A commented report of the Conference

A TRIPLE HELIX OF UNIVERSITY, INDUSTRY, GOVERNMENT RELATIONS: THE NEW LOCATION OF RESEARCH? (1)

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- GENERAL REMARKS

The Book of Abstracts of the Conference includes 117 papers, besides the one of the convenors - Henry Etzkowitz and Loet Leydesdorff- that was the Theme Paper of the Conference. The institutional ascription of the first author of the papers gives an overwhelming majority for universities, with a share of 67.5% .

The distribution by institutional ascription of the first author is as follows:

	Number of contributions	%
Universities	79	67.5
National Agencies	22	18.8
Ministries	2	1.7
Research Centres	7	6.0
Private Centres	4	3.4
International Agencies	1	0.09
Private Persons	2	1.7
TOTAL	117	100

As for the region and country of origin of the first author, it appears also a clear bias, in this case in favour of Europe: Western and Eastern Europe considered together account for 52 % of all the papers.

The regional distribution of the first authors is as follows:

	Number of contributions	%
Western Europe	47	40.2
Eastern Europe	14	12.0
Total Europe	61	52.2
Asia	13	11.1
Australia and New Zealand	2	1.7
English Speaking America	23	19.6
Latin America	18	15.4
TOTAL	117	100

The papers came from 30 different countries, 11 West European, 9 East European, 3 Asian, 2 of the South Pacific area, USA, Canada and 3 of Latin America. The individual country with more contributions was the USA, with 19 papers, followed by Brazil with 12 and by the UK and Japan with 8 each.

The overall picture of country origin of the first author is as follows:

Western Europe: UK (8); Sweden (6); France (6); The Netherlands (6); Italy (5); Germany (4); Portugal (4); Finland (3); Norway (2); Spain(2); Belgium (1)

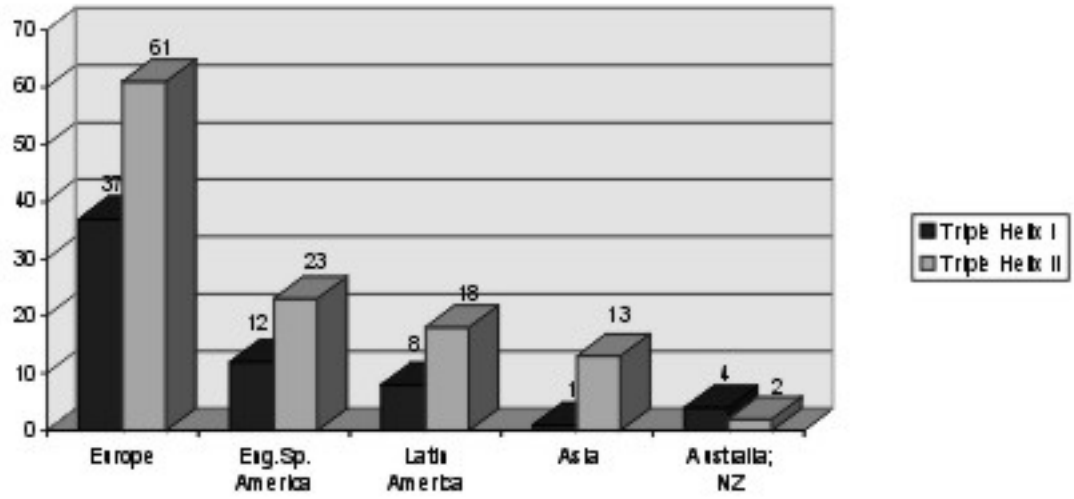
Eastern Europe: Ukraine (4); Poland (3); Bielorusia (1); Czech Rep.(1); Hungary(1); Slovene (1); Bulgaria (1); Russia (1); Rumania (1)

Asia: Japan (8) Philippines (1); India (3)
Australia (1); New Zealand (1)

English Speaking America: USA (19); Canada (4)
Latin America: Brazil (12); Mexico (5); Uruguay (1)
Other features of some interest are the following:

- 100% of the Latin American contributions came from universities.
- 64.3% of the East European countries contributions came from National Agencies -for the most part National Academies of Science -.
- 44.5% of all the papers were co-authored -52 contributions-; 37 of them came from authors from the same country and the same institution, 5 came from authors of the same country but different institutions, 5 came from authors of different countries in the same region and 5 came from countries in different regions. In this last case, 4 of the 5 contributions included a partner from Brazil.

A comparative picture between Triple Helix I (Amsterdam, January 1996) and Triple Helix II (NY, January 1998) shows an important growth from the first to the second Conference:



- ABOUT THE CONTENT OF THE PAPERS

In the midst of such a wealth of approaches, issues and addressed problems, it is not easy to organize "patterns for reading" -what the French speaking scholars use to call a *grille de lecture*-. This kind of patterns is necessary to really get an overall picture of the "state of the art" in the reflection about what is going on with the production and use of knowledge and also with the "production of knowledge on the production and use of knowledge".

The main question is, of course, what the organizing criteria would possibly be. Several sets of such criteria are useful for the suggested purpose: one of them is precisely the one used by the Conference convenors to group the papers in the different chapters of the Book of Abstracts. The exercise we have done is slightly different and could be described as "following similar concepts": the idea is to group the papers that appear to address the same type of key concepts or issues, even if its development is not the main purpose of the paper. In this sense the exercise could be named "looking for common concerns", and the

fact that the concerns founded could be just a comment on the papers says also something about what kind of problems are worrying the writer of this report. In this sense, a third way of naming this exercise could be proposed, like "thinking about the Triple Helix from the South".

- The convergence on the problems that are currently facing the research process in general and the universities in particular

The entrepreneurial university

"Out of a variety of research and teaching formats, in contrasting national traditions, the university is moving towards a new common form in the late 20th century. The entrepreneurial university is emerging in the U.S., Latin America, Europe and Asia as an economic and social actor as well as a research and teaching enterprise." "At least two major trends can be identified that affect the future role of the universities: one is the shift to ever greater dependence of the economy on knowledge production and the second, an attempt to identify and guide future trends in knowledge production and their implication to society". "The first trend potentially increases the centrality of university as a social institution while the second arguably decreases the independence of academia, as inducements are offered and requirements put in place as a condition to funding to shape the university to meet expectations for particular kind of knowledge production and reproduction.". (Etzkowitz, Webster, Gebhardt and Terra) (3)

A first question that appears in the above general statements is, what does "the entrepreneurial university" really mean? Entrepreneurial is such a "heavy" concept, implicating a whole set of tacit meanings as well as cultures, values and explicit success measures, that putting together "university" and "entrepreneurial" deserves more explanation. It can be taken as only a metaphor to stress the pattern of actual changes, but it can also be said in a more direct and explicit way. A second question that emerges is, how universal is this trend? For example, even if it is possible to find common patterns of behaviour in universities itself, is the "ever greater dependence of the economy on knowledge production" a universal trend? And, if it is, is it universal the trend to relate this ever greater dependence to endogenous capabilities? The authors we just quote are well aware of this questioning:

"How far are these new structures transferable across different countries with distinct innovation systems, and different academic traditions? While the globalization of innovation encourages an increasing convergence around certain R&D procedures and practices, national systems of innovation and their distinct styles mean that new university structures will be mediated by local cultures and interests." (Etzkowitz, Webster, Gebhart and Terra)

The Keynote address of the Conference was given by Richard R. Nelson, and the title of his talk was, precisely, "The entrepreneurial University: Whether? Whither? Wither?". Nelson discussed a received truth. Basic research is not being substituted by more short term and directly practical science; there is a broadening of possible outcomes: a new flow of invention reports joins the traditional flow of papers. The real new feature is the actor that

conducts the invention reports towards the proper channels for their follow-up: it is a specialized agent -not the researcher itself-, and this pattern of specialization directed towards the commercialization of research findings is indeed one of the characteristic features of the entrepreneurial university. But this feature is not widespread: some areas are especially touched by this pattern and they are precisely those for which legislation regarding intellectual propriety rights has changed dramatically in the last twenty years (biotechnology, software and electronics). But perhaps the most worrisome remark of Nelson conference was the one related with the possible users of research findings which have increasingly the form of invention reports. Many of this findings are of use for other researchers and not for business; nevertheless, they are "privatized" in an early stage of development while they are in need of further research to be integrated in a development project. The consequences of this pattern of the entrepreneurial university -the intellectual propriety rights claims over early research findings- are worth to rise concern.

Triple Helix and national systems of innovation

Here a quite important concept appears, national systems of innovation, and it is worth reflecting on the degree of similarities between this concept and that of the Triple Helix. If university structures -moulded by its interactions with other social actors- will be mediated by the distinct styles of national systems of innovation, it is arguable that both concepts, NSI and TH, are rather different. If this is the case, which can possibly the main differences between both concepts be? Or, as Sutz and Casas paper asks, which are the "identity marks" of the Triple Helix vis-à- vis national systems of innovation? "There is not any single dramatic difference in the Triple Helix identity *vis-à-vis* the NSI, but nevertheless differences do exist, mainly related to the self perception of institutions -universities, enterprises and the state-, to the perception of each institution regarding the others and to the concrete role these institutions are assuming." "…perhaps the most outstanding differences in self-image, perceptions regarding the other actors and roles assumed are concentrated in the state. The state in the National System of Innovation operates mainly in a widespread way: its duties regarding the innovation health of firms and of the whole country are basically to assure the smooth operation of a smart network of incentives able to push each part of the system into the innovative road." "In the Triple Helix, the role of the state undergoes some changes. The problem is no more just to get the innovative milieu right, but to shape the course and the direction of the innovative behaviour at the micro and institutional levels." "In other words, the state of the NSI is a supplier of conditions for innovation while the state of the Triple Helix is an interventionist agent in the relationships between universities and the productive sectors." (Casas, Sutz)

Techno-nationalism versus techno-globalism

More in general, there are doubts about the result of the trade off between "techno-nationalism" and "techno-globalism" (4) Coming out of a recent OECD study, the following conclusion is put forward: "Important differences in structures, funding, performance of research systems can be explained by key factors that pertain to socio-cultural backgrounds, organisational heritage and techno-industrial specialisations." "At the same

time converging trends are noticeable as a result of the globalisation process, common problems such as reduced government budgets, and diffusion of best practices." (Aubert)
Other presentations elaborate on the same vein:"General theoretical treatment of university-industry-government relations have implicitly assumed that basic university-industry-government relationships around basic and applied research are fairly similar across nations and that 'national systems of innovation' can be treated as if they were relatively autonomous entities." "Furthermore, though traditionally most authors have relied on the underlying 'rationality' and 'unity' of science and technology to link communities homogeneously across the globe, more recent work has argue that science and technology are more heterogeneous in practice than is commonly supposed and that macro civilizations such as those found in Western Europe and North America, in the Near East and in East Asia have a more important influence on the nature of the economic and technological order in different parts of the globe than is commonly appreciated." (Kaghan) The empirical part of this paper, based on work experience on a technology transfer office at a major American research university, "discuss some of the 'civilizational' differences in relationships between educational, government and commercial sectors in Korea (as representatives of East Asia civilization) and the United States (as representative of Western civilization) and the sort of difficulties that these differences are likely to create for cross-cultural/cross-national research relationships between the different sectors involved in the triple helix." (Kaghan)

A similar remark is related with the East European situation and an attempt is made to demonstrate "the importance of cultural factors, both local and transferred.": " The after-1989 participation of multinational companies in the late industrialization of the Post-Socialist Eastern Europe is an interesting test case for the investigations of the real depth of globalization processes in general. Industrialization is described as a historical succession of periods of pervasive adoption of clusters of technological and organizational innovations. The resource and environmental intensiveness of different industrial paths is influenced by a mixture of different national and company styles and the emerging industrial landscape should be conceptualized as a mosaic of those technology clusters. Are the multinationals in Eastern Europe now in this process carriers of until now unknown management techniques and transfer agents of distinctively new values in the region and/or are they the actual buyers on a final sale of accumulated results of an former isolated or autochton technological culture?" (Tamas) The answer is a mixed one and some features are interesting indeed: "the foreign firm's crisis-handling strategies are very close to the local ones. Their time horizon, technological innovativeness as elements of the structural change in most cases imitate the local business culture and distinctively differs from the same firm's technological policies in the core countries."

The future location of research in East Europe and Latin America

Differences also have to do with the fact that every nation has universities but not every country has well structured systems of innovation: how could we envisage the future location of research in such desestructured contexts? This question is an important one in all the Latin American context, but not only there. In one of the relatively few contributions from Eastern Europe coming from university, the Polish situation regarding the adjustment to European standards in science and technology is described as follows: "A much lower

level of expenditure on R&D both per capita and as a percentage of GDP (now much less than 1%); A different approach to science. The predominant approach assumes that it is easy to make economies of science instead of an approach which tries to answer a question: How to capitalize on the national science in the long term?; A small variety of forms and methods of carrying out research and research co-operation between disciplines, especially in social sciences; A different predominant model of innovation processes. In Poland, a linear science-push model still predominates; A very low level (intensity) of science-industry cooperation, results of which are, among other things, a narrow and slow industrial implementation of R&D results and the diffusion of technological innovation; A narrow range of international research co-operation." (Jasinski)

Perhaps the difference between this pattern and the Latin American one, even if it reflects so much of the LA situation, is related to the concept of the linear science-push model: in Latin America this model is adopted by defect and not explicitly, that is, in the absence of sound industrial and technological policies directed to foster demand for research results, everything happens as if this model was the dominant one. But nobody can say the Latin American situation is describable in terms of "science-push".

The tuning between Latin American academic landscape and the Eastern Europe one can also be seen from a formerly East Germany contribution: "Our analysis of newly established research institutes in East Germany have shown that a strong orientation towards the application of research has continued. This has less to do with political pressure than with significant financial pressure (consideration of the interests of the funding bodies). The increasingly strong involvement of the academic sector (both universities and publicly funded institutes) in applied research means that a continuing shift in the spectrum of research topics dealed with must also be reckoned here. This will have a long term impact on the cognitive profile of research. This tendency is strengthened by the short-term framework of the research projects and contracts. In contrast, larger projects, based on many years of study, are increasingly being pushed into the background. What impact this move away from curiosity oriented topics will have on the research landscape remains an open question." Till now, this description is not particularly East German or Uruguayan, but rather general, and perhaps all over the world academic researchers could agree that it gives a good description of their own situation. But against this framework there appear more specific "underdeveloped" features: "Basic research within disciplines must meet international standard but often lacks the necessary facilities and other preconditions to do so. On the other hand, the partners in industry required for more innovation oriented activities are no longer present. This raises questions about the structure and future of national research in many countries or regions in Eastern Europe." (Meske)

University and industry, problems and policies

The same kind of comments about divorces between policy written re-orientation and conditions for fulfilling the proposed goals came from former USSR countries like Ukraine, a country that following the latest World Bank report is still the larger in the world in terms of number of engineers and scientists per capita but has "the problem of how to use existing resources of scientists and engineers more effectively in the situation of economic crisis

and low demand of R&D results from the side of industry" and where dynamic sectors like "electronic and biotechnology were proclaimed as priorities, but they hold no adequate support for their development." (Egorov)

In that "impasse" situation someone has to be blamed. In Latin America it is very often heard the advocacy against the stubbornness of universities ivory towerists researchers that wouldn't even try to get closer to the demands of the productive sectors. Like a direct answer to this, Indian scholars wrote: "Industry needs courageous ideas, but they have to support such projects and proposals. It is not constructive in a society to criticize that the University output doesn't attend to the needs of the industry without giving them a helping hand." (Sachidanandam, Bilgrami and Bhaskara Rao)

Nowhere is industry alone able to give this helping hand. That is why organizational changes "Triple Helix like" came into being. Incentives from public money are one of the ways to help. In Brazil a wealth of measures have been developed to induce and foster research -industry cooperation, and some of them have had quite powerful effects: "…for instance, the U$S 1.9 billion in R&D programs committed by industry and agriculture during the last four years in Brazil under the tax incentive Law 8661 brought about many opportunities for creative forms of co-operation. One example is Poema ('poem' in Portuguese), an acronym for an R&D co-operation project between the Mercedes Benz local subsidiary, the Federal University of Pará, and an organization of small producers of babassu (a Brazilian palm tree) and other natural products, which are now used to 'tropicalize' auto-parts." (Plonski) But these kind of arrangements are not without problems, in the sense that they are part of a wider regional policy that rises ferocious wars between states to attract high-tech companies, foreign direct investments and other supposed vectors of prosperity. And this type of concern is shared also in the USA: "Supporters of state and local subsidies and development incentives for high tech industry claim that these programs are necessary to create a positive atmosphere for future economic growth. This, they argue, results in the attraction of new firms to the state, the retention and expansion of existing industry and ultimately, the creation of high paying jobs. Such logic however has led to intense competition between states for high tech investments leading to often irrational giveaways with no guaranteed returns." (Federenko and Bereano)

Another feature of the issue of "giving a hand" is the problem of ill conceived policies, defined with a poor understanding of how the innovation process behaves, either in a national basis or in a sectorial one. In this sense, the following comment, even if coming from Australia and mainly directed to the biomedicine field, could quite well have been written in many Latin American countries: "Increasing interest by governments in driving greater economic growth through leveraging university research and translating it into commercial activity has meant that some kinds of networks have been deliberately created by government as instruments of economic policy. These include policies which links private firms and public researchers into centres such as the Cooperative Research Centers in Australia and affect the funds available of researchers in the biomedical field. Such Centers are one instance of collaboration between private and public sector partners. The notions lying behind their creation rely, however, on rather limited theories about the role in innovation of other important players and neglect many dimensions of interaction between the four set of players -users, producers, researchers and government regulators- which critically affect the outcomes of network innovative activities and which link players

into ‘innovative complexes’.” Moreover, “…both the nature and the operation of the innovation networks and the nature and outcomes of the innovative activity generated can only be understood in the broader organizational and policy/political context. Not understanding this is a critical reason why many policies for research commercialization are less than successful.” (Marceau)

Another wave of almost worldwide recognizable patterns are that related to policy options. “Small countries like Finland face a permanent problem in trying to strike a balance between their national R&D interests and priorities, on the one hand, and international developments in science and technology, on the other. On the level of science policy decision making, there is further strategic dilemma of choosing between strong priority policy (i.e. selective concentration of resources on key areas) and a policy of more equal opportunities. Should science policy be highly selective and concentrate resources on reaching the international forefront at some specialized areas or should it support the development of a broader national R&D competence in the first place? Obviously there are no easy or clear-cut answers to these questions.” (Kaukonen and Nieminen) A small country in Latin America like Uruguay faces, in the realm of its university research council, the same type of dilemmas. And perhaps the analogy can go further to reach not so small Latin American countries, because it is not clear if the key issue is the size of the country or the size of the research community within the country.

Other reflection from these Finish authors is related with the relative strength of the interaction between the helices of the TH: “The institutional developments also vary on national base. We estimate, for example, that in Finland the less developed links in the R&D matrix are in the areas of interdisciplinary (academic) and intersectoral (governmental) co-operation, mainly due to institutional constrains...” This is an observation that could have been written for Uruguay, out of a recent research on the institutional approach to the country system of innovation. One difference with Finland, though, is that entrepreneurial co-operation is quite weak in Uruguay.

Some times -and we get acquainted with it by mere chance-, researchers in different countries address similar questions in the context of similar problems. This is the case with Pirjo Niskanen in Finland and Hein, Mujica and Peluffo in Uruguay, regarding what academic researchers say about why are they interested in “business oriented projects” involving external partners. The general framework is equally valid in the very North as in the very South: “In recent years, interaction between industrial and public sector, especially academic reset, has increased. This trend is to a greater extent due to societal and economic demands and to an ever more severe competition for research funding” (Ninkonen) And also similar are the type of answers: both the Finish researchers involved in EU sponsored joint research activities between industry and public research institutes and Uruguayan university researchers involved in specific research funded by industry said that the main objective of their work was to provide new scientific knowledge. In the Finish case, research funding ranks in third place among the main objectives declared; in the Uruguayan case in the fourth place. The second objective for the Finish was European collaboration, while the second and third objective for the Uruguayans was the better knowledge about the productive reality of the country and the improvement of teaching brought about by the research. If we take for a moment these results as trends, we could be

quite optimistic about the possibility for researchers to get closer to industry without changing their old soul.

The “new location of research” is really new or could it be better characterized as “old location of research facing new policies”? A Canadian answer goes as follows, regarding the “policies developed since the mid-80’s in order to orient public research institutions (PRI) towards more direct industrial relevance”: “Although most of these PRI are new, they emerged from previous institutions and succeeded in getting funds because of their previous activities as important research groups.” “The same applied for university-industry, those which had previously established university-industry relations were more successful.” (Dalpé and Ippersiel) This situation seems to be rather widespread suggesting that there are no two institutional worlds of public research, an old one relatively stable and hard to change and a new one invested with the new philosophy of more industrial relevance. The situation rather is that of new institutional set-ups and forms of governance built upon old experienced institutions, which means built upon “old” people. And this “old” people, all over the world, seem to share the fears reported in this Canadian paper, fears related to “the important negative impact of outside intervention” and “centred around the traditional lower support of the private sector for pure research and its tendency to favour ’privatization’ of research results.”

Coming from an Swedish “hybrid” academic setting -a computer supported co-operative work-, we can find an echo of these fears, related to “questions as the impact of increasing collaboration with industry on intellectual property, academic freedom and responsibilities, the relation between research and teaching, the difficulty of demarcating where research should leave off and product development begin, how much transfer is necessary or desirable, etc.” (Heaton)

These type of concerns can be structured around a set of questions and problems that academic research milieus are addressing all over the world: “a) Strategy: how to imbalance blue sky research, contracted research, and joint developments; b) structure: how to professionalize interfacing structures that respect the academic ethos of each university; c) institutional: how to comprehend university-industry co-operation in career and department evaluation; and d) negotiation: how to change from a cost to an added value approach” (Plonski)

But even if these kind of questions and concerns are in need of new formal arrangements, other things, more subtle and difficult to achieve seem to be the key challenge: “The transfer of knowledge occurring in a university-industry relationship is characterized by high uncertainty. The development and enforcement of a complete contract are therefore very problematic, requiring a high degree of mutual trust.” “In the case of university-industry relationships, conflicting interests and cultural barriers make the development of trust relationships very difficult and the different organizational and contractual arrangements used affect both system and personal trust. Trusting behaviours have been proved to be essential in facilitating knowledge exchange and co-operative creative efforts. Therefore, the success of these new arrangements governing the production and diffusion of knowledge will depend on their ability to promote trusting behaviour among the parties” (Ferraro and Borroi) This is a reflection surely inspired by the European reality, but it points to a probably universal trend. At least in Uruguay, research conducted on university-

industry relations shows clearly that mutual trust was a fundamental part of both the relation in itself and the success in the project development. The only problem is that trust was "biased", because the relation in all the cases was established between peers, that is, not between academics and entrepreneurs but between academic researchers or engineers and "enterprise" researchers or engineers. But for this to exist at all, there must be researchers and engineers in both sides. The question -also a quite universal one-is then: is the university going to be able to establish trust relationships with the productive structures of SME that are at the same time the vast majority of enterprises, one of the most important providers of local jobs and the weakest part of the economy in terms of their contacts with formalized knowledge?

On the location of frontier research

A last issue in this "comparative concerns" exercise is related to the new location of frontier research in the globalization landscape. The explicit warning came from a British paper dealing with the problem of research equipment in the UK universities, squeezed between the "…decreased levels of public funding for research and the increased importance of complex and expensive instrumentation for scientific research." (Nedeva, Georghiou and Halfpenny) They add that, following recent surveys "…there is a positive 'sophistication' effect, whereby the real price of the equipment required to remain at the forefront of science is rising, despite the productivity gains from innovation in key components, notably electronics". The result of this trend seems to be " that the scientific equipment and facilities in UK universities are insufficient; these are getting old and obsolete which affects their performance, reliability and conformity to safety standards and regulations; and university research is hampered by this situation." A good deal of British industry seems not to be very worried about this situation and its probable negative impacts on young science and engineering graduates. (5) But some firms are worried indeed, and what they say evokes all the troubles associated with globalization: "We recruit and collaborate with academia world-wide. Clearly, the decay in academic infrastructure is affecting the competitive position of the UK in supplying these services to us." But it seems that not only some British firms are looking elsewhere for their collaboration with academia due to the "equipment problem": some British academicians are also looking abroad to perform research for the same reason. "Brain-drain warning over UK lab facilities" was an article in Nature -29 January 1998- reporting that an increasing number of Britain's brightest science graduates are willing to seek positions in the USA. "People who want to do research degrees will go to the United States, not because there is more research money, but because the research facilities are vastly superior to what we can provide. There is already a vast gap, and it is very important that that gap does not get any bigger." It is easy to imagine the situation of countries that, unlike the UK, have to deal not only with research facilities vastly superior to theirs but also with research money and personal incomes from academic research in orders of 5 to 1 or 10 to 1. So, the problem of the new location of research is not only an "internal" one, expressed in terms of a shifting balance between public and private or between academic and entrepreneurial. The problem has also an international dimension. Are we going to witness new geographical clusters of frontier research? And from a development perspective, will the long standing underdeveloped

countries marginalization regarding the "main science production" be substituted by plain exclusion?

- Is the Triple Helix a "complete" concept?

Some contributions at the Triple Helix II Conference rise the question of the degree of "sociological accuracy" the concept bears; in other words, does the Triple Helix account for all the main actors involved? In her intervention at the Conference, Joske Bunders, from The Netherlands, puts forwards the question of users as a missing category in the Triple Helix conceptualization. "The Triple Helix model replaces the well-known and strongly criticized linear model for innovation. Analysis of the complexity of interactions between different actors, lacking in the linear model, receives due attention in this new model. The focus on university-industry-government relations, however, bears the risk of ignoring the important contribution of other relevant stakeholders to the learning processes which often occur in complex technology development trajectories. Learning processes among many different stakeholders are particularly required when embedding of a new innovation needs to take place in a complex local context. Such learning processes can be achieved through implementation of an interactive approach. Principles of such an approach are: the entire innovation process is end-user driven, feedback mechanisms are created, mutual learning is facilitated, coalition building is enhanced, and intermediaries guide the process." Her reflection is inspired in a "pro-active" research related with biotechnology and rural development in Africa and Asia: " …(the small-scale farmers) knowledge, gained through generations, should be inventoried and harmonized with modern science to evolve a diversified technology base. Researchers must accept that they need to learn from the farmers and to build on farmer's innovation. But the farmers too must fill gaps in his or her knowledge and learn new technologies that will underpin sustainable gains in production." (Bunders *et al*, 1996, p.20) The advocacy here seems to be for the inclusion of two-sided user-producer relations -in this case user-researcher relations- as a sub-loop in the Triple Helix.

Another approach that stresses the importance of users is that presented by Laredo in quite a radical way: what happens when the actor that commands research is not representative of industry -even if the commanded research could have impact on what industry will ultimately produce- and has constituted itself as an actor in an antagonistic relationship with government? This seems to be the case of patient associations and of "…their overwhelming role in the few research areas on which they have concentrated: it is commonplace to speak of Cohen, his gene map and genethon, but all of this has been made against government priorities, with the sole support of patient association." "…the reasons people support the association bear very much about the fact they do not trust the state any longer to be capable to handle any matter that is specific (and thus near to the people)". "These transformations even enlarge the triple helix model not so much through the addition of another dimension but through a renewed understanding of 'collective action' and their 'operators': the implicit association between the former and national government no longer stands." (Laredo)

Both Bunders and Laredo, from very different frameworks, seem to converge to a problem in the Triple Helix conceptualization related to the question of the research agenda: in some important cases the definition of the agenda includes some actors that are not fully taken into account in the university-industry-government relations model.

In another vein but addressing both problems -more actors and the agenda setting- goes a contribution that tries to understand the relations between research, production and government through an "audition system in performing arts" model. The idea is that in the performing arts there is a key actor, the producer, that is responsible for the agenda setting, in the first place, and to propose this agenda to the players and the sponsors that will fund the play in the second place. Once the agenda is agreed upon -the ex-ante evaluation of the proposal- he organizes the gathering of the players and the use of the funds; the ex-post evaluation is made by the audience once the play is performed. This "audition system" model, once applied to R&D, puts a strong light on "the producer", the actor that proposes the research agenda and gathers researchers and sponsors to agree upon it; the other actors are sponsors, clients, researchers and also "the audience", that is, those "…who are expected to receive the research outputs". (Kobayashi, Wen) Even if in the abstract the authors do not mention any example, it seems possible to imagine that "the producer" can belong to the most different institutional arrangements, adding complexity but also flexibility to the Triple Helix idea.

- The role of the users in the Triple Helix or the problem of the setting of the research agenda by social demands

A quite explicit attempt to relate social demands to a research agenda is made in a case-paper in which demand is represented by the government in its role of regulator -as Marceau had pointed out- and where the aim is answering "how the change in environmental regimes, especially the banning of CFC, has influenced the field of heat-pumping technologies" (Naesje). The amount of empirical work is impressive: "some 6.700 publications in the heat-pump area for the period 1986 to 1996" were examined. In this case "the user" is planet earth, represented by governments assuming they regulator role, probably pushed into this role by environmental movements.

The role of government as regulator can be seen not only as related with the setting of the research agenda, as in the previous case, but as the "voice of the voiceless", that is the users. In this case, a big question indeed is the one that asks "(which is) the place for social accountability in the working of the triple helix." (Morris) This question arises from a study on biomedical research, a field in which "there is general acceptance that involvement of the commercial sector is an effective, indeed an essential, step in assuring that the results of biomedical research reach the public in the form of health care products and treatments." When the question of innovation is the main focus, one can speak of "the relative ease of the transition, in the biomedical field, to a new model of government- industry- academia working in support of innovation…"; but when the focus shifts to the government role as regulator, a separate role regarding the triple helix, things became much more complicated. "With regard to the development of medicines, though, government has a separate, central role which is quite distinct from its mission to further economic advancement- that of

protector of the public health against unsafe products." "How far does this left hand know what the right hand is doing?" This question is a structurally complicated one, being mentioned among the issues at stake the problem of "i) the lack of structures to enable the control function to keep pace with innovation; ii) the future location of research, currently undertaken under public sector establishments and iii) the transfer of functions previously undertaken by government to the private sector" (Morris)

In some cases, the role of the users and the setting of the research agenda by social demands are unmistakably clear. One of this cases was the Scandinavian Utopia project, "an experiment in workplace democracy organized in collaboration with the Nordic Graphic Workers' Union", developed in the early 1980s. Building on this experience, some Swedish university laboratories converged into Computer-Supported Cooperative Work projects, which are inherently interdisciplinary "sites of intersection of numerous actors and forces". Finally, in 1996 a new institution was established: the Center for User-Centered Information Technologies Design (CID). The Utopia project "gave several key Lab members, then computer scientists in a mathematically and theoretically oriented department, their first experience at working interdisciplinarily, as well as their first industrial contacts. Since then, the value attached to collaboration with a wide range of partners has helped the Lab develop and maintain industrial contacts that are reactivated from project to project." In this case the social demand to the Center was explicitly formulated by the government, a main factor in its institutionalization: "to contribute to an improvement of the working environment for employees at all levels…CID aims finally to make IT available for a broad range of users irrespective to education levels and special needs." (Heaton) But the setting of this "social agenda" has been put forward by the government because the Utopia experience demonstrated that it was possible for technology to be built upon workers demand and not only from management design. The Utopia project was Triple Helix like, but the relations were established between universities, trade unions and government: its inheritance seems to be crucial in the actual CID working system, research agenda included.

A model that takes into account the social demand in the setting of the research agenda is the one named Incentive Chain Model (Hayashi and Hirasawa). The focal points in this model, that are networked by different kinds of links, include: university (basic research), national labs and other type of labs (R&D), industry (products supply), government (coordination), and society, which function is demand and purchase and which relation with government is given through the articulation of social needs. The model allows to analyze "whether or not an output of one actor's operation becomes an imput (incentive) of another actor's operation. If this chain of incentives consists of a closed loop, the technology can develop autonomously. But if not, that is, if incentive chain is cut off or the loop has the disincentives inside, the technology needs governmental support to reinforce incentives or to eliminate disincentives."

This statement seems to be a whole program for public policy, particularly for policies directed to put in place Triple Helices of research-society-government relations able to develop in closed loops, in the above mentioned sense.

- The role of public policies

The public policies branch of the Triple Helix is one of the most active and direct modeller of the academia-industry-government relations and many of the contributions to the Conference address this issue, some with a comparative aim and some regarding particular situations.

A main question regarding innovation governance through Triple Helix like arrangements has to do with a policy cross-road: should the state point to a macro policy aimed at "getting the innovative milieu right" or should it rather have a more micro interventionist policy? A paper comparing the role of the state for generating biotechnological innovations in Germany and in the US states that: "Whereas Germany has pursued a model of direct intervention to support biotech innovation in industry and academic research institutes, the US pluralist approach of empowering the context for innovation has been by far more successful." "…the incentives given to various factors of the US system of biotech innovation were more appropriate to bring academic research results from the biotech laboratory onto the market." (Giesecke)

It seems that the Swedish public policy regarding biotechnology is nearer to the German style than to the US one: the Swedish government policy for Biotechnology Process Technology "was explicitly designed to support industrially relevant research and also to explicitly bring together university researchers and industry researchers through combined government and firms financing (Nutek, 1997)" (McKelvey and Persson) Sometimes both public policies and private responses are so in tune that it is possible to assert, as in the case of the fifth Swedish biggest city: "The development which has taken place in Linköping during the last 30-year period can be likened to the spiral where success begets success." Even if one of the explanations lies in "the researchers, university students, and people from other high-tech milieu who have diligently been starting their own firms (it is estimated that there are about 400 small computer companies in the Linköping area)" it is also true that this was fostered by the kind of micro industrial policy that is characteristic of the European intervention pattern: "the formation of effective and progressive support organizations for technology-based firms (Mjärdevi Science Park, The Foundation for Small Business Development and the Centre for Innovation and Entrepreneurs)". (Klofsten and Jones-Evans)

US policy style on the one side and Germany and Sweden policy style on the other side: it seems a too scarce evidence to jump into conclusions. But when a contribution aimed at comparing industrial policy in Europe and America confirms the trend it is possible to be more confident on the generalization.

"Why are specific micro-economic policies and programs to foster commercial innovation taken for granted in Continental Europe but looked askance in the U.S.? Industrial policy (IP) is a forbidden concept virtually across the entire American political spectrum. Government actions to assist industry are viewed as an illegitimate interference in the market and are depicted as an attempt to 'pick winners' among companies and technologies, a selection process that government is held to be inherently ill suited to manage.·" "Nevertheless, despite the unwillingness to explicitly frame policy measures under this rubric, an industrial policy has been put in place at the federal level in the US as a result of actions taken for other purposes or through measures to achieve the goal indirectly…" "Despite the widespread US belief in the market as the arbiter of innovation,

government subsidies have been key to the development of such industries as aircraft, oil and atomic energy. There is an accretion of programs to deal with particular industries issues, assisting small firms, helping industries in trouble, e.g. semiconductors in the face of Japanese competition in the late 1980'. There are also industry policy implications of policies directed towards other problems, e.g. national security and health." " Thus an immanent industrial policy exists in the US through the accumulation of precedents and programs."

"European national governments, on the other hand, accept a role in subsidizing and otherwise encouraging innovation in national firms as part of their normal responsibilities." "It is expected (by company R&D executives) that a significant part of their resources for commercial innovation will be provided by national governments. From provision of R&D funding through national foresight exercises to identify future technologies, government plays a leading role in industrial policy in Europe that US observers both deplore and wish to emulate." (Gulbrandsen and Etzkowitz)

The final idea is that this diverging patterns are now rather converging: "Europe and America are converging on common policy agendas, each borrowing from the other." Perhaps what is happening is that the US continue to do almost the same as always but more openly, given the lowering of ideological barriers and Europe, without changing former micro interventionist industrial and innovation policies is willing to act "filling the gaps" at a more general policy level, particularly related with regional innovation policies, fostered by the unevenly distributed unemployment problem. But nevertheless it seems that differences, rooted in long standing historical traditions, continue to be present.

Some of the instruments developed in the US are indeed in an openly public policy vein. One of them, the Cooperative Research Centers, "autonomous structures, established at universities, and whose operation is supported by the government and various enterprises", has become an inspiring structure for other realities, like the UK, France, Japan, Canada, South Korea and Australia. And it is interesting to note that the American CRCs are now 25 years old.(Stal) Research policy in Europe, on its side, has been dealing with the challenge of the small size of each national research effort if compared with the amount of money spent by the US -both at public and private level-. This has not be an easy challenge, neither from the pure research perspective nor from the innovation one: "In Europe, research infrastructures are often characterized by inadequate pooling of resources for researching new generations of techniques, much duplication and lack of complementarity and heavy limitations on the mobility of transnational users." Moreover, "the need to focus on the scientific tasks for which infrastructures are created can act as a strong disincentive to pursue hi-tech innovations per se and to further exploit them or simply diffuse them." One of the answers developed by the European Commission regarding these problems has been to organize a series of thematic networks -called Round Tables- "that bring together large-scale national facilities of the same type and representatives of their users, including users from industry." It appears that from such infrastructure cooperation networks it emerges "a paradigm for technological co-development based on transnational and transdisciplinary mobility, at the European level, of researchers and technology suppliers acting as vehicles of new ideas….the generation of critical mass for the development of new techniques, the promotion of complementarity and

interoperability of infrastructures, the creation of distributed 'virtual' facilities (and) more generally the creation of a new culture of cooperation." (Malacarne)

A quite recent and rather radical exercise in changing public policies devoted to science, technology and innovation is the New Zealand one. The reform process was fostered by a complex of factors including "a change in political leadership which brought a new government,…the influence of free-market thinking coming from other countries,…the election of governments with similar reforming agendas in the USA, UK and to some lesser extent Germany (that) provided enormous leverage for the New Zealand approach…" (Reeve and Davenport) It appears that "the guiding principle for the changes to governmental institutional structures has been the separation between the funding of services, the provision of services and the development of relevant policy advice", formerly highly centralized. The policy part of the reform was implemented through the creation in 1989 of a Ministry of Science and Technology "to manage the development of policy and to set the strategic direction"; the separation of the funding function was achieved through the establishment of the Foundation for Research Science and Technology. As to the provision of services it seems that the reform operated through the transformation in 1992 of formerly research performed in governmental departments to a series of Crown Research Institutes, "empowered with a great many of the freedoms of private sector companies such as the ability to borrow funds and form joint ventures" even if they also are "required to act in a manner which was to the benefit of New Zealand." "The effect of the changes has been to synthesize a market for research", in which the Ministry acts as a purchaser through the priority setting process, the Foundation create programs of research out of these priorities and the research is performed by "so-called science-providers". A market scheme indeed….The evaluation comments goes as follows: "Even though it is now around five years since most of the major structural changes were completed it is still not possible to say what the real effects have been. Certainly the new system is more rational, contestable, consultative, transparent and overall more rigorous. It is apparent however that most of the attempts to quantify the success of the new structure and mechanisms have focused on issues of process -how many projects has been completed in time (and the like)…- Interestingly, the tendency towards mechanistic auditing of process rather than demonstration of real beneficial effects as the basis for assessment has been acknowledged as one area in which the larger New Zealand process has been at its weakest." It seems also to have been acknowledged that "the research prioritization process must take a longer and more far-sighted view." The "need to build priorities on the basis of a collective vision of what the future might look like and what sort of economy environment and society we are to have" are at the base of a next foresight exercise designed to attempt "to establish a wide consensus among key stakeholders including industry, government and the research community on the future of science and technology research in New Zealand." From a Latin American perspective it looks really surprising that a long standing vindication of the intellectual left -the wedding of first rate research to social needs and national priorities- is in this case the flag of a "neoliberal" government.

Regarding the question of public policies associated with the production and use of knowledge one general remark has to do with the growing complexity and the changing patterns of the underlying problem. The changes include "modifications in incentive organizations and instruments, missions and resources of the different actors, their policies

and links, the impact of new technologies for the access to information an the dissemination of knowledge." "The dynamic of the (research) system is so high and the boundaries between actors are so fluxing that very often policy-makers (considered as principals) are not able to manage changements by imposing their own goals both to researchers and institutions (considered as agents)". (Reale and Scarda)

These problems and the challenge they imply for the definition of public policies are not restricted to the developed world. In the case of India and China, for instance, a major issue is that even if "these countries have established a strong research base in terms of institutional infrastructure and manpower which are comparable to the best research institutions in the word…however they lack capacity to translate innovation in terms of economic gains." (Kharbanda) This is a long standing challenge -and not only for India and China- but it is like a moving target: the objective is always the same, but the ways to achieve it seems to be changing all the time. In the Latin American situation, one of the changes has to do with the massive process of privatization. This process has many consequences regarding the problem of production and use of knowledge, and many of them has to do with public policy: "…the federal government is developing a program of privatization of the state industries and at the same time reducing its role in the other spheres besides the social one. In consequence, the state government of Rio de Janeiro, which was in a secondary role in terms of R&D, increased its actions and at the same time gave them a local flavour, with priority for actions in S&T directed to the social and economic local development." (Terra, Etzkowitz, Mello)

If, like Webster and Etzkowitz suggest, we are witnessing an era of "growing preeminence of knowledge capitalization" , when "the economic growth depends not only of a new cycle of innovation but on a new structure for innovation , which tightly intertwines basic research with applied research", then public policies are called for non trivial changes. One of this changes is located at the management level of public institutions, related to "funding sources, ways of prioritizing projects, research products classification and interorganizational relationships", a trend that seems to be now under way in some institutions in Brazil, like the National Institute of Technology. (Maculan and Moraes)

All these changes in the public policy arena that are under way -or, at least, are recognized as important, in the most different contexts, can be analysed along two dimensions: "the steering dimension and the aggregation dimension". "The first one focuses its analysis on the attempts of the state to have scientists that pursuit its goals: the aim of this feature is to describe the capability of the research system to respond to steering impulses. The second dimension refers to processes of agenda building and the actors in this process, both organization and researchers. The focus of this second dimension is on the existence of infrastructures that can support that process: the intermediary bodies can play an important function in establishing the agenda-building process within institutions." (Reale and Scarda) This analysis concentrates in the academia-government part of the Triple Helix relations, but what about the other part, the one that links government policies and industry involvement? One central question on this regard is the one related to "the possibilities and limits of government policy", analized "in relation to a reconceptualization of the public vs. the private goods dimension of knowledge." (McKelvey and Persson) Both analysis proposals seem to be quite useful regardless of the concrete place of its application.

- The new role of the university

"The variety of definitions and interpretations of concepts such as applied research, development and innovation turns into a even more complex issue when it is explicitly recognized that universities shooed increase their collaboration with industry. In developing countries like Mexico, this phenomenon has been evolving during the last fifteen years, and presently, important institutions like the National University consider technology development as a legitimate activity among the university functions. Despite this validation of research oriented to the exploitable results and innovation, neither the UNAM (National Autonomous University of Mexico) nor the Mexican science and technology policy institutions have devoted enough efforts to conceptually clarify these technological activities and effectively legitimate and counterbalance them with traditional scientific research." (López-Martínez and Rocha-Lackiz)

This observation is true for all the Latin American landscape: explicitly or tacitly, all the universities have de facto agree upon the legitimacy of employing research university time to solve concrete problems of concrete clients willing to pay for this service. Even more, it has been standardized the practice of sharing the revenues of these activities between the institutions -school, institute, department- and the faculty staff participating in the projects. But it is lacking almost everywhere an updated academic evaluation system that takes into account that what is academically legitimate to do must be accountable in academic terms. It seems that there is a strong discourse in favour of the new role of the university but a heavy reluctance to touch the old criteria for validating university work, mainly teaching and research.

In some developing countries it is reported that universities have not yet acknowledge any "new role": in Turkey , for instance, "state educational institutions charged with engineering and technology education do not now consider outreach among their stated missions which include only teaching and research." (Alp, Alp and Omurtag) This situation is seen as a serious one due to the inadequacy of manpower for upgrading the technological base of national production.

The situation is not the same in all developing countries, nonetheless. Coming from similar concerns as the ones expressed in the Turkish case, in Philippine it seems that they could manage to effectively change the role of universities. "It was in the early 80's when engineering faculty and students were noted to have inadequate exposure in the manufacturing industry. This observation led to the establishment of the University of Philippines Manufacturing Linkage Program." "The Philippine Council for Industry and Energy Research and Development of the Department of Science and Technology initiated the program so that teaching in the academia can be geared towards industry requirements. Closer ties between technological institutions and industry will enable these institutions to produce graduates that conforms to the manpower needs of industry in terms of quality and quantity" (6) (Frando)

It seems that this type of reflections are coming only from the less developed realities. The last one directed specifically to the new role of the university came from Portugal, and the

peripheral condition of this country is explicitly highlighted in relation to this issue. " The role of universities as a promoter of socio-economic development acquires a striking importance in the context of peripheral regions, where the predominant characteristics of the productive system, based largely on traditionally runned small and medium enterprises, combined with the lack of R&D investments, the low learning capacity and the weakness of the institutional support system, highlights the role that universities can play as a factor of socio-economic development. The co-operation between Government, Universities and Society is gradually coming into the policy agenda in Portugal, one of the less developed economies of the European Union. (…) Although only a few of them have so far a consolidated and coherent policy , most of them have some sort of initiatives, even if in a tentative basis, clearly directed to co-operation outside the 'ivory tower'". (da Rosa Pires, Rodrigues, de Castro)

Sometimes it appears as if an old role of the university -performing basic research, for instance- has come under scrutiny and criticism to such an extent that defending the need to assume said role looks like advocating for a new one. This scrutiny is not an imagined one but a reality: a review of the academic literature on the "effect of publicly funded basic research on productivity, the impact on specific industries, the availability of research skills and their influence on the location of industrial R&D, UK company's awareness of public funding for basic research, whether explicit criteria are used overseas to determine the level of funding for basic research, and the benefits foreign governments expect from publicly funded basic research" has been conducted by SPRU for the British Treasury. (Senker) The two main arguments to be reviewed are "the 'public good' argument and the view that scientific knowledge is embedded in individuals and organizations and flows through training and networks". The conclusion is that "traditional justifications for public funding of basic research require expansion". This sort of pendulum -expecting almost everything from basic research as in the wild linear model or denying any specificity or importance to basic research as some "technology" and "business" approaches to innovation do- deserve an empirical research of the "long-cycles" type. But at least there is a pendulum: in Latin America instead, the external legitimation for doing basic research in the universities has never been fully acquainted.

Another type of pendulum is the one related to the kind of relationships between academia and industry: "Historically, university and industry have oscillated between assertive autonomy and various degrees of wilful interdependence." "I hypothesise that during some historical moments education systems and industrial systems each focus on issues of their respective internal structure. At alternative periods they establish structures of interaction that frequently entails the invention of innovative transfer mechanisms." "At a given conjecture, however, evolution in cognition, technics and organizational forms, and the repercussions of economic competition, exhaust the benefits embedded in extant cooperative arrangements. Misalignment occurs. This leads to a renewed search for novel forms of coordination." (Shinn) This comments shed a strange light on the question of the "new" role of the university and the "new" location of research: is there something really new or instead what occurs is a periodical oscillation movement that gives us the impression that something new is happening?

- The impacts of the "new role" on the university

"Research cooperation between industry and university has increased dramatically over the past few decades. Fuelled by a number of social forces, including shrinking federal support for research, pressures from global competitiveness and the increasing importance of science-based knowledge to the innovation process, and by a proactive public policy, industry's share of academic research has more than doubled over the past two decades, from 3.1 percent in 1975 to 6.9 percent in 1995 (NSB, 1996)" There are people concerned by the consequences of these changes in many places, one of them being government itself. "In the early 1980's hearings in the U.S.House of representatives examined two issues: (1) whether university-industry relationships violated scientific and academic freedom and responsibilities, and (2) whether these relationships best served the interests of the American public·" One of the participants in the debate said that "the concern of the impact of industry on academia, how it is going to destroy values, is very reminiscent of the same type of arguments which went on 20 or 25 years ago when large amounts of federal funds began to flow into the academic institutions" In the other position, another participant in the debate "expressed an uneasy sense that programs to exploit commercial developments are likely to confuse the university's central commitment to the pursuit of knowledge and learning by introducing into the very heart of the academic enterprise a new and powerful motive. The search for utility and commercial gain". But some years later, in 1988, some scholars could write that "despite the plethora of literature on the subject of university/industry cooperative research which usually conclude with a critical opinion, very few, if any, in-depth studies exists on the subject." An empirical research aimed at measuring the impact of U/I collaboration on graduate students -given that "in many instances it is students rather than faculty who actually conduct the research"-, including issues like "freedom in conducting research" and "freedom in communicating research", gave some interesting results. One of them is that even if there were not founded significative differences between industry and government funding and the form of the partnership, more significative differences were founded between sponsored and unsponsored research. (Behrens and Gray) A result to be expected, but nonetheless worth to think upon.

The impact on universities and research centers coming from their new role of direct relations with industry is not independent of the policies followed by the agencies devoted to promote said relations. "R&D stimulation programmes, and their managers, are not the only coordinators in a field of thechnology. Such programmes are implemented into an existing field of relationships, with their own loci of coordination. Within this loci different logics of action exist and are followed. A programme that neglects these logics has limited chances for success. In other word, a successful programme tries to operate on these logics for its own purpose." This comment came from The Netherlands and it refers to R&D programmes within Dutch innovation stimulation programmes, specially in the area of agricultural biotechnology. Research institutes need money to survive; they also "have to keep they best researchers satisfied", that is "we do not want to develop one vaccine after the other, we also want to do new things". What happens if policy designers -in this case the managers of the innovation stimulation programmes- wants to retain heavily in their hands the steering of the research conducted with 'their money'? "Like many R&D

stimulation programmes, the innovation ones have a re-orientation goal. That is, the programme must bring about a re-orientation of the R&D infrastructure in the public domain towards the need of industry. If this goal reflects the expectation of policy-makers that R&D programmes will urge academic researchers to give up their 'hobbies' in favour of working for the common cause, or can be forced to do so, we must qualify this expectation as naive. Researchers do not change their interests only to please policy makers and to earn a little money. The innovation stimulation programmes experience clearly shows that coordination which is forced upon research fields does not work. Successful cooperation must satisfy certain conditions, which have to do with logics of action of which we have revealed a few examples." (Jelsma) This situation is not only due to the stubborn personality of researchers, but also to the difficulty to rely on industry for the definition of a research agenda directed to solve their own problems. "Thinking in terms of re-orientation suggests also that influencing public research in the direction of the market is a one-way process, i.e. that industry -knowing the market- can guide academic research on the basis of crystal-clear needs. Our data point in another direction. Academic researchers (…) told us that the needs of industry are often diffuse. It is not uncommon that firms approach researchers in public institutes asking to tell them which products to develop. In many other cases, it was clear that supply and demand from both sides become articulated and structured in a process in which all kinds of options are explored" (Jelsma)

A good question is to what extent the above stated is taken into account. For an agency devoted to stimulate R&D this implies to accept that a good deal of freedom in the setting of the research agenda is necessary for research to be done at all, a first step of giving up authority. But more than that, it implies that even if they have the power for imposing the research agenda, they do not have the right questions at hand, because industry -their big partners- does not have the right questions either. It is surprising to find precisely this last remark in a developed context like The Netherlands: a common difficulty found in Uruguay both in the university and also in the high tech small firms acting as "technological tailors" for other companies, is that the technological demand of firms is diffuse and to finally find out what the problem really is takes a lot of time and of mutual trust building.

Sometimes things appears to be even more complicated. In the case of France and of its decentralization policies, to the general problems that academia is facing in these new times is added, at a regional level, a real mess of objectives, "patrons" and interests. Being a centralized country, in 1982 the government decided to entrust regions with a new role in stimulating technological development in small and medium enterprises. (Vavakova) "But, if the regions now have competence in matters related with their economic development, they did not receive a complement of resources needed to fulfil their new mandate." This is particularly true in the case of R&D resources and, worse, "the hierarchical nature of the R&D and university systems left decisional authority over matters such as curriculum or the hiring of researchers and university lecturers in the hands of those at the center." The impact over academia of the demand for a more direct contribution to the regional economic welfare in the context of a still centralized country like France seems to be the following: "In the 1970's local researchers had depended entirely on central authorities for finance, career advancement and the orientation of their research… By the mid-1980s they had moved from a situation of a single 'patron' with its strongly 'national' interests, to that of four 'patrons' each with its own agenda." Thus there are quite a lot of "tensions and

contradictions created for scientific researchers in France's regions as a consequence of the multiple new roles they were now expected to play vis-à-vis regional authorities, European authorities, and their MNC partners." This three new patrons sum up to the old central authorities patron to make the four patronage system in which researchers must develop their work. (Vavakova)

The three papers commented in this part stressed in a way or another an important feature of the actual situation of research: funding agencies -and not a single agency- are main actors in the setting of the research agenda; they constitute a landscape that is of the utmost importance for the researcher to master in terms of goals, styles, evaluation methods and requisites to be able to get the funds without which he/she would not be able to continue in the research community any more. By this imperative, agencies are in a privileged position to influence the "university norms regulating systems". "Research funding can, it has been argued, be one impetus to changes in the norms system. Some funding agencies struggle to develop hybrid communities (e.g. the mission-oriented agencies), where the assessment of research is broader than in the collegial model, whereas others basically reproduce the existing structures of reputational control (e.g. the research councils)." In the Swedish situation, two type of funding agencies are in fact competing in terms of orientation: "The Research Council for Engineering Sciences and the National Board for Technical and Industrial Development (NUTEK). (…) the former represents an attempt to reproduce (and in some areas create) a system of reputational control through peer review, whether the latter attempts to build networks between researchers and industry with transepistemic criteria for quality assessment." (Sandström and Benner)

If the impacts on university research coming from the "new situation" are to a great deal moulded by the different philosophies of funding agencies, it is not less true that history and traditions counts on that matter. The French centralism, the Swedish tradition of wide citizenry participation in community issues, the American immense variety of institutional arrangement, both for research and for funding research… It is not surprising, then, that the "Latin American University", moulded by the University Reform Movement, presents a peculiar way of expressing the new tensions and impacts. "The University Reform Movement hall-mark, autonomous government of universities by its students, teachers and graduates, has been obtained, lost and even reconquered in several cases. Those events favoured special relations of the URM with some collective actors -trade unions and left wing parties particularly- and lasting enmities with others, specially with the political power. That long history moulded and original institution, the Latin American University, and a specific 'idea of university'. According to that idea, the University feels closely related with Society as a whole and particularly with the most deprived sectors, assumes that the University by itself must decide how to collaborate with national development, and asserts that such development must be orientated not by the market but by the search of public welfare." How to integrate the triple helix mode of operation into such a peculiar "idea of University", an idea that stressed that the university cannot be indifferent to the fact that the region hosts some of the most deprived and less equalitarian countries in the world? "In spite of many deficiencies, public universities are undisputedly the main actors of the scientific and technological research carried out in Latin America; its situation and possible transformation are being intensely discussed. Since the relation between university, industry and governments have become so relevant, it may be said that the

future of the tension between the tradition of the University Reform and the 'triple helix' will have great influence in the economical and social use of knowledge in this continent, and consequently in the future of its inhabitants" (Arocena)

Case analysis from a university or academic perspective

On informal contacts

One important first statement pretty common in all the contributions directed to case analysis on University-Industry relations is the importance of informal contacts. In a study of 725 "common" projects at the University of Campinas, Brazil, it is stated that "Informality was predominant in establishing contacts. In more than 50% of cases contacts occurred through informal personal ways. The performance of institutional liaisons mechanisms has been very fragile." (Corder, Gomes, Mello, Brisolla) The importance of this statement goes farther than the anecdote. Brazil is a huge country, so the high occurrence of informal contacts is not only a characteristic feature of small countries or small communities; Brazil is a developing country, but it seems that informality is recognized in the advanced countries as a "good practice", to the extent to try to protect it from the "chilling" of a too bureaucratic handling. This generalized situation opens the question of which the role of liaison offices really is: promotion, economic control over professors revenues, quality control of results, legal advice in the formalized stage of the contacts…?

The unchallenged importance of informality, even after years of formalization efforts for the collaboration between university and industry, is not only a "less developed" phenomenon. In Japan, it is stated that " it is difficult to understand fully the impact of these collaboration because many of them are apparently made in informal manners and few of them apply for patents jointly." (Odagiri)

On mimetic behaviour

In another vein, it is also a pretty common problem in Latin American universities the copying without much criticism the institutional arrangements in fashion in the developed world-a situation recognizable for science, technology and innovation policies as well-. The following remarks, coming also from Campinas University, are representative of a broader regional situation. "As it has historically been the case, science and technology policy frameworks designed in the context of advanced countries tend to be promptly adopted by the developing ones. So it is that promoting and stimulating university-industry collaboration is a top priority in the research agenda of all countries today. Brazil, of course, is not an exception to this rule." "In spite of the fact that existing research on the subject implies considerable diversity in university-industry linkage as far as fields of knowledge, region of the country, state of the development of the technology concerned, policy instruments and initiatives seem to desconsider such differences. In other words, the schemes developed to promote university-industry links in Brazil, either by government or by the universities themselves, take no account of the differing needs, demands, structures

and operating ways of different industries, technologies or 'end users'." (Velho, Mello, Corder) These remarks are particularly significant, because the problem of "mimetic behaviour" in terms of science, technology and innovation policies has been a constant nightmare in Latin America: in the developed world it is given for granted what in fact represents long historical and social trends, while in Latin America it is assumed that key factors in the social metabolism of knowledge production and utilization are present with the same characteristics than in the developed world -which is obviously a misleading guide for efficient action-.

On university and change

When analyzing the university situation regarding the triple helix development, it is usually taken for granted that as reality changes, university is forced to change. But in underdeveloped realities things seems to happen also the other way round: the news of change that come from the developed world impacts the policy makers with a sense of urgency but without actors to play the game, and it is usual to find that the universities are really the most interested players in the promoting triple helix like arrangements. This is due, to a great extent, to the weakness of national systems of innovation: at least this is the situation in Latin America (Casas, Sutz). But not only there: "The weakness of the Portuguese regional innovation systems, rooted in the lack of strong regional powers and in the characteristics of the Portuguese socio-economic structure… (it will be argued) that can be at least partially compensated by the combined action of municipal authorities and Universities." (da Rosa Pires, Rodrigues, de Castro)

On transdiciplinarity

The issue of transdiciplinarity as a must derived from the new kind of relationships between university and production is present in various contributions to the Conference. The idea is that as important as building communicating bridges is to build common languages to be able to cross these bridges, and it seems that the only actor really in a position to learn new languages is the academic one. But, how could possibly the university learn to do that if "the university in many parts is divided into separate knowledge cultures, making the university educational organization rigid and not open for changes"? This assertion came from Sweden, from the health sciences schools of the Gothemburg University, where it is stressed that "one of the challenges of the university lies in the demands to develop co-operation and cross-fertilization between different knowledge areas." (Hultberg, Rosenberg, Brogren) The problem is interesting indeed: to be able of establishing "outside triple helices" the universities have to learn how to establish a transdisciplinary culture indoors, not only for research but also for teaching: "Thus we propose that more attention be given to transdisciplinary research groups and a revision of the curriculum giving more room to problem oriented and multi- professional education." (Hultberg, Rosenberg, Brogren)

Vocation and the 'science-shy phenomenon'

What about vocation? Is there any impact on students preferences coming from the greater involvement of university with "practical matters"? Odagiri discussed "the so-called 'science-shy' phenomenon, namely, the decrease in applications to science and engineering departments relatively to those in humanities and social sciences departments (in Japan)". The explanation suggested for this phenomenon is recognizable from a Latin American perspective and rises the question of its possible generalization: "It is suggested that this phenomenon was partly caused by an economic factor, that is, a lower expected income after graduation from science and engineering departments, and a supply factor, that is, the government policy that depended on private universities, which preferred to expand less costly humanities and social science departments, to achieve the increased enrolment." (Odagiri) This is a quite paradoxical outcome: the more technological the civilization, the less rewarding seems to be the technological higher education.

The 'science-shy phenomenon' seems to be widely generalized; at least this can be inferred from the following comments: " For some time now, university educators in the United States have been concerned -as are faculty in Europe as well- with diminishing enrolments of college students in mathematics and in the physical sciences. For a variety of reasons, students are not longer 'interested' or as 'well prepared' to study mathematics and science as they once were. With actual and perceived reductions in the number of academic and other research jobs in mathematics and science, enrolments may fall still further, resulting in a downward spiral in the total available intellectual capital necessary to a technological economy." " In the US and more and more in Europe as well, we are losing our best students to law and finance and there is a growing 'gap' in U.S. corporations between those who know technology and those who do not. " (Tobias) (In Latin America the fight would be to gain students from the long standing and overwhelming preference for law and more recently finance and business management.) What the author proposes as a remedy is to change the idea that the only outcome for a scientific career is to go into research. This needs "new career pathways within the framework of some new education and training dynamics intended to enlarge the recruitment to university mathematics and science of non-research oriented students." The idea is that it is precisely this profile which is needed to fulfil many jobs and roles, like "application to a variety of problems not narrowly mathematical or scientific on the surface, (like) technology transfer, management and management consulting, patent and regulatory affairs, teaching, public understanding, and concern with the ethics of science and technology". (Tobias) The question is, however, what a level of consensus could rise the statement that for doing all those things it is useful to have a mathematical or scientific background….

On the relative legitimation between science and technology

One of the consequences of the changing rules of the game for academic research fostered by the appearance of the triple helix is the new positioning of relative legitimation between science and technology -an old problem in less developed countries-. But if this is a rather obvious consequence, it does not show the same degree of virulence for every field of research. Where the costs of doing research are higher and the expected economic or military impacts of applications are also higher, the trade off can be quite difficult. This

seems to be the case with fusion research and particularly with the Princeton University Plasma Physics Laboratory, "operated by a major research university for the federal government and funded by the United States Department of Energy", a good example of "the complex university-government relationships characteristic of contemporary 'big science'". "…the dual mission of producing fundamental scientific knowledge and developing a practical energy technology provide a rich example of the negotiated boundaries between science and technology, which are now being redrawn as part of a major policy shift on the part of the funding agency" (Kinsella)

An expanding research

A last remark related with case analysis from a university or academic perspective is that empirical research regarding both the university-industry contracts per se and the institutional setting for university-industry relations is growing everywhere. And what is surprising -or perhaps it shouldn't be- is that empirical research in very different countries are organized around almost the same set of questions. In the case of a research conducted in Sweden, Finland, Ireland, Portugal and Spain, the "chapters" of the field work are :"The general role and function of the industrial liaison office and how has this changed the involvement of the university in different types of industrial links; the main opportunities and barriers to the development of links between university and industry; the benefits to the university from industrial links and the perception of industry's assessment of the relationship with universities. " (Jones-Evans and Klofsten) The first study of the University of Campinas here mentioned is organized in the same lines and such is the situation also in the Uruguayan study mentioned earlier -that by the way gave quite similar results than this Brazilian one-. Again and again, in the midst of all the differences, similar structures of reality appear and also similar ways of studying them.

- Case analysis of Triple Helices

In the Mexican case, a research was undertaken to study triple helix like arrangements in a double dimension, regional-geographic and knowledge differentiated. Academia-production relations were studied in three regions and in three new technology fields - biotechnology, new materials and telecommunications. A general conclusion is that the technological field in itself, the economic situation of the regions as well as political factors related with the status of the research institutions -autonomous, public and private universities, public and private technological institutes, etc. - which in turn have an influence in the mechanisms developed by government to support networking are main factors in the strength and performance of triple helices modalities in Mexico. As the authors put it: "Accumulated research experience in universities and research centers seems to be one of the key elements in successful relations but not necessarily the determinant one." (Casas, De Gortari, Santos)

A contribution coming from Spain expresses a series of doubts about the pertinence of the triple helix conceptualization that are, at the end, confirmed partially in the Spanish landscape. "The three spheres (academia, industry and government) have always been, with

different balances and labels, the bases for understanding the dynamics of R&D activities; but to what extent the evidence on the tendencies shows us some radical new developments? Behind the argument is a divide: Could we accurately describe the situation as 'three actors in a single system' or as 'three systems with independent dynamics' that will change (and sometimes increase) their ways of interactions?" The Spanish case is very interesting indeed due to the clear purposeful action of the state regarding triple helices like arrangements and also for the strong push to change the institutional framework of action for universities in the mid 1980's. More so, from these policies came into being a wealth of "non-firm organizations specialized in technology transfer" that "have bloomed in the nineties in Spain", even if with "a big internal variety -some are new governmental initiatives, some R&D operator initiative and also users initiative." The conclusions presented by the author are as follows: "From the analysis done…we will observe that pressures for stronger collaboration between actors are big, but still much of the research activity continue to be developed under independent models: inter-firm collaboration playing a bigger role than academic-industry collaboration, academic research regulated mostly by internal rules of action and traditional reproductive process, while the 'strategic or priority collaborative R&D' is still playing a small role in the S&T policy." (Sanz-Menéndez)

The US provides a particularly interesting case study because one of its most recent and outstanding experiences of Triple Helices, the Engineering Research Centers, has its governmental helix represented by an agency mainly devoted to the promotion of basic research, the NSF. "In terms of number of industry and university participants, level of funding, and longevity, ERCs represent one of the major public sector innovation of the mid-1980s in fostering improved cooperation between industry and university." More than that, and perhaps due to the particular agency that was responsible for their design, ERCs have among their key objectives one that is not so commonly found in other experiences of this type: "the conduct of crosscutting engineering research by interdisciplinary, often newly created, assemblages of faculty, students, and facilities." As it is clearly stated by the author, "a related premise is that industry demand exists for this type of engineering research". An industry demand existed indeed, as demonstrated by the answers to the interviews conducted among firms involved in the program, involvement that implies cost-sharing, "a requirement contained on NSF's program solicitation." A primary reason for participation was "firm's need to acquire access to ideas, research-based knowledge, and university expertise"; another reason was "the cost-effectiveness of being able to leverage multi-million dollar externaly-performed R&D programs with their far more modest participation in fees". Even if the funding firms participation was modest, the author stressed "the central, if at times muted, role of the (federal) government sponsor in inducing firms to support ERC". The main findings of the study seems to suggest that caution is needed before declaring that major changes have been produced in the previous rationale of the main actors. In the first place, there are "distinctively intra-firm influences on the extent to which knowledge generated by new R&D partnerships is used by the firm". In the second place, "the standing of interdisciplinary programmes on major US research universities remains problematic; they have been described as 'orphans' of the fiscal bureaucracy in a recent Government-University-Industry Research Roundtable report." Finally, a big question remains in the air: "the pending 'graduation' of a number of ERC's as they reach the maximum number of years of support", and "the extent to which

interdisciplinarity has become institutionally and organizationally viable or remains dependent on the programs requirements and funds of external sponsors." (Feller, Roessner, Ailes)

In some cases, the initiative for the constitution of a triple helix like arrangement comes from the academic community. These are cases where the dialog between academic people and government people must be quite strong and probably situations like these are not easily generalized but instead focalized in some particular areas of research. This exactly seems to be the case of the Brazilian National Software Export Program (Softex 2000). "Softex 2000 is a initiative owed to the Brazilian academic computer science community. In fact, it was planned and it is coordinated by outstanding members of this community. The program focal point is the National Research Council (CNPq), an entity of the Ministry of Science and Technology which supports scientific development (teaching and post-graduate research) instead of the technological development supporting entities or the Industry and Commerce Ministry." The academic origins of the initiative leads to "similarities (that) may be noticed between the organization and conduction of this program and the usually favoured University work methods (team work, peer review, flat structure, etc.)." The program as a whole has not yet been evaluated, but it seems that its main goal, "stated in the start of Softex 2000 activities, (that) is a 1% international (software) market participation, estimated at the time in two billion dollars" is probably not going to be reached. The reasons seem to include the general policy orientation of the program -"an excessive optimism in determining the export level to be reached" that added to other reasons leads to the conclusion that "a greater preference for the internal market would have mean a greater Softex 2000 success"-. But it is also mentioned "a resource scarcity for program development" and "the relatively lesser importance attributed by the program to the encouragement of technological activities." (Prochnik)

Another initiative coming from the academia that was successful in terms of gathering money from government is the Barcelona Science Park. The project was promoted by the University of Barcelona with economic and political support coming from the Catalan Autonomous Government and the Spanish Government since the beginning of the project and funding also coming from European Union through the European Funds for Regional Development, the Catalonia Savings Banks, and a University of Barcelona Foundation. This kind of ambitious projects are particularly interesting in the Spanish landscape, where it "appears the dichotomy between the historic marginality of science and the new modernization discourse of the eighties…" (Bellavista)

What is the extent that the concept "triple helix" is able to cover? If this is at all an answerable question, a good answer could probably be that the concept covers all the case situations that are reasonably depicted in its terms. A bit less "classical" than other cases reported is the situation of the IN2P3, that part of French national system of science and technology devoted to nuclear physics. "Of all the areas of science, that of nuclear physics, and particularly corpuscular theory, is of particular interest to researchers, since it represents the model of 'big science' which is accused of dominating all other scientific activities. According to this model, the organization of scientific activities is 'industrially structured' around a large-scale, targeted programme within which technological innovations and their incorporation into instruments and apparatus are playing an increasingly important role in the advancement of scientific knowledge." (d'Iribarne and

Gadille) The triple helix functioning of the IN2P3 is evoked by its attempts to "bridge the gap between science and technology (and to) manage a combination of scientific competences, training resources and scientific innovations likely to be taken up and developed by firms…" The development of the triadic relationships in this case is very particular, precisely because it has to do with 'big science': "…over the 25 years of Institute's existence, management of this area of scientific endeavour has become highly centralized and strengthened under the pressure of the enormous budgets required for the development and construction of successive generations of the energy sources and detection instruments that are necessary to explore the 'structure of matter'. Thus what emerged is a single central structure that 'manages' all the laboratories engaged in basic research, whatever their status, and which, above all, schedules the investments in new equipment, using capital from financial consortiums that are increasingly international in character." "As a result, a triangular structure is emerging in this area, the three points of which are large scale programmes, independent laboratories and large-scale instruments and apparatus and the central objective which is the co-production of technological innovation and scientific knowledge. To this end, this triangular structure maintains close, if tense relations with, on the one hand, the university system, which is the source of its human resources and theoretical knowledge and, on the other, industry, which is playing an increasingly indispensable role on the development and exploitation of increasingly costly technologies." (d'Iribarne and Gadille)

Triple Helices cases are heavily influenced by the same kind of factors as Systems of Innovation, that is, history, traditions and values. A case reported from Italy has, in this sense, the same type of flavour than the industrial districts of the Third Italy, a phenomenon that seems to be rooted in the old city-states from the Renaissance. The case is the one of CISTAI (Center for Scientific and Technical Innovation of the Agro-Industry Sector), located in the Abruzzo region, in the South of the country. In spite of the recent betterment of the economic situation -which made that "the region has come out from assistance of the Structural Funds of the European Union"-, heavy problems remain: "the unemployment rate of young people, an inadequate training system, infrastructures deficiency, poverty of the bank system and the fragility of the SMEs". (All problems easily recognizable from a Latin American perspective). The Centrer operates in a quite singular arrangement, named the Territory Pact, "an agreement among authorities, big and small industries, banks and research and technology centers for developing the territory" that "constitute an example of integrated utilization of the local actors for a bottom-up development …" In this case the goals of the CISTAI in the framework of this agreement is twofold: on the one hand, to enhance the production of traditional food by studying ways to upgrade their quality standards and, on the other, to innovate to be able to develop value added compounds derived from local agricultural products. (Maffei, D'Amario, Anconitano, Algeri, de Gaetano) This "program" reminds the trajectory of many countries and regions that jump into international competitiveness through exactly the same strategy: enhancing traditional production and adding value to them. But perhaps the most innovative feature of this case is its bottom-up development, unfortunately an innovation much more difficult to imitate than any technological one.

The Italian mostly Central and Northern phenomenon of the Industrial Districts (ID) are also presented as a sort of Triple Helix like situation. ID differ clearly according to

location, political situation, productive sectors involved, etc., supporting the claim made by many contributors about the welcomed lack of unicity underlying the Triple Helix concept. Comparing the Emilia-Romagna and the Veneto situation, for instance, the author stated that: "In Emilia-Romagna local government created centers to support small firms with 'real services' like industrial, technological and business information, or in the field of innovative technology, as well in evaluating and financing innovation or business plans." "Instead Veneto misses such a local government , and experienced a much more self-organizing and recent development." The general remarks inspired to the author by nearly 30 years of research in ID (not only Italian ones) are interesting indeed and the question of the degree to which they can be extended to the Triple Helix concept arises immediately : "(i) these phenomena are very self-organizing ones, with strong synergetic effects; (ii) they require the action of some catalyst factor; (iii) family, church and political parties are loosing their importance as catalyst and sustaining factors; (iv) much more important are cultural values oriented to prudent trust and cooperation, and most important is historical memory of firms' reciprocal past experience; (v) that can explain the scarce presence of industrial districts in southern Italy; (vi) central government intervention discourage and hinder creation and trigger of self-organizing process, and that can also contribute to explain the scarce presence of ID in southern Italy." (Biggiero)

As a last remark, we can ask weather this description is also valid for the Triple Helix concept: "ID should be regarded neither as a mythological phenomenon… nor as a residual form of capitalism. They show a new trend of capitalism, the capitalism of networks, at a regional scale." (Biggiero)

The idea that changes are coming so fast that institutions lag behind seems to be confirmed by the situation of US technology licensing offices, "which continue to struggle with appropriately balancing the new emphasis on financial productivity with faculty support service activities" and which "continue to report institutionally to academic, rather than financial administrators" even if "the metrics used by institutions to judge productivity (of these offices) have changed dramatically in recent years". "Of increasing importance are equity and value of equity in start-ups, local/regional economic development and industry sponsored research funding." (Berneman and Denis) Another trend of change is a "movement towards partnering and small business relationships."

Changes have also affected the structural framework for the management of cooperative research projects between university, government and industry in Japan, but in this case the changes are due to the fact that "the technological level of Japanese companies has improved to such an extent that it has now become both possible and necessary for Japan to develop its own technologies", which call for transformations in the prior forms developed in a long history of tripartite cooperation. (Eto) The author makes a taxonomy of types of cooperative research projects and assess their trends: (i) Product development supported by academia or government : they tend to become less common, due mainly to the fact that "the level of technology in companies has attained the same level as in academia and the national laboratories"; (ii) Cooperative research projects for product development: they are also diminishing, and due to the same reasons, that in this case operate in a different way, that is, as the technological level of the companies rises, they are less and less interested in entering in cooperative research; (iii) Basic research supported by companies: they are currently increasing in number by three main reasons. Firstly, the companies prefer

cooperative research to donation because they can access results much more quickly; secondly, the companies are in need to reduce their research budgets and outsourcing basic research to the public sector is a good manner to do that and thirdly, "many university researchers have changed their previous negative attitude to cooperative research with industry"; (iv) Cooperative research projects in basic research: they are rare in Japan, the rather famous Erato program being one of them. Even if they are rare their philosophy seems to have spread to other types of cooperative research modalities: "nowadays the main issue in any cooperative research project is not the precise theme of the cooperative research but the selection and recruitment of suitable researchers." Based in this existing taxonomy, the author proposes a new type of co-operative research which main features would be: (i) a flexible research system for a moving target; (ii) emphasis on researchers; (iii) carefully selection of member companies and (iv) include a government official as a policy adviser, because "at a time when a new technology developed within a cooperative research project is ready to be marketed, inappropriate regulations can easily hinder the diffusion of that technology". (Eto)

We use to think about the Triple Helix as being a new pattern of interaction even if it is easily recognizable that tripartite co-operation has been present since long. The "new" is concentrated not exactly in the interaction per se -even if it displays many new features- but in the changed context in which it is developed, which gives a more structural and formal shape to said interaction. It is interesting, then, to find a contribution that argues that Triple Helices existed in the past and become debilitated after. "There is evidence in the Canadian context that tripartite collaboration was a well developed element of the advance of science and technology throughout most of the twentieth century which was interrupted by the almost pathological rapid growth of the universities and the scientific establishments in the post World War II period. The rapid growth ruptured the networking among the players essential to the triple helix. One might venture to say that the helix was 'denatured'." (Langford and Whitney Langford) Regarding megascience (7) in Canada: "We find a pre-World War II situation where megascience, with some exceptions in astronomy, depended upon intersectoral relationships linked to 'problem oriented' motivations. By contrast, the period of rapid expansion of the scientific enterprise in the post war period allowed the emergence to prominence of a 'trickle down' theory of social benefits of research which made 'academic science' the controlling influence, de-emphasizing tripartite partnerships. As limits are approached, research is becoming more strongly influenced by Mode II concerns and newer triple Helix relationships are becoming very prominent." (Langford and Whitney Langford)

- Relating theory and political recommendations

The Triple Helix concept has yet a "fluid" theoretical status. One reason for that is that it is a new conceptualization in the midst of a wealth of in some way or another related concepts: national systems of innovation, techno-economic paradigms, the new economics of science, the (linear, chain, interactive, distributed) model of innovation, the "Mode 2" of knowledge production, the evolutionary approach coming from a sort of combination between economics and sociology. More than that, even if it is seldom mentioned, it is not difficult to find, when dealing with the Triple Helix, reminiscences from social history of

science and of technology. On the other hand, at what level are we considering the Triple Helix? It can be considered at geographical macro, meso or micro levels; it can also be used as a descriptive tool or as a prescriptive one; Triple Helices can be the base for analysis of the general knowledge evolution of a given society or for a better understanding of the evolution of a particular technology or set of technologies (the environmental technologies, for instance). We can even ask which the status of the Triple Helix could reasonably be in the "battle of determinisms": would it be alignated to the social, the economic, the political, the technological determinisms? If the answer, as expected, is "none of them but all at the same time", how is the concept to deal with the necessary articulations? Some contributions to the Conference were more clearly directed to this kind of issues than others, even if the theoretical challenge was faced, with much or less emphasis, in almost all the papers.

On techno-science

"The present day technology is rapidly outgrowing the capabilities of the existing R&D infrastructures. This is reflected among other things in the problems affecting the organization and financing of long term technical or strategic research." The "causes of the trouble are largely conceptual in nature and have to do with the changing character of technology itself." (Stankiewitcz) This change in character has as a key feature the alleged blurring of the cognitive distinction between science and technology, giving birth to the notion of "techno-science". But "what precisely is 'techno-science'? In the absence of a new theory we tend to slide back into the supposedly 'dead' linear model of innovation. At the root of the trouble is our failure to develop a model of technology as a cognitive system in its own rights." "The putative collapse of the linear model of innovation in the late sixties has not led to the emergence of a coherent theory of technology as an autonomous cognitive system." A "economic model" of technology came into being, giving rise to the concept of "technology pool" or "technology base", to replace the older "technology -as-applied-science". " In this model, the cognitive agenda of technology was construed as generated by economic forces and the institutional structure of technology came to be viewed as tightly correlated to the economic structure." But "short term technological entrepreneurship" is far from adequate to grasp with the problem, and "the concepts of the linear model begun therefore to appear again under a variety of new guises: 'finalized science', 'technological paradigms', 'strategic science', 'transfer science'." The author proposes to cope with the problem by "looking at technological growth as the evolution of 'design spaces' and the associated 'design languages'". "The spaces undergo change in two main ways: (i) through the expansion and transformation of the set of ('technological primitives'), and (ii) through internal structuring and articulation, i.e. evolution of 'design languages'." "Design spaces are largely self-organizing. Over time they evolve complex structures and generate 'research agendas' of their own. These agendas consist of strategic problems the solution of which enhance the overall power of the design spaces, by increasing the efficiency of technological problem solving processes. (8)" This characterization facilitate the following conclusion: "The problem today is that the design space of technology have reached the level of sophistication where its research agendas begin to offer intellectual challenge of the same order of magnitude or greater than that of traditional science. It is that reversal of the roles of science and technology which creates

today's 'techno-science'". The policy conclusion driven from this theory is that "the institutional requirements of technology are progressively diverging from those of science. And this is by no means limited to the economic dimension… Technological communities have different composition and structure than scientific communities. They require interfaces of entirely different nature than the traditional sciences. And they also need instrumental infrastructures of different orders of magnitude." (Stankiewicz) I can recognize this claim as a familiar one: Uruguayan technology researchers at the university often complain that they are embedded in a scientific culture that denies their identity -even if they don't know very well how to define it- and that the problem is far from solution through the classical dichotomy papers vs. patents or things like that.

Beyond the linear model

In another contribution, the heavy criticism against the linear model of innovation -"that even the most stubborn vested interests cannot re-animate"- is accompanied by the welcome to the Triple Helix conceptualization "that enables to discuss implications of alternative policy theories" (Dits and Berkhout) This alternative policy theories should take into account: (i) "cyclic approach of knowledge and innovation"; (ii) "the increasing significance of alliances"; (iii) "the definition of research activities in a two by two matrix", where the classical dichotomy between basic and applied research could be substituted by two dimensions: "one dimension defines the level of disciplinary vs. system-orientation of the research, and the other one defines the extent to which the research questions are originating from scientific vs. economic and wider social actors." As a concrete example of how this way of looking policies is being taken into account, the authors describe a policy designed in the Netherlands to overcame the fact that "in the usual concept of technology transfer implicit knowledge incorporated in people is underestimated". "Policy measures have been proposed from a communication perspective on this human resources issues of knowledge intensive innovation processes. Special policy initiatives have been proposed to enable co-development by intensifying mutual (often temporary) transfer of people between public research organization and innovating companies." (Dits and Berkhout)

In other concrete attempt to overcame the linear model -" an oversimplification"- it is proposed a much more complicated scheme that includes three cycles (Research, Technology design and Innovation), each of them running in a separate domain and each domain having its own momentum. (Rörsch, Verkaik, Rutten) "Depending in the differences between the momentum of each cycle, the system as a whole may be characterized as being dominated by technology push or market pull." "The progress of research, technology and innovation, is influenced by many factors, (e.g. investment, teaching, competence, culture) and among these especially pure chance." This leads to the conclusion that the process as a whole "will inevitably jerk like a rattling wheel-work." That is why managers in industry develop risk-avoiding strategies, like spreading risk through a portfolio of approaches or projects. More than that: "over the last decade, industrial R&D departments have reduced their in-house activity in fundamental research and went more and more shopping in universities for exploitable knowledge. This is due to the extraordinary high risk of research." Reducing jerking is obviously a good thing for the

system as a whole, but the problem is that if this goal is attempted in a too direct way -for example if one domain accepts the rules of the game of another domain- the overall effect could be worse: “It is questionable whether the universities, in their increasing cooperation with industry, serve best by compiling portfolios of overall low risk, with respect to direct applicability of results in the field which industry demands. This may turn out to be a misjudgement of the very nature of science at the frontier of our knowledge, a violation of a fundamental law, like the second in thermodynamics or the theory of biological evolution.” The policy conclusion is straightforward: “ Therefore the construction of a stable triple helix, the adjustment of governmental, industrial and academic R&D policy might turn out to be an illusion.” (Rarest, Verkaik, Rutten) The policy challenge is then to find out how to reduce jerking without jeopardizing the inner logic of each domain.

Techno-Economic Paradigms and Nets and Constructive Technology Assessment

Two important theoretical approaches to innovation processes are the Techno-Economic Paradigms and the Techno-Economic Networks. Many features differentiate both approaches, and in fact a table with those differences is presented in the paper by Green, Hull, McMeekin and Walsh -originating discipline, scale&scope, originating country, agents of change, mode of interaction, results of interruption and privileged issues-. These differences make it difficult to compare the policy implication of both approaches, TEPs focusing on generic technologies at a macro level and in the long term and TENs centered around specific technologies studied at a micro level and in the short term. (9) Nevertheless, the authors put both theories at work regarding environmental issues to try to assess their level of usefulness. In the case of TEP, their conclusion is that even “Freeman’s presentation of the transition to a green TEP is characteristically stimulating”, there are problems in this approach: “there is a huge distance between, on the one hand, the basics of the t*echnology* and, on the other hand, the necessary environmentally-friendly *artefacts* (i.e. the actual products and processes that are the visible manifestation of a combination of technological principles) and their supporting social institutions and practices related to the artefacts. Whatever pro-environment policies are put in place, there is no guarantee that they will bring into existence either the artefacts or the institutions. The TEP model is too broad-brush for the necessary understanding of the multitude of changes required.” Regarding TEN, the comment goes like this: “it is difficult to escape the criticism that the only practical use of analysis based on TEN concepts is to point out that all programmes/projects/products/systems require simultaneous construction of inter-penetrating networks of people and technologies. Conscious understanding of this will certainly be useful to people running policy Agencies, in that it presses them to seek to *know* what technical and social networks they are putting or have to put into place for their initiatives to succeed. But what policies *should* they pursue? What *kinds* of networks should they construct?” A third approach is presented by the authors under the title “Constructive Technology Assessment as a Resolution of TEN vs.TEP”. Regarding the classical TA , with its focus on the external effects of a technology and the choice between different technological options, “the new field of CTA shifts attention to the steering of the internal development of the technology”. CTA is welcomed by the authors because “it is at this level that policies can be derived to encourage linkages between academia, government and industry”. But problems subsist: “The CTA advocates have identified some of the ways

that the variation activities of firms and other research and development capabilities can be influenced. They also suggest ways that the selection environment may be modified. There is little discussion, however, regarding how the ability to act on a network is distributed across different actors with different perspectives. The quasi-evolutionary model and the CTA framework point to the fact that any group, provided it acts according to the strategies suggested, has the ability to influence the rate and direction of development. However, we might reasonably suppose that some of the actors have more *power* than others and that, provided they use these same strategies, will be more successful at controlling development." In fact, there is an assumption in this approach "that all actors have the same capability to influence decisions." The three approaches depicted by the authors have important contributions. One coming from TEN is particularly relevant in terms of policy: "All 'technological' innovation is the simultaneous construction of networks of relationships between people, things and knowledge. Any agency concerned with making innovation happen (for any policy purpose) is enjoined, therefore, to consider how such networks can be constructed, rather than merely concentrating on issues of funds, project management or the 'transfer of technology'." But why is then that the authors are not satisfied with either approach? "There is a tension between the essentially 'top-down' identification of external patterns in the TEP approach and the bottom-up 'discovery' of patterns specific to particular technologies in the TEN approach", and also regarding the "attempt to resolve the TEP and the TEN approaches as with CTA." The authors proposal, still under construction, is to choose a different *scale* for the object of study, called the "meso-level techno-economic." The analysis is then "focused on the meso-level network of institutions and actors that are at work in *national systems of innovation*, in *firms and their strategies* and in the *construction of markets and consumption patterns*." (Green, Hull, McMeekin, Walsh)

- Communication between the helices

The three helices of the Triple Helix are not, in principle, an harmonious ensemble in which each helix by its own will refrain or mould its own interests for the sake of common good. The outcomes of "triple helix research" -any research which is substantively influenced by academia, industry and government- is the result of complex processes of more or less explicit negotiations; for these to occur at all communication between the helices are crucial. Exploring the communication patterns, that is, the interaction process between the helices, is one of the ways of addressing the question of the dynamics of knowledge creation.

"The interactions between the helices can have different meaning for the interacting units. By providing the interactions with meaning, each helix codifies its operation in a self-referential update." "Innovation is based on a recombination from among different codes into a new code. Disturbance is not a sufficient condition; the disturbance has to be codified. A recombination among codes can be considered as a change of meaning or a translation. Translation systems build upon codes of different systems. For example, a research result can be translated into a product by a firm, or a market demand can be made relevant for a research programme by a funding agency. In a social system, recursive

translation among codes is the medium of communication that is able to carry innovation." "The communication units codify the translation by providing the interactions with meaning from their own perspectives. These communicative interactions among them are the unit of analysis for innovation studies." "Institutions have served the reproduction of communication hitherto…. Social roles are defined at this level. Note that the question of the future location for research can be addressed from the perspective of creating social roles by taking the institutions as unit of analysis and/or from the perspective of creating new functions by taking the communications as units of analysis." "Innovation disturb the stabilized institutions by providing translation of codes, but the institutions can adapt by providing niches for further exploitation." (Leydesdorff)

An important part of what is communicated in innovation processes is knowledge. But this is something far from being straightforward, and not only because of the famous "we know more than we can tell" with which Michael Polanyi introduced us in to the complex world of the tacit dimension. "Contemporary science and technology development in university-industry-government relations shows an acceleration of innovation cycles. The main resources of these cycles is knowledge. One of the problems which arise within this context is the problem of knowledge transfer between different areas of knowledge-production. The main question is: is it possible to de-contextualize knowledge, to disconnect it from its original and to transfer it to arbitrary contexts? To answer this questions it is necessary to consider, whether and how the transferability of knowledge depends on the location of its production." (Ahrweiler, Kueppers and Kuhlmann) "To transfer knowledge successfully means in most cases to reproduce knowledge production and application in arbitrary contexts. Only the reliability of this reproduction mode allows planning, prediction and choosing between alternatives of action." But to reproduce knowledge production and application is not so easy. The authors give the example of "industrial companies, which seems to be incapable to acquire and use relevant knowledge coming 'from the outside' in spite of innovation pressure." The underdeveloped world is well acquainted with this problem, and to some extent for the same reasons presented for much more advanced contexts. "Incoming knowledge has to be evaluated, interpreted and used in for special purposes…New knowledge is not to be adapted to existing structures, but to be integrated with an already defined environment." To do this, knowledge need to be "de-contextualized" and "re-contextualized". "In performing these processes … all participants in the Triple Helix permanently re-define the contents, the limitation and the shape of knowledge. Transfer problems are not only working on an organizational level: they change our representations of knowledge and through that -the process of knowledge production, the research work." (Ahrweiler, Kueppers and Kuhlmann) (10)

Communication and "knowledge translation", both intimately related, are essential for innovation. But what about the "human space" in which both activities take place? "Field work in industrial research institutes has given rise to the hypothesis that a decisive factor for success of industrial R&D programmes is whether relevant parties succeed to come to 'mutual agreed expectations'. This seems to be a continuously process of interpreting, adapting, accentuating, highlighting and contrasting expectations." " We will defend a broad definition of expectations. Wishes, possibilities, needs, prognoses, estimations of risks, predictions, scenarios or visions of the future should all be taken in, because these all can be considered as 'expressions of own expectations and/or of attempts to influence the

expectations of others'." "'The construction of mutual accepted expectations' lays a solid basis to take following decisions that will be accepted by many participants. We will defend the hypothesis that (a) by continuously adapting expectations the relevant groups manage to influence each other so that mutual shared expectations are effectuated but (b) this will be exactly and above all occur on the level of implicit formulated expectations, where boundaries between groups with different cognitive, normative and social perspectives happens to be more easily exceeded. In this way the construction of 'mutual shared expectations' fulfils the function of an interface between different scientific disciplines and different social and political groups." (Luyten and Gremmen)

- The new location of research

The new location of research is a hot discussion topic from many perspectives. One of them, coming from evolutionary and neo-schumpeterian economics, is the discussion on the role of the national state or of the national space in innovation systems. Are they National the Systems of Innovation or are they much more adequately described as Systems of Innovation (of different kind of issues) in a globalized world? The following comments, comparing recent trends on Germany and China show clearly the many facets the problem has. China has been recently a huge receiver of direct foreign investment, and the most prominent German MNC are present there. "Big companies more and more recruit graduates from Chinese universities to substitute the expensive German managers in the joint venture firm or in wholly foreign owned companies…Many of the Chinese employees on the regional labour market with job experience have been trained for the socialistic system and show a strong technical background and lack skills in accounting, sales and management….and evidence show that the so called global players conceive this as a major problem." "Companies start a major attempt in setting up commonly financed recruitment centers for Chinese managers and workers in the region. That strategy takes the dimension of a design of a new educational system in China." "This activity goes on in China while big companies give up their continued education schemes, sacrify the dual system and life long learning in Germany. Multinational companies develop close ties to universities in China while they cut back university support in research in Germany. Interestingly, they engage themselves in systematically building up an improved version of the German dual system abroad." "Chinese employees praise the educational possibilities German companies like Siemens, Braun and Bosch provide for them. Thus programmes turn out to be highly effective." (Gebhardt) Where, then, is the future location of research for these MNC going to be?

The question of new locations of research in terms of globalization is not only related to geographical issues -which are, nevertheless, of the utmost importance. Research has become increasingly international, with governments and inter-governmental organizations, mostly in the developed world, pushing towards more and more international co-operation projects. If the reasons for this trend was mostly cognitive, nothing would have changed in terms of the type of public policy supporting internationalization; something like a "united nations"of NSF, CNRS, and agencies of this sort. But this does not seems to be the real situation. "A study of international research cooperation on the level of inter-firm research

showed that access to other's markets has been among main motivations for co-operation …Therefore, it is not surprising, for instance, to find the MITI in Japan to be the main agency responsible for co-ordinating the country's S&T activities. This could also be explained by the fact that trade in high-technology products constitutes a growing share of global trade in manufactured goods…The link between technological R&D overall, and R&D collaboration in particular, and trade is, so, an issue of high policy relevance. In fact, this assumed relationship between R&D collaboration and industrial activities, especially, trade activities, has provoked a political debate in the US on whether to continue providing access to Japanese firms to the American academic research scene. Japanese access to American academic basic research has been perceived as a factor behind Japan's trade surplus with the US in high-tech products." (Mahroum)

The new location of research is also related to the evolution of particular fields of knowledge and its applications. For many of them, along the problem of production of knowledge or of technology appears the problem of appropriation and regulation -this last one being a problem widely mentioned from very different perspectives-: "the notion of 'product space' is based on the three domains of technology, appropriation and regulation." "Appropriation is substantially contingent on the prevailing technology and its material manifestation through the commercialization of products. The degree and method of appropriation is contingent on the level of control the inventors possess and exercise. Control is based on the prevailing regulation that aim to govern the actualization of the technology -the scope of protection, patent laws, anti-trust regulations, global harmonization of property rights, safety and health regulation, etc.-" "The notion of 'product space' is an attempt to delineate the regularities and patterns in the process of commodification of 'knowledge' that characterize each technological sector". (Rangnekar) The 'product space' is not in itself a new location of research, but it could be used as an analytical tool to understand the dynamics of research location for specific technologies. In the case of plant varieties, the author proposes that once identified its 'product space' through a certain numbers of tendencies and trajectories, both technological and commercial, it could be stated that "these tendencies and trajectories are related to the strategies of innovation and appropriation such as the evolution of a social division of labour between public and private research in plant breeding. This division of labour has enabled the expropriation of public research." (Rangnekar) If "the new location of research" refers not only to the broad and general tendencies but exhibits particular features for particular technologies and fields of research, then the concept of 'production space' could be a useful empirical guide for "new locations" identification.

If there are new locations of research, particularly related to interactions between different actors, it must be possible to identify them. The classical statistical measures of R&D are not able to capture the empirical evidence that there are indeed new locations of research that evidence themselves through new or stronger linkages. "New statistics are being developed which attempt to measure the linkages between people and organizations and have been characterized in a recent OECD document as the measurement of: 1. Interactions among enterprises; 2. Interactions among enterprises, universities and public research institutes; 3. Technology diffusion and 4. Personnel mobility. This new orientation is also leading to an array of different approaches to analysing the national systems of innovation, using linkage statistics." (Anderson) "Although the boundaries between public and private,

science and technology, university and industry are in flux, the linkages between R&D actors are not arbitrary. Rigorous statistical analysis reveals certain patterns in the linkages and can contribute to the understanding of the functioning of university-industry-government relations and networks." This seems also important because surely the linkages are not regular for all type of knowledge, technology, firm, governmental agency, etc. The"new location of research" is a good expression for a heavy trend, but perhaps what is really happening is that there are many new locations, all sharing a common pattern of rupture with older institutional, organizational and cognitive structures but each with distinctive features related to stages of technological evolution, blurring of disciplinary boundaries, regulation policies of the state, etc.

In the same vein goes the contribution by Bianca Pioti, of Italy. The exploration on the new location of research comes in this case from the study "of the significance of the scientific research as a knowledge source in the industrial innovation process." The empirical tool for doing this is a huge survey conducted under the Community Innovation Survey (DGXIII and Eurostat) by the Italian national statistics board and research institutes. The number of responding enterprises was of 22.493 from which 30% resulted innovative firms. One of the conclusion confirms an assertion that appears in many papers presented to the Conference: "we cannot reason in terms of trends and we remain at sectoral level". Specificity seems to be irreducible, so the new locations of research may not show a final common pattern.

Another question could also be: are the new configurations of partnership and relatedly, the new locations of research, stable? Or can they change over time in some predictably way? A long standing research and follow-up of start-ups by researchers in France proposes as hypothesis that "local connections are crucial for the starting period while changing scale lies in the capability in enlarging (and in great part renewing) the sphere of major partners." (Mustar) The idea that SME and big firms have totally different research needs, cultures of collaborations -among them and with the research system- and also capabilities to make their best out of knowledge is in the base of many specific innovation policies in the developed world. How are this specificities reflected in the Triple Helix conceptualization? A British research addressed a similar question from the angle of "the regimes of governance and appropriation that shape the commercialization of university science, specifically as this is undertaken via university spin-off firms." "How are knowledge and innovation -inherently uncertain and random- stabilized and translated into commodified, economically valuable products?" A partial answer is as follows: "Where regimes of appropriation and governance are in tension with each other, the possibilities for successful commercialization are much reduced. This is true for both public and private sector science, suggesting that there are common problems faced by both sectors when they engage in the process of commercializing knowledge." (Webster)

One thing is where research is located and another is who pays for research. Nevertheless it is interesting to ask which is really the "place" of a research done in a particular "space" but paid by another "space". In any case, a contribution to the Conference rises the question of how much people know in the US about the location of research. "For example, when Research! America asks who pays for medical research, about 75% says the government and taxpayers. Only about 10% says business and industry, yet industry pays for more than half of the medical research conducted today." "There is public confusion as to who

conducts research as well. For example, when Research! America asks at what type of institutions or organizations do you think most of the medical research in this country is conducted, universities are most often listed as the top response. Industry actually conducts most of the medical research conducted in the US. " (Woolley) So, even if the location of research is where the objective data says it is, people can think otherwise…

- OPEN QUESTIONS

In their referential paper, the Conference convenors make a strong assertion: "Within academia, puzzle solving has nowadays become as important as truth finding. The quality of the communication and the validity of the knowledge claims is warranted by disciplinary control, while the system opens laterally in terms of the agendas that the various specialities are designed to address. Thus, universities take on some business roles: marketing knowledge, taking research into product development, and assisting in the formation of new firms. The recombination of elements from different sources has become a major challenge, leading to new developments." (Leydesdorff and Etzkowitz)

Assuming the general validity of the first phrase - within academia puzzle solving has become as important as truth finding-, a wealth of questions appears, shedded into the open by the ensemble of reflections and empirical research presented at the Conference. Just to make a point, we present only three of them:

How is changing the university research agenda given the growing importance of puzzle solving activities?; how are equilibrium preserved or changed between researchers' activities in terms of puzzle solving and truth findings? What is the level of autonomy of academia while searching for these equilibriums? Which are the main factors that determine the degree of autonomy?

How is changing the academic system of evaluation to take into account the levelling of importance between puzzle solving and truth findings? Or it is not changing, at least explicitly? If we agree that an evaluation system is not only a "reward or punishment" system but also a "signal system" to guide future research efforts, how could the future agenda of research be forecasted taking as point of departure the new evaluation systems?

Puzzle solving is a much more social activity than truth finding; it needs more an external demand than the following of internal paths of scientific search. Latin American universities have been in the past -and still are, even if to a lesser extent, in the present- committed to society as a whole and particularly to the most deprived sectors in society. Social awareness has been an "identity mark" of the Latin American public university, even if this commitment has taken more a direct political form than an academic one. Now that puzzle solving has become so important, a big challenge must be faced: for whose problems shall the puzzles be solved? For the ones in a position to pay for the service or for the ones that need solutions regardless their capacity to pay? Is this a university responsibility or is it government the actor that should answer these problems? In any case, if cognitive social awareness could be avoided when truth finding was the main academic activity, this can no longer stand now when puzzle solving puts in such a direct contact

research with society, without distances. How to think the future of research in such a landscape?

Montevideo, March, 1998.

Notes

(1) The author of this relator thanks the Canadian International Development Research Center for its generous support and encouragement.
(2) Academic Coordinator of the University Research Council, Universidad de la República, Uruguay.
(3) "In the longer historical perspective, an increasing differentiation and diversification of R&D and its institutional setting has taking place and the pace of changes still seems to be accelerating. " "This has meant a clear shift of emphasis form the disciplinary context of knowledge production to an application oriented and commercial context of R&D, or from the public 'republic of science' to a less public, but more competitive system of 'scientific entrepreneurship'." (Kaukonen, Nieminen)
(4) Terms quoted in Kaghan contribution form Ostry, S. and Nelson, R. (1995) Techno-nationalism and Techno-globalism: Conflict and Cooperation. Washington D.C.: Brooking Institutions.
(5) Some of the remarks made by British firms in this direction are quite interesting from a comparative perspective. What these firms say regarding the importance of having access to the latest laboratory equipment is exactly the same that Uruguayan software producers say explaining their preference for the engineers trained at the public "academic" university and not for the graduates from private and much better equiped colleges: *"Graduate have been recruited because their intellectual ability and generally have to be trained in the use of the wide range of sophisticated equipment we regularly employ…"; "It is much more important that he/she understands* ***how****, for example, a Fourier transform spectrometer works than how to switch on a particular manufacturer's model."; "With postgraduates we are indeed looking for relevant skills which can be transferred. However, again we are not critical of their general experience and recruits that have had to do their research with 'make and mend' equipment are also regarded as having proved their ability*". (Nedeva, Georghiou and Halfpenny)
(6) This is a kind of aim that could not be accepted at all, at least in this open formulation, neither by the authorities nor by the teachers and the students of almost any public Latin American university.
(7) Megascience is defined by Canadian agencies as "those projects which are undertaken primarily for the production of knowledge and which requires both formal management structures and resources which cannot be supplied by a single patron (agency) without unacceptable distortion of the budget of that patron (agency)," (Lanford and Whitney Langford)
(8) This characterization reminds the distinction made by Nathan Rosenberg between "technological desequilibrium" and "technological convergence", the former acting as a sort of "self-organizing technology agenda" and the latter explaining the expansion of a given set of innovations.
(9) The authors quoted a paper by Laredo and Mustar - "The technoeconomic network: a socioeconomic approach to state intervention in innovation", in Coombs, R., Richards, A., Saviotti, P. &Walsh, V. (eds), *Technological Collaboration: the dynamics of cooperation in industrial innovation*. Cheltenham: Edward Elgar, 1996- in which these French authors "argue that the TEN is a new form of collective actor, which creates collective knowledge and skills. They called the research carried out 'basic technological research'. It is 'basic' because the large majority of the research teams, and not just the academics, place a great deal of emphasis on outputs normally regarded as 'academic' such as PhD theses and publication in refereed journals. It is 'technological' because a majority of the teams, and not just those of industry, take part on the assumption that a new commercial product or process will (eventually) result from their work." Perhaps it is worth mentioning that exactly this expression -"basic technological research"- is the one used by technologist in the Uruguayan university to describe what they do.
(10) This remark , made in the context of a reflection coming from the sociology of science, is very similar to the one done almost twenty years ago by Edgar Pisani, then European Commissioner for the Lome Convention on development policy for the Third World. Pisani described the problems of the usual concept of technology transfer and finished by stating that anyone that want to use a foreign technology, must, id a sense, re-invent it. Nothing different than that is the process of de-contextualize and re-contextualize knowledge, process in which the representations of knowledge are changed. And this has not only cognitive consequences but social consequences as well.

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Paul Naesje (Norwegian University of science and Technology, Norway): Between the "Ozone-Crater" and a Change of Climate. Heat-pumping Technologies meets Enviromental Regimes before and after the Montreal Protocol.

Maria Nedeva, Luke Georghiou, and Peter Halfpenny (Victoria University of Manchester, UK): Research Equipment in United Kingdom Universities: is industry going to help?

Richard Nelson (Columbia University): The Surge of University Patenting: What are the Causes? (Opening paper of the Conference)

Nirjo Niskanen (VTT Group for Technology Studies, Finland): Knowledge Production in Transition: Merging together Scientific and Technological cultures?

Hiroyuki Odagiri (University of Tsukuba, Japan): Innovation in Japan and the Universities

Guilherme Ary Plonski (University of Sao Paolo, Brazil): Industry-University Cooperation in Latin America: Old Dilemmas and New Challenges

Bianca Potì (CNR, Rome, Italy): The role of the public research system in the national wealth creation through innovations

Victor Prochnik (Universidade federal do Rio de Janeiro, Brazil): Cooperation among University, Industry and Government in the Brazilian Software Production and Export Industrial Policy - Softex-2.000

Dwijen Rangnekar (Kingston University, Kingston, UK): Technology, Appropriation and Regulation: The Product Space of Plant Varieties

Bhaskara Rao (University of Brasilia), **Uma Bala Rallabandi** (Ancient History Consultant, Hyderabad, India), and Rajyalakshmi Karumanchi (Contemporary Political Scientist, Lisbon, Portugal): Market Oriented New Educational Order for the 21st Century

Emanuela Reale and Anna Maria Scarda (CNR, Rome, Italy): Intermediary bodies as engines of the future location of research in postmodern research systems

Nevill Reeve (Ministry of Research, Wellington, New Zealand) and **Sally Davenport** (Victoria University, Wellington, New Zealand): The Nature and Impact of Changes to the Public Sector Infrastructure of Research Science and Technology in New Zealand

A. Roersch, A.P. Verkaik, H. Rutten (National Council for Agricultural Research, The Netherlands): The Function of Portfolio Management in Research and Innovation Policy

Artur da Rosa Pires, Carlos José Rodrigues, and Eduardo Anselmo de Castro (Universidade de Aveiro, Portugal): The Co-operation between higher Education-Industry-Government in Portugal: The Effects of Cultural and Organisational Characteristics of Universities

A. Sachidanandam (Consulting Economist, Hyderabad, India), **S.A.Bilgrami** (Consulting Economic Geologist,Karachi, Pakistan), and **A. Bhaskara Rao** (University of Brasilia, Brasilia, Brazil): Globalisation and U-I-G Integration in Developing and Newly Born Countries

Ulf Sandström & Mats Benner (Linköping University, Sweden): Academic norms in transition? The instititutional regulation of university research in the "triple helix".

Luis Sanz-Menéndez (CSIC, Madrid, Spain): Academia-Industry-Goverment Relationships: Single Dynamic or Co-Evolution of Three Independent Systems?

Jacqueline Senker (SPRU, Brighton, UK): The Relationship Between Publicly Funded Basic Research and Economic Performance

Terry Shinn (CNRS, Paris, France): The Stone of Sisyphus: Structures, misalignment, and re-stabilization in academia/industry transactions

Eva Stal (University of São Paulo, Brazil): Cooperative Research Centers in a developing country: will they enhance university-industry-government relations in Brazil?

Rikard Stankiewicz (Copenhagen Business School, Denmark): Technoscience and the Evolution of Design Spaces

Pal Tamas (Hungarian Academy of Sciences, Budapest, Hungary): Government-sponsored research and multinational corporations in Eastern Europe. The case of the Hungarian industrial research networks

Branca Regina Cantisano Terra, Henry Etzkowitz, and Jose Manoel C. Mello (Federal University of Rio de Janeiro, Brazil / SUNY, Purchase, US): The Role of Government in Innovation: A Diagnotic Study of the State of Rio de Janeiro - Brazil.

Sheila Tobias (Tucson, AZ, USA): The Science Trained Professional: A New Breed for the New Century

Blanka Vavkova (CNRS/IRIS, Paris, France): Local research systems in centralised Nation states and a global economy: the case of France

Lea Velho, Deborah Mello, and Solange Corder (State University of Campinas, Brazil): Engineering Research at the University of Sao Paulo, Brazil: Has Anything Changed in the Last 10 Years

Vivien Walsh, Ken Green, Richard Hull, and Andy McMeekin (Manchester University and UMIST, UK): The Construction of Techno-Economic Networks

Andrew Webster (Science and Technology Studies, Anglia University, UK): An Approach Towards the Commercialisation of Science: Beyond the Public and Private Divide

Jiang Wen and Shin-ichi Kobayashi (University of Electro-Communications, Tokyo, Japan): University-Industry R&D Network in Japan: Is Japanese Firms' R&D shifting toward more academic research?

Mary Woolley (President, Research!America, Alexandria, VA USA): Who Should Support Research In the United States? The Public's Opinion on the Role of the Federal Government, Academia and Industry