enough that the receiver knows much more than the sender about the economic, social and political conditions in the receiving country since he knows too little about the technology and its context dependency. Hence, there are often very limited possibilities to debug the technology and make it work under the new conditions. Furthermore, the "maintenance" of the knowledge is frequently not good enough, the learning potentials from using the technology are not realized and the knowledge is sometimes quickly forgotten.

There are, of course, many different reasons for the frequent failures of knowledge transfer, but often they have to do with both the complexity and context dependency of knowledge. The more complex the knowledge is, for example if it is about "research capacity" rather than about how to build a road, the more difficult it is to transfer. The more context dependent it is, for example if it requires institutional, educational and infra-structural support, the more difficult it is to utilize. It often needs to be backed-up by an institutional capacity to be useful or even meaningful in the new context. And often even relatively simple knowledge, like how to build a useful road, turns out to need so much local backing of tacit knowledge that it leads to clear project failures.

Knowledge transfer may be regarded as taking place on different levels. Müller (1999) mentions 5 such levels. The simplest is the level of consumption; a firm in a high-income country sends a product, which is supposed to be consumed in a low-income country. Even if this often is simple enough, it sometimes requires that knowledge about how the product can be distributed and used (consumer learning) is developed in the receiving country. It is more complicated to transfer the technology for producing this product; for example machines and the knowledge necessary to use, maintain and (re)produce them. This may be called knowledge transfer on the level of production and it requires producer learning, in the form of learning by doing and learning by using.

In a changing economy production processes have to be continually adapted by "incremental" product and process innovation in order to survive. This requires continuous learning by doing, using and interacting, i.e. it requires a more developed learning capability. Such a capability does not come by itself. It has to be built and sustained and it may require repeated long-term interactions between the technology sender and the technology receiver. A further development of this incremental innovation capability may lead to a more advanced innovation capability; a competence to develop more genuinely new products and process. This may require that firms in the receiving country set up Research and Development departments or engage in long term development co-operation with other firms and organisations. Müller refers to this level of knowledge transfer as the 'development level' and in addition to this he identifies an even more complex 'research level'.

It goes almost without saying that transfer of knowledge on the more advanced levels is extremely complicated. It is a process over time rather than a one shot event and it

presupposes the existence of knowledge infrastructures and suitable institutions as well as consumer and producer competence and learning and innovation capabilities.

When a more developed country tries to help a less developed country to enhance its research capacity it may be viewed as involving transfer of "research technology" (Müller, 1999). It is true that research technology may be transferred also at the lower levels mentioned above. Researchers from a scientifically advanced country may produce research reports, with or without assistance from local researchers, and send them over the Internet to the in the developing country. This corresponds to the two lowest levels of knowledge transfer. However, since it involves very little interactive learning, it will have almost no influence on the research capacity of the receiving country. In order to improve the research capacity knowledge also has to be transferred at the higher levels, which means that a process of intercultural learning has to be organised and sustained for a considerable period of time. This is Müller's conclusion. Knowledge flows are usually not unidirectional. Efficient transfer requires that knowledge flows in both directions. The sender as well as the receiver has to learn.

In spite of all the difficulties associated with transfer of research technology this is the aim of the ENRECA program.² To enhance research capacity in developing countries necessarily involves transfer of knowledge at all the different levels and it encounters all the knowledge asymmetries identified above.

The research questions of the SUDESCA project

The SUDESCA project (see <http://sudesca.una.ac.cr/>) within the ENRECA program will here be used as an example of intercultural learning in social sciences and in development aid. Learning by researching and specifically by interacting and co-operating in research processes (including a PhD-program) is used as a method for transfer of knowledge. In the project Denmark is the knowledge sender and Costa Rica, El Salvador and Nicaragua the receivers.³ Costa Rica, which has a more developed knowledge infrastructure than the two other Central American countries, occupies a role "in between" organising much of the communication and interaction within the region. The project is an effort to build research capacity in a problem area, which is both "down to earth" and politically relevant: Formulation and implementation of environmentally, socially and economically sustainable development strategies for Central American countries. The overall research question is, if it is possible to support development by increasing international competitiveness in ways, which are also socially and ecologically sustainable. One of the

² ENRECA is a program within DANIDA, which is the development aid organization of the Danish ministry of foreign affairs. ENRECA consists of about 40 projects distributed over approximately 25 countries. The projects are typically funded in three-year phases at an average level of US\$ 625.000 per phase. Up to four phases may be funded. For a description and evaluation see (Ministry of Foreign Affairs, DANIDA, 2000).

³ It would be more accurate to say that it is not countries but specific research groups in the different countries that are the immediate senders and receivers. Furthermore, when we say that a Danish research group is a sender of knowledge this does not exclude the possibility that this group may learn more in the process than the Central American groups. It only means that the project is organized to implement a supposed knowledge transfer potential between Denmark and Central America.

basic ideas behind the project is that different kinds of innovations are necessary, and often also possible, in order to induce the technical, organisational and institutional changes, which feed processes of development. Furthermore, without technical, organisational and institutional innovations it will not be possible to integrate the economic, social and ecological aspects of sustainable development. Without an ongoing upgrading and restructuring of the knowledge base there is a serious risk of being locked in into a development strategy, which is unsustainable, both from a human resource and natural resource point of view – for example competing by low wages, cheap natural resources and inadequate environmental protection.

The SUDESCA project is formulated and carried out within a “system of innovation” approach, which includes the idea that interactive learning and innovation processes are driving and forming growth and development (Lundvall (ed.), 1992, Nelson (ed.), 1993, Edquist (ed.), 1997). The essence of the innovation system approach is, that the innovation capacity of a country (region, sector) is determined not only by the innovation capacity of its individual firms and organisations, but also by how they interact with each other and with the public sector. In addition, the patterns of interaction and the production, distribution and use of knowledge are supported and formed by the institutional framework and the knowledge infrastructure of the country (region, sector). It is also a central proposition in the system of innovation approach that innovation possibilities are different in different sectors of the economy, which means that the production structure or specialisation pattern matters for the innovation performance of the economy. There are, thus, both territorial and structural aspects of innovation systems. The system of innovation approach also implies that both the formal and informal economy are part of the innovation system and affecting innovation performance.

There are different ways to conceptualize innovation systems, but when explicitly focusing on the South a broad approach, in which innovations are seen as rooted not primarily in research and development, but rather in everyday activities in firms and in the competencies and capabilities of ordinary people, is to be preferred. Furthermore, the importance of a broad approach to innovation systems increases when we think of development itself in broader terms, as more diverse and qualitative than plain macro-economic growth. A narrow focus on the role of science and science-based, high-tech activities is not what is most needed. The concept has to cover all aspects of competence building in all types of socio-economic activities.

One may say that the system of innovation approach is a way of analysing innovations – their character, their causes and how they affect economic growth and development – in the learning economy. The concept of a learning economy refers to a phase in economic development in which processes of technical, organisational and institutional learning have been built into the fabric of society. Learning and innovation has become a major instrument of competition and continuing economic and social changes require that people, as consumers and as producers, have to learn almost throughout their entire life. Furthermore, in a learning economy there is a well-developed knowledge infrastructure in society.

Some contradictions in the globalising learning economy.

The SUDESCA project is, of course, itself a part of the learning economy. Within the project research is carried out about national, local and sectoral systems of innovation. So far, special focus has been put on the textiles and forest sectors and comparisons between countries in the region have been carried out. The project is now in its 5th year and includes cross-country subprojects on the role of small firms, local development, cleaner technologies and property rights to natural resources. It has without doubt implied intercultural learning and affected the competence of both “senders” and “receivers”. In the rest of the paper we will discuss some of the preliminary experiences. We will take up two questions: What have we learnt about the usefulness of the system of innovation-approach, and what have we learnt about knowledge transfer? First, however, we will discuss some general contradictions in the “globalising learning economy”, which complicate the research question of the project

Even if the research question may seem down to earth and straightforward it is difficult to handle. One reason for this is that it is related to, and affected by, some central contradictions in the present mode of capitalist development; contradictions which follow from the tendencies of globalisation on the one hand and the increasing dependency on learning and knowledge on the other hand (Jessop, 1999).

Globalisation – increasing interconnectedness in the world economy and increasing speed and volume of financial capital movements – increase the dependence of developing countries on economic decisions in high-income countries and specifically on short-term financial dispositions. The tendency towards a knowledge based learning economy is particularly strong in the countries on or close to the technological front, but may nevertheless cause severe problems in developing countries, which do not have adequate knowledge infrastructures and institutional frameworks to capture the potential economies of this tendency.

Combining the two tendencies you may talk about a tendency towards a global, knowledge based economy; a “globalizing learning economy” (Lundvall and Borras, 1998). This is characterised not only by new potentials for growth but also by deep contradictions. On the one hand short-term economic calculations and speedy processes of decision-making (especially in financial flows) are getting more and more important. On the other hand competition depends more and more on dynamic efficiency rooted in knowledge or knowledge related resources with long term characteristics. These resources can be quickly destroyed but often take a long time and sustained efforts to build. This is because interactive learning and innovation processes are cumulative and depend on trust and other kinds of “social capital”. Knowledge building is a cumulative process, which builds on an ability to form lasting patterns of interactive learning.

There are also other aspects of this contradiction. On the one hand knowledge is increasingly treated as a commodity and firms are trying to capture knowledge economies, for example network economies, through intellectual property rights. On the other hand knowledge include elements of public goods characteristics and is socially produced in narrow and broad networks, which may be destroyed by a commodification

of knowledge. Furthermore, it is difficult to capture and distribute its returns. On the one hand firms want as free access as possible to information and knowledge in order to profit on its public goods characteristics. On the other hand they want to charge for the knowledge they produce themselves.

The tendency to treat information and knowledge as commodities is ubiquitous. Firms are increasingly becoming aware of the possibilities to sell knowledge in different ways. Business consultancy is one of the fastest growing activities in some high-income countries for example. Also public organisations and government agencies are increasingly charging for their supply of information and knowledge services. Budgetary pressures support this tendency; public organisations are required to, partly, finance their activities in this way. As has already been mentioned this commodification of knowledge is in itself contradictory in several ways. It is also well known that some peculiar characteristics of knowledge make it very different from ordinary private goods: It is difficult to sell, since the buyer needs to know what he buys before the transaction, but once he knows it, he may not be interested in paying for it. It is not scarce in the sense that it diminishes through use, etc.

In the language of Karl Polanyi (1944) one would say that knowledge (like capital) is a fictitious commodity. It is embedded in social relations. One might even say that knowledge is a social relation. The productivity of knowledge is not rooted in its immanent character but in the social relations, which it is a part of. It is usually not valuable in itself, but a social reorganisation or institutional change may be required to make it valuable. Sometimes, for example, knowledge has to be transformed into intellectual property in order to be exploited in the economic system. Sometimes it can only be effectively used in networks. The fact that some people (and some organisations) are knowledge producers or in other ways have access to knowledge, while others are excluded, profoundly affects the ways economic activities are organised and income distributed. It also influences technical innovations. Efforts are made to divorce intellectual labour from the means of production by building it into smart machines and expert systems for example.

These contradictions are characteristic for capitalism in high-income countries. They induce organisational and institutional innovations, which are often accompanied by conflicts and power struggles between different groups. However, they may pose even more difficult problems for developing countries. In the south it is often more difficult to build adequate knowledge producing networks and it may be even more difficult to capture the network economies due to lack of social capital. Lack of social capital also make it difficult to implement the organisational and institutional changes, which might solve the problems. Thus, the contradictions of the global learning economy hit many developing countries with great force. To analyse the combination of sustainability and competitiveness in developing countries obviously requires a research approach, which can focus both on knowledge building and utilisation and on the connected and necessary organisational and institutional changes. To enhance research capacity in this field means developing, and implementing such an approach through a process of interactive learning between North and South.

The SUDESCA project also ventures into another more specific contradiction of capitalist growth and development connected to the question of ecological sustainability. As discussed above the globalizing learning economy is characterised by a tendency towards short-term economic calculations and speedy processes of decision-making. This is often in contradiction with a sustainable use of ecological resources. These may be quickly, and especially in developing countries, very cheaply exploited and destroyed, but they are usually built up through slow, long-term processes. To this may be added that the increasing exposition to international competition and to short term decision-making leads to pressure for quickly raising levels of consumer satisfaction, which heightens the exploitation pressure on ecological resources.

The dynamic production function approach to development

There is no ready made method of introducing “knowledge” and “nature” into the analysis of the development process as required by our research question. From the perspective of economic theory it may be natural to start out with a "dynamic production function" approach: Together with labour and capital knowledge and nature (land) are regarded as "factors of production". They deliver inputs into the production process, which in turn delivers outputs in the form of different kinds of private and public goods and services. If the form of the production function is known you can analyse the contribution of increases in factors of production and improvements in their efficiency to economic growth and development. Economists of different schools tend to agree on this approach, even if they do not agree on the specific form of the production function or on the relative importance of the factors and their possible interdependencies.

The thinking about development has tended to concentrate on the factors one at the time. Classical economist paid much attention to land, which was regarded as a scarce and limiting factor in the process of growth. Later, economic growth theory put the focus on capital and in the 1950s and 1960s interest was concentrated on restrictions on saving and capital accumulation and different inefficiencies in the capital allocation process. In the late 1960s labour became a key factor and attention shifted to investments in human capital. Lately, knowledge and another group of factors, which are not included in the production function but may be said to lie behind it– institutions - have moved into the centre of interest (World Bank, 1997 and 1999). Maybe we can talk of a movement from natural capital (land) over physical capital and human capital to social capital.

In a general sense also the SUDESCA project has used a dynamic production function approach and looked upon different factors of growth and development. But since the development process we want to study involves so many fundamental changes in both inputs and outputs, we also wanted to introduce in our project a way of thinking, which is more deeply dynamic. We need a way of thinking and researching about sustainable development, which may be adapted and improved after the present project is finished. It is not a model for sustainable development in an open economy, ready to be implemented, we want, but a capability to analyse, formulate, implement, evaluate and re-formulate, etc., such models. Development has more to do with human capabilities than with resource endowments (Sen, 1999).

One aspect of this is that we should not look upon the main factors of development simply as stock variables. It has become fashionable to refer to social and economic phenomena as forms of capital. There are not only the traditional, real (physical) capital in the form of tools, machines, buildings, etc. but also natural capital, human capital, knowledge capital and social capital. These concepts are often convenient, but they may also be misleading. None of these "capitals" are homogenous entities, which can be accumulated, stored and used like water in a tank. To think of them in this way leads one to overlook the existence of structures and interconnections within them, which influence how they interact with each other and affect development.

Even more problematic than this is that thinking about the factors behind growth and development as capital stocks hides that they are social relations. It was a major insight of Karl Marx that capital implied a relation between social classes with different positions in the production processes and with different types of income. This social relation has effects on the speed and character of economic and political change, which vastly exceed the effects of capital as a simple stock of tools and buildings. As has already been mentioned above, knowledge should also be recognised as a social relation in this sense.

In some respect the same is true for natural capital. Ecological resources are necessary for social and economic processes. Without the natural environment there would be no economic system at all and economic processes often directly depend on the "services of nature" (Costanza and Folke, 1996, Segura-Bonilla, 1999). This is obvious. It may be less obvious, however, that the value and productivity of ecological resources can only be defined and materialised by the way nature and society interacts. These interactions are affected by, and affect, social relations. They are formed within an institutional matrix. There is a tendency in many countries to internalise ecological resources more and more into the economic process. Property rights are formed where no property existed before and common property is transformed into private property. Nature is turned into commodities and new products. Services, which include elements of nature, are developed, as for example eco-tourism and carbon bonds. This is done in order to capture rents from nature. However, the act of doing so may in some cases negatively affect other economic activities. The consequences of these changes for sustainable development depend on the social and economic aspects of the ecology, i.e. primarily on the institutional system (Segura-Bonilla, 1999).

When thinking about development it is important to analyse how the different development factors interact and feed upon each other. Investment in physical capital, human capital or knowledge capital can not in their own respects explain development. When it comes to policy making for sustainable development, it would not be a good idea to concentrate exclusively on one key factor. It does not, for example, make sense to try to identify the contribution of physical capital to growth independently of knowledge if investments are motivated primarily by the development of new technology. The growth factors always interact with each other and the specific ways they do this determine the path of development. This is a well-known result of the evolutionary critique of neo-classical growth theory, especially so called growth accounting (Nelson and Sampat, 1998).

The factors of development should not, then, be looked upon simply as capital stocks, since they both depend upon and imply social relations. Furthermore, they may, or may not, interact with each other in specific development inducing ways. These two propositions lead to the conclusion that one needs to bring in “institutions” to understand how different factors play together in growth and development. This includes above all reflections on how institutions support, or fail to support, interactive learning. It also includes how institutions control, or fail to control, social conflicts, for example conflicts about income- and power distribution.⁴

The system of innovation approach and developing countries.

After this brief discussion of what kind of approach we need for the research questions of the SUDESCA project, it is possible to argue that a system of innovation approach is well suited (Arocena and Sutz, 2000). Its conceptual glasses help to concentrate on what we believe is important in development: It takes departure in learning capabilities and focuses on innovation processes and their role in development. It has a broad explanation of innovation; they are based both in research and in everyday, routine economic activities and in both high-tech and low-tech sectors. Its growth factors are interacting and feeding upon each other. Institutions and production structures matters. And interaction between firms, organizations and the public sector is the essence of the concept. Furthermore, it is a flexible approach, which, for example, can put the emphasis on local, national or regional systems and their mutual interdependence. Finally, it is an inherently comparative approach; it does not try to define illusive states of equilibrium but compares the anatomy and changes of different innovation system.

But it is also important to be aware of the weaknesses of the approach, as it has been used so far. Some of these have to do with the fact that it has mostly been applied to developed rather than developing countries. One aspect of this is that it has been used mainly as an ex-post rather than as an ex-ante concept. It has been used to describe and compare relatively strong systems of innovation with well-developed institutional and infra-structural support of innovation activities. It has not, to the same extent, been applied to system building. Since most Central American innovation system may be described as fragmented and rather weak, the focus in the SUDESCA project must be, increasingly, shifted in the direction of system construction and system promotion.

Even if the SI approach covers both territorial and sectoral systems and even if territorially defined systems in principle include local, national, regional and global systems, the focus in the research done so far has mainly been on regional (within countries) and national systems. In a developing country context one should devote much more interest to local systems and their interaction with regional and national ones. Furthermore, the relationships between globalisation and national/local systems seem to be relatively under-researched. It is important to know more about how globalisation

⁴ In this connections institutions are understood as patterns of behavior and interaction. Or more precisely, the things which lie behind patterns of behavior, like norms, habits of thought, routines, rules and laws. Institutions can be both formal and informal, but the point is that they influence and shape how actors in the economy get things done and how they learn. They do this by making certain kinds of actions and certain types of interaction natural, attractive and less costly than other ones (Edquist and Johnson, 1997).

might affect the possibilities to build systems of innovation in developing countries and local systems are important parts of this.

But the most important weakness of the system of innovation approach, at least when applied to developing countries, is probably that it lacks an adequate treatment of the political and power aspects of development. Introducing new technology and changing the control of knowledge is often an instrument for changing the power structure. The close relations between power and knowledge has been emphasised by Foucault (Gordon, 1980) and it seems necessary to take these relations onboard when analysing innovation systems in developing countries. The focus on interactive learning – a process in which agents communicate and co-operate in the creation and utilisation of new economically useful knowledge – has led to an underestimation of the conflicts over income and power, which are also connected to the innovation process. Interactive learning and innovation immediately sounds like a purely positive sum game, in which everybody may gain. In fact, there is little learning without forgetting. Skills and competencies are rejected and destroyed and many people experience decreasing income and influence. Increasing rates of learning and innovation lead not only to increasing productivity and income but also to increasing polarisation in terms of incomes and employment.

It is true that it does not have to be like that. Different types of policies might counteract the tendency. But the tendency is, certainly, inherent in the learning economy and counteracting policies are in more short supply in the South than in the North. Furthermore, a certain amount of stability in the macroeconomic and financial environment, including well behaved, not too conflict provoking, fiscal and monetary policies, is important for interactive learning and innovation. Again, such stability is typically lacking in developing countries.

Above, we have discussed some of the conflicts and contradictions, which characterise the global capitalist learning economy. The tendency in the system of innovation tradition to neglect the political dimension is a consequence of "forgetting" the central role played by these contradictions in the present development process. To use an earlier much used and almost worn out, but now largely forgotten, way of expression: There has been relatively too much attention to the development of the forces of production and too little to the relations of production. We can conclude, then, that the system of innovation approach has to be adapted in some important respects, when applied to the Central American region. To do this is one of the aims of the SUDESCA project.

Lessons learnt about knowledge transfer through the system of innovation approach

It is increasingly being recognised that both the role of knowledge and the problems of knowledge transfer and utilization have been underestimated in development theory and policy. However, the idea that information and knowledge can float more or less freely between countries and that the costs in this connection are small and are presently being further reduced by information technologies and the internet seem still to have some prevalence both among policymakers and in the academia. It is therefore important to get more realistic and precise knowledge about knowledge transfer. In the first part of this

paper this was discussed on a general level using the concepts of knowledge asymmetries and levels of knowledge transfer. The second part was devoted to some contradictions in the learning economy, which affect knowledge transfer. In the third part the system of innovation approach and the need to adapt it to developing countries was discussed. In this final section some more concrete experiences from the SUDESCA project will be discussed.

It should be noted that the discussion is preliminary. Enhancement of research capacity is by its nature a long-term process, not the least the part of it that involves knowledge transfer. Interactive learning requires mutual trust and understanding, also when it takes place on the research level. Time is here a resource in its own respect and the returns on the investment in trust that have been made can only be realised over a longer time perspective.

It should also be underlined that SUDESCA is a small-scale project with a rather limited budget. This means that most of the project participants can only allocate a small part of their time to the project. This prevents a concentration of attention on the project for extended periods of time, which must be regarded as a hampering factor. However, it should also be recognised that a certain amount of synergy between different more or less parallel projects have been noted in some of the participating research organisations.

In the beginning of this paper the phenomena of different levels and asymmetries in processes of knowledge transfer were discussed. In the SUDESCA project we are in fact dealing with knowledge transfer between four different countries – two from the south, one from the north and one in between. Furthermore, there are six research groups involved, which all have different goals and research traditions. It seems, for example, that the Central American tradition is a bit more action oriented than what is common in Denmark because of more pressing political agenda. This forces research to try to at least give the impression that it is immediately useful in order to get funding. There is also a pressing need to establish contacts and co-operation between the research community and other sectors of the society. Even if this implies a substantial learning potential it also, needless to say, makes the intercultural learning process rather complicated.

Already when the project started in 1996, it was clear that the involved researchers in Central America and Denmark shared values about the importance of increased competitiveness and social and ecological sustainability. Furthermore, both sides were sceptical about the usefulness of mainstream neo-classical theory in this context and wanted to apply a more dynamic, process-oriented approach. These shared values and methodological preferences had been discovered through a small pre-project before the main project started and must be regarded as important preconditions for a successful communication and co-operation. In spite of this it turned out that interactive learning by research co-operation was not that easy.

One problem is that the IS approach is part of a research paradigm (institutional and evolutionary theory and economics of technical change), which does not fit very well into the existing Central American tradition. This tradition is, in terms of economic theory, rather neo-classical with its intellectual inspiration coming from North America. This

makes communication with colleges and diffusion of the results from the SUDESCA project a bit more difficult. The difficulty should not be exaggerated, however. In fact, it seems to have been motivating to work in a critical tradition and being, in some sense, on the research front. When, later, it turned out that colleges in other Latin American countries were also working with systems of innovation, this also increased motivation.

To work within a new research paradigm, which is still not well known in the intellectual environment of the research group, makes it important not to change the project staff too often. Every new member of the research team has to use time to learn this way of thinking and get used to the concepts. Frequent changes of the team can become very costly. The SUDESCA project has had to cope with such costs, but so far the project has been lucky in this respect and the staff has been relatively stable.

In the beginning of the project it was difficult for the researchers on the Central American and Danish sides to look at the project and its intentions in the same way. The Americans tended to regard it as a kind of consultant job while the Danes looked upon it more as an example of learning by researching in an interesting part of the world. On several occasions discussions about the project design were interrupted by a Central American researcher saying something like: "Well, if you want us to do all this, we have to have more funding". This was both surprising and a bit frustrating for the too naive Danish "responsible party". It has taken some time to build up a sufficient amount of mutual trust and knowledge about the working conditions and styles on both sides of the Atlantic in order to be able to calibrate the ways the participants look upon the project and what to expect from it. In the process it has become obvious that the Danish party has had to learn much more about Central American economic structures and institutional frameworks in order to be able to communicate efficiently with the Central American parties. Also the two Danish research groups have had to improve their mutual communication and co-operation.

Lack of trust and insufficient knowledge about each other between different co-operating individuals and groups is a problem, which can be found not only within specific research projects, but also on the macro level of society. Specifically, in Latin America there seems to be some distrust between universities, government bodies and private enterprises. Active and sustained co-operation between these three parties is not very common. Even within the single university the different departments seem to be relatively isolated from each other. This is a serious drawback for a research project, which, like SUDESCA, needs data on decision-making and learning within the government and private sectors. In order to understand the anatomy and change of a national innovation system you need to communicate with these sectors. Ultimately, in order to build a well performing innovation system you need communication and co-operation between all three sectors.

The development of ICT and the Internet are now changing the possibilities, benefits and costs of knowledge transfer. Some observers expect this to make it easier, quicker and cheaper. In the SUDESCA project we have also been affected by IT revolution and have already experienced that it has become more easy to keep each other informed, plan seminars, cooperate in writing papers etc. We have also observed, however, that most of

the time consumption in intercultural learning (which is the essence of knowledge transfer) still remains unaffected by the ICT revolution. Collecting field data, reading and writing, for example, takes just as much time as it used to do. Sometimes the ICT revolution seems to create expectations of time savings and access to data, which, when they are not realised because of hardware and software problems, lack of competence, shortage of time, etc. lead to frustrations and communication breakdowns.

Expenditures on ICT hardware and software is now demanding an increasing share of the project budget. This will without doubt lead to considerable improvements in terms of access and transfer of information. Hopefully, we will also be able to improve the efficiency of our interactive processes of communication and learning. In fact, this is the reason for present efforts to launch a support project, which will investigate how ICT may enhance the co-operation and mutual learning within the project as well as between the project and other organisations and research groups. One of the ideas is to create a so called virtual learning community.

But we will probably also experience that the efficiency of the ICT-based systems for communication and interaction depends just as much, or more, on organisational and institutional change as on technical possibilities and that there are only limited possibilities too substitute ICT for time in interactive learning. The hypothesis is that time will remain a resource in its own respect in processes of intercultural learning.

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Danish Research Unit for Industrial Dynamics

The Research Programme

The DRUID-research programme is organised in 3 different research themes:

- *The firm as a learning organisation*
- *Competence building and inter-firm dynamics*
- *The learning economy and the competitiveness of systems of innovation*

In each of the three areas there is one strategic theoretical and one central empirical and policy oriented orientation.

Theme A: The firm as a learning organisation

The theoretical perspective confronts and combines the resource-based view (Penrose, 1959) with recent approaches where the focus is on learning and the dynamic capabilities of the firm (Dosi, Teece and Winter, 1992). The aim of this theoretical work is to develop an analytical understanding of the firm as a learning organisation.

The empirical and policy issues relate to the nexus technology, productivity, organisational change and human resources. More insight in the dynamic interplay between these factors at the level of the firm is crucial to understand international differences in performance at the macro level in terms of economic growth and employment.

Theme B: Competence building and inter-firm dynamics

The theoretical perspective relates to the dynamics of the inter-firm division of labour and the formation of network relationships between firms. An attempt will be made to develop evolutionary models with Schumpeterian innovations as the motor driving a Marshallian evolution of the division of labour.

The empirical and policy issues relate the formation of knowledge-intensive regional and sectoral networks of firms to competitiveness and structural change. Data on the structure of production will be combined with indicators of knowledge and learning. IO-matrixes which include flows of knowledge and new technologies will be developed and supplemented by data from case-studies and questionnaires.

Theme C: The learning economy and the competitiveness of systems of innovation.

The third theme aims at a stronger conceptual and theoretical base for new concepts such as 'systems of innovation' and 'the learning economy' and to link these concepts to the ecological dimension. The focus is on the interaction between institutional and technical change in a specified geographical space. An attempt will be made to synthesise theories of economic development emphasising the role of science based-sectors with those emphasising learning-by-producing and the growing knowledge-intensity of all economic activities.

The main empirical and policy issues are related to changes in the local dimensions of innovation and learning. What remains of the relative autonomy of national systems of innovation? Is there a tendency towards convergence or divergence in the specialisation in trade, production, innovation and in the knowledge base itself when we compare regions and nations?

The Ph.D.-programme

There are at present more than 10 Ph.D.-students working in close connection to the DRUID research programme. DRUID organises regularly specific Ph.D-activities such as workshops, seminars and courses, often in a co-operation with other Danish or international institutes. Also important is the role of DRUID as an environment which stimulates the Ph.D.-students to become creative and effective. This involves several elements:

- access to the international network in the form of visiting fellows and visits at the sister institutions
- participation in research projects
- access to supervision of theses
- access to databases

Each year DRUID welcomes a limited number of foreign Ph.D.-students who want to work on subjects and projects close to the core of the DRUID-research programme.

External projects

DRUID-members are involved in projects with external support. One major project which covers several of the elements of the research programme is DISKO; a comparative analysis of the Danish Innovation System; and there are several projects involving international co-operation within EU's 4th Framework Programme. DRUID is open to host other projects as far as they fall within its research profile. Special attention is given to the communication of research results from such projects to a wide set of social actors and policy makers.

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