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Executive Summary

This report analyses the feasibility of the European Institute of Technology (EIT) as proposed by the European Commission in the draft Regulation of November 2006 by positioning it in the context of existing universities, research establishments and institutions and programmes for supporting innovation and technology transfer in Europe. Because the EIT has been put forward as an important contribution to close the gap in growth and innovation with the US, the analysis draws extensively on the situation in the US and, too a much lesser degree, in Asia. As the conclusion is that the impact of this particular form of the EIT would suffer from too many constraints, the report puts forward in the concluding chapter an alternative, coined a cluster EIT consisting of multiple European Institutes of Technology in Fields X, Y, Z, etc. It proposes as well that the European Parliament advocates the creation of a European Innovation Fund.

EUROPE’S WEAKNESSES ARE NOT HOMOGENEOUS

The relative weakness of Europe to convert knowledge into commerce and critical mass or to reward entrepreneurship and excellence in research and education is not a problem that is the same for all countries, all regions or all institutions. Ignoring this fact might result in assuming too easily that a European level institutional solution is necessary in cases where national or regional approaches might be more appropriate.

Based on the Summary Innovation Indicators of the Commission’s Innovation Scoreboard, several of the smaller European countries and Germany perform significantly better than and/or as good as the US and Japan.

But national differences in innovation performance obscure regional strongholds that are often based on specialization. The 2006 Regional Innovation Scoreboard highlights several instances even in the new member states. Both national and European policies should strengthen such strongholds, learning from the US that the variation in the research and innovation performance among the various US States. Overall growth, catching up and specific national measures should continue to focus on reducing GDP disparities. However, the EIT should not be judged in the framework of such policies. Compromising its goal of excellence will render the initiative useless.

Many individual European universities perform quite well on formal indicators such as patents or executing licenses or start-ups, so much so that Europe on the whole does not fare badly compared to the US. However, European students’ and universities’ attitudes towards entrepreneurship or a career outside academia, particularly in the fields of science and engineering, are less favourable than one would desire. 8% of first year students at the ETH Zurich considered setting up their own company, but only 2% were still interested in doing so by the end of their study. Income secured from industry contracts for university research in Europe equals 7%, a percentage that is slightly higher than that in the US, though of course large differences between individual institutions exist. MIT (~15%), Stanford (<5%) and Caltech (<2%) demonstrate that industry income is not the measure of being highly valued by industry and society.

Finally, a more down-to-earth view of what the EIT proposal refers to as ‘integrated approaches towards education, research and innovation’, demonstrates that at a practical level more is being accomplished by many universities and research establishments than an abstract analysis would indicate.
DISTILLING THE PRECISE NATURE OF THE EIT AS PROPOSED

The Knowledge and Innovation Communities (i.e., made up of 100 academic staff, 300 researchers, 600 technical and supporting staff from universities, research institutes and companies, 600 Master students and 400 PhD students with an annual budget envisaged for 2013 at ~ 135 M€) are the ‘workhorses’ of the EIT. These widely dispersed communities will conduct research, train students and support innovation. Contrary to the Commission’s proposal, the Knowledge and Innovation Communities will not produce innovations, given that we believe that the production of innovation is the core activity of companies especially those companies that participate in a KIC. The universities and research institutes as well as the EIT, must provide a fertile environment so that the required interactions with industry can take place.

The direct impact of the EIT, then, is the result of concrete direct outputs:

- Graduates;
- Scientific publications and other direct research outputs;
- Technological and other useful knowledge;
- Inventions;
- Intellectual property (e.g., patents, trademarks, designs, plant breeder’s rights, etc.);
- Spin-off companies.

The indirect impact of the EIT can be subdivided into:

- Improved performance and modernization of the European higher education institutions through its activities, outputs and governance;
- Improved performance and modernization of the European research institutions through its activities, outputs and governance;
- Improved performance of European companies by offering a reference for new forms of collaboration with higher education and research institutions;
- Improved performance of networks of partners from these categories by offering a reference for new forms of collaboration between them.

In addition two more should be expected from an EIT:

- Increased innovations in European industry through EIT graduates, technological knowledge, inventions and IP;
- Increase of future academic and industrial leaders who have the added experience of working in an environment that encompasses both academia and industry.

It is important to realize that the EIT has to become the best institute for higher education and research in Europe to accomplish the proposal’s ambition that it becomes a strong reference point for the existing best European universities and research institutes. Indeed, its various direct outputs must be better than those of the best-in-class institutions since quantitatively its eventual overall annual budget of 0.9 B€ only equals that of top-ranking European universities and is much smaller than annual budgets of the top US research universities.

Three basic organizational models exist. The first model is based on a fully centralized EIT that would be located at a specific location. The Commission proposal opts for a fully decentralized model where research, training and the support for innovation at one KIC will be carried out by a large number of teams across Europe.
We propose a third option, a cluster model for the EIT. This option consists of multiple institutes or KICs – to derive the terminology of the Commission’s proposal – but each being physically concentrated at one or only a very small number of adjacent locations. The various institutes are knit together only by a funding instrument and a brand name.

**Pointers from the Economic Analysis of Knowledge Production**

Knowledge is a form of ‘joint production’: private and public investments in knowledge have strong complementarities and geographically strong agglomeration features.

The formation of relatively closed national ‘joint production’ R&D systems coupled with the fragmentation and dispersion of funding among European universities and other public research institutes located throughout Europe, has diminished their ability to attract European and foreign firms that have gone international in search of alternative joint knowledge production opportunities.

The ‘crowding out’ of fundamental, basic research by private firms as it occurred over the last twenty years, has been paralleled by a ‘crowding out’ of applied research by universities. National competition in the same priority areas (e.g., ICT, life sciences, etc.) are not optimal in bringing about increased quality and concentration or in reducing fragmentation.

The ‘human capital’ argument which is heavily based on making the researcher’s profession more attractive, equally involves increasing the dynamics of the local environment. As this requires work on the physical, social and local cultural factors, both national and regional policies must become more aligned to support the local and regional poles of attraction, which could in turn help to increase human capital mobility.

A decentralised EIT that works with local teams or groups will only marginally contribute to regional poles of attraction. A centralized EIT would strengthen one pole, if time, money, champions, etc. were available. However, it would unlikely have a real impact on today’s existing European universities and research institutes. Under the prevailing conditions, a third alternative cluster model has the greatest potential to strengthen the main local/regional agglomeration aspects of joint knowledge production in different research areas turning them into attractor poles for knowledge workers.

Such a cluster EIT will, moreover, attract regional funds to enhance its feasibility and fits the broader vision that ultimately the success of Europe’s regional knowledge attractor poles will determine whether Europe will achieve its Lisbon ambitions.

**European Institutional Lessons**

A first lesson to be learned from the many attempts to create European institutional solutions for higher education and research -- that is solutions linked to the formal political European system -- is that a rationale to do so was lacking. That rationale could be the need for an institution with a truly European nature, which underlies for example, the European University Institute in Florence, Italy.

A second lesson that might be learned is that success is only possible when a strong supporting rationale is coupled with the legal basis and implementation instruments in the Treaty. The case of large research facilities illustrates this point: while in this case a clear rationale exists, and should have lead according to the principle of subsidiarity, to a legal basis, the Member States did not accept it. The ERC is maybe the first instance where external pressure convinced reluctant ministers and an equally reluctant Commission to create a new
institution. The rationale in this case is provided by the success of the US federal funding system.

The rationale for establishing an EIT as a European institution should therefore be closely scrutinized; if it turns out that the rationale is weak, then the absence of evidently applicable legal instruments in the Treaty would constitute a serious hurdle.

**EUROPE’S UNIVERSITY LANDSCAPE**

There is a US system of higher education, but there are no federal universities. Of course there is no Asian system of higher education, but it is clear that both the degree structure and policies for mergers, excellence and autonomy, in several of the larger Asian countries are headed in the same direction as those developed at American top tier institutions. Attempts to create Asian institutes of higher education have faced similar hurdles as in Europe.

While there is little doubt that Europe will experience the development of new high-quality universities, many of which will evolve from existing ones, they will most likely be private or will be set up or supported by national governments. It is not unlikely that some of these private universities will be set up with a European character, student population and faculty in mind, especially when European countries would agree to develop European instead of national accreditation schemes. However, it is unlikely that they would be dependent on or closely linked to the European Union, given that the Treaty exclusively reserves responsibility for higher education to the member states. The process will hopefully be kept on the track of greater differentiation, larger concentrations of excellence, and more and more substantial competitive European level funding instruments for academic research.

A summary of the position and the way ahead for European universities, based on our overall analysis and the comparisons made in this section, leads to several pertinent statements.

Europe has several top tier universities of high quality offering excellence over a broad range of subjects. Where they differ from US equivalents is in their selectivity of admission, share of undergraduate and graduate students (apart from a few exceptions such as ETH Z), size of research budgets, and to a lesser extent, in their level of interdisciplinarity which might be related to the much narrower bachelor curricula in Europe.

Over the past 15 years, many universities have been actively engaged in projects to collaborate with industry and commercialise the knowledge that they developed. While many of these attempts have been stifled by bureaucratic transfer offices, it is safe to say that several very successful examples exist. A small selection of examples include initiatives in Leuven, Belgium with the Leuven Research and Development centre, in Cambridge, UK with the Cambridge University, in Stockholm, Sweden with Karolinska, in Zurich, Switzerland with ETH, or in Warwick, UK. Each of these initiatives is based on the drive and determination of individuals who were able to carry forward simple approaches over a period of several years (i.e., in the order of 10 to 15 years) to show success in terms of employment generated and capital created. European universities should be more active in institutional learning from these and other examples.

The challenges for European universities as a whole are great: more concentration (which does not imply an increase in the sheer number of students, as the US example indicates), larger differentiation, increased autonomy, increased selectivity of admissions, more flexibility within the internal organization and funding arrangements to stimulate interdisciplinarity, changing the mind-set of students and staff to include a focus on the outside world, which in turn would include more flexible employment regimes which for
example would straddle the border between academia and companies are all paramount to success.

That said, one must recognize the substantial reforms that have already been initiated across Europe. Sure enough, these reforms did not uniformly occur across Europe, but neither were they limited to for example, the North-western region.

It is important to realize that all of these challenges must be met by the universities themselves and by national governments and policies. At the European level some very important conditions can be created, one of the most important of which, as our comparison with the US shows, includes increased European funding instruments for academic research. This is why the European Research Council (ERC) is regarded as such a critical institutional innovation. Resembling the large US federal funding agencies, the ERC can provide a major boost to the European landscape if (a) it lives up to the challenge of being an independent, non-bureaucratic institute focused on excellence, and (b) if European governments will agree to increase its budget and give it the time to develop longer-term funding schemes without becoming impatient for its results.

This is the context in which the assessment of the EIT’s impact will be studied and discussed.

INSTITUTIONAL LANDSCAPE OF RESEARCH ESTABLISHMENTS

One might be inclined to conclude that the European landscape of research establishments is very fragmented and that much greater concentration is required in this fragmented European landscape. Yet, it is not concentration into very big establishments that seems to be the main challenge. For in this regard the US example is less instructive and conclusive. In the first place very large research organizations exist also in Europe, partly with a mission-driven background (e.g., CEA in France) not dissimilar to some of the big labs in the US. More importantly, the Federally Funded Research and Development Centres (FFRDCs) are not on average accredited with the better growth and innovation performance of the US economy (note that there are exceptions such as the Lincoln lab operated by MIT).

Size and critical mass are of course important. As more and more research becomes interdisciplinary and collaborative by nature, often requiring a variety of equipment, small research labs will become less able to compete at world level in the areas the EIT would concentrate on. To be clear, the individual research teams need not necessarily be large, but they should work in an environment where many research teams focused in related areas, exist. The EMBL illustrates the way that this is accomplished. It is, however, important to note that there are also limits to the size of a lab. While it is different when large-scale technology development is at stake, in many areas, such as the life sciences, nanoscience and technology or materials science, laboratories with a population greater than 300-500 scientists, including postdocs and PhDs, do not necessarily offer substantial added value. In fact, recent developments in the pharmaceutical industry where large research labs have been split up into units of this size (i.e., 300-500 personnel) further illustrate this point.

No doubt, some of the smaller national research institutes need to open up further, starting with an increased international performance assessment. They would also have to increase size to reach critical mass, which might be accomplished through mergers, including mergers with universities. Similar to the situation for universities, the national governments are in charge of leading this process, and much can be accomplished by reorganizing funding instruments at the national and European level.
Aside from ‘opening up’, institutes should establish closer links with universities or should consider merging with universities. The German Max Planck Gesellschaft is well on its way to work on this.

A public and transparent evaluation of the performance of the research centres or larger units located within these centres, including university departments, would help enormously. It would be especially important that action takes place at the European level. The previous commissioner Busquin has started working on this, but there has been no follow-up. The level of detail cannot be too high for the exercise to be manageable. The global university rankings provide useful methodological suggestions.

**INSTITUTIONAL SUPPORT FOR INNOVATION AND TECHNOLOGY TRANSFER**

Several large-scale co-operative schemes exist at the European level which companies, universities and research centres find attractive and effective for joint technology development and future innovation, provided transaction costs (i.e., bureaucracy, administrative overheads, politically correct partnerships, etc.) are kept to a minimum. Some of the large EUREKA clusters act as examples. The Joint Technology Initiatives, which do not yet exist, have also received a positive reception. Adding an EIT might result in an overpopulation of the realm of these types of instruments for large-scale cooperation between firms and with universities and research institutes. An EIT KIC, a JTI or, a MEDEA cluster could theoretically each be given a niche of their own on the chain from more basic research and development to market introduction, in practice though the instruments will very likely compete for partners.

Analyses made by the key players in for example, micro-electronics and nanoscience and nanotechnology, strongly indicate that the key feature of the desired European landscape is a series of strong, critical mass centres at existing universities or research institute coupled with a few large scale institutions to bridge the gap between academic research and company in-house technology development.

Countries have started to implement policies to introduce greater differentiation among their universities (e.g. Germany and the UK). However, this is in the first place, a realm for national policies including the judicious use of Structural Funds wherever applicable. Funding instruments for academic research, such as the ERC, seem to be the only realistic instrument that can be implemented at the Community level.

Several examples have been given of national policies to promote innovation, which now invariably cover a broad spectrum: supporting problem-driven R&D, ensuring sufficient capital including seed capital is available for the various stages of the innovation process, stimulating technology transfer and incubation. Often in conjunction with ever more explicit policies of regional and local authorities, these policies increasingly focus on regional concentrations of players in the innovation process as a basis for national and international coalitions.

Explicit attempts have also been mentioned to bring together public and private research in structurally funded strategic partnerships (e.g., Belgium, France, and the Netherlands). Underlying these attempts is once more the conviction that critical mass (e.g., human resources, facilities) is necessary and that this is best realized in a fair degree of geographical concentration. The partnerships which are at the core of the EIT (i.e., the KICs described in the Commission proposals) should reflect this.
The European Institute of Technology (EIT) as proposed by the Commission combines the following three objectives: graduate training, research and innovation, which we have argued should be read as, support for innovation. Its purpose includes being ‘best in class’ thereby becoming a reference for the reform of higher education, research and collaboration with industry. Each of the KICs that are at the core of the EIT will be comprised of teams made up of several universities, research establishments and companies that will be based throughout Europe. In addition, there will be a Governing Board supported by a small administrative headquarter that will be used for the KIC selection and evaluation process and for the setting of overall policy. The first KICs should according to the Commission’s proposal be operational by 2009. The concept of KIC as in the reference proposal of the Commission with the specific characteristics as outlined above (i.e., the combination of training, research and innovation support; the fully decentralized nature; the rapid pace at which it is created and made fully operational) raises serious questions regarding its feasibility.

When one compares the proposed size and budget of the EIT: i.e., an eventual annual budget of 900 M€, 115 M€ of which should come from the Community budget as core funding with the budgets of large American and European research universities at 1 to 2 B€, major research organizations such as EMBL at 120 M€, and IMEC with a 200 M€ turnover rate and regional concentrations of R&D such as Minatec with its proposed employee base of 3500 fte, it becomes clear that the proposed KICs with their average budget of 135 M€, will not provide for a uniquely large enterprise given their dispersed nature. There is clearly a need here for a more seriously thought-over financial basis for such KICs based on mixed public and private funding but allowing for differences amongst the various KIC fields in the relative contributions of public and private funds.

There is no question that there is a need to modernize and improve all levels of graduate training in Europe (i.e., not only for PhD students). That said, it is important to note that a KIC does not provide the proper environment for such training. Students choose for a ‘place’, a university or a large research institute, where they can find a large number of stimulating faculty, a rich course offering and a variety of other facilities and opportunities to expand their scope and enhance their capabilities to extend beyond the narrow focus of their specific research topic. This holds a fortiori for education at the Masters level. Furthermore, being part of an alumnus of such a university or institute is of considerable value to both the graduate and, increasingly to the institution. One only needs to look at the importance attributed to the financial contributions from alumni to universities and research institutions through the US. The ability to create a unique, specialized ‘place’ or environment where people wish to migrate to is paramount to the success of the EIT.

Quantitatively speaking, a KIC would not make a significant contribution to the number of graduates within a specific study area. With respect to the granting of degrees, this report argues that the value of each degree is intimately linked to the reputation of the university that confers them. An EIT as proposed cannot offer through the KIC format, an environment equivalent to those provided at top tier research universities. Therefore it is unlikely that a joint degree from a participating university and the EIT would add any substantial value to the degree received from the university alone.

The analysis of the size of the teams participating in a KIC indicates that no significant increase in the overall research output of any given field would result. European researchers are already productive and so any additional output would therefore be more or less proportional to the additional number of researchers. It is hard to predict whether a KIC would lead to a substantially higher number of publications in high-impact journals. Once
again, experience suggests that a stimulating physical environment of critical mass with students and staff of high calibre is the best predictor for this. While researchers may be more strongly motivated to collaborate with their peers in a KIC, one should not underestimate the degree of collaboration and co-publishing that already takes place. It is also important to note that research in science is highly competitive and this limits the desire of researchers to form large networks or more formal communities.

Considerably stronger output from industry-university-research institute collaboration and subsequent support for innovation, including technology transfer, is not likely either. In terms of numbers, the differential that a KIC would add is not large enough. Longer-term relationships between firms and universities and research institutes will not involve that many players. A KIC with partners throughout Europe is also unlikely to provide a best-practice technology transfer service across Europe. Such services are either built up at a particular university or institute, or between limited numbers of institutions located within a geographically limited area.

The report points out that there may be significant substitution problems. In several important fields where a KIC would most likely be considered, instruments already exist or are under construction to promote collaborative research, technology development and technology transfer. EUREKA clusters are a case in point, where partners may not see the advantage of being replaced by a KIC. The Joint Technology Initiatives currently being formed under the FP7 would also appear to compete with any potential KIC given the fact that the differences between these two entities are not clear enough. We note, but do not simply adhere to the views expressed by some companies that a KIC will complement rather than compete with such initiatives.

The limited impact that a KIC, hence the EIT, would have on the quality of graduate training, research and, industry-university-research institute collaboration, coupled with the substitution effects, suggests that the EIT through its KICs cannot easily develop into a reference for the existing top tier universities or research institutes in Europe. Its dispersed nature would not assist the universities and national governments in their quest for reforms leading to for example, increased differentiation, autonomy and better governance, or for more effective technology transfer practices.

ON LEGAL ASPECTS

Establishing the EIT on the basis of Article 157, paragraph 3, does not seem to pose problems. However it is doubtful whether a Community institution can confer degrees, as Article 149 EU Treaty confirms the primary responsibility of the Member States for education. That said, it has been argued that an EIT degree would not have great added value anyhow.

It is not advisable to establish the EIT legally as a Community institution. Like the ERC it is far preferable to establish any EIT as an independent organization. Indeed, few national governments would consider establishing an institution of higher education as part of their government structure. The Joint Undertaking option (or any other structure) on the basis of Article 171 EU Treaty runs into the problem of determining who shall be members of the Undertaking, and the fact that structure and organization have to approved by Council and Parliament bodes ill for simplicity and independence.

An intergovernmental organization such as CERN or ESA is already for a long time no longer the favoured solution of governments who dislike on the whole international personnel statutes and similar amenities.
Instead, the structure of the EIT can follow one of the national constructions available in the country of its headquarters.

To create a European Economic Interest Group is not evident as an EEIG serves to facilitate the activities of its members that are existing economic actors that, moreover, in the first place are thought of as companies.

The internal legal aspects require further detailed consideration. This report touches upon a few issues, some of which are complex, such as the legal nature of a KIC. It is our belief that complexities associated with the internal aspects are all surmountable, as the experience in large European collaborative structures have demonstrated.

ON FUNDING

The funding model proposed for the EIT does not seem feasible. An institution for education and research with a core funding of only one eighth of its estimated budget will not be sustainable because it would not provide sufficient incentive for others to provide matching funds.

Acquiring large amounts of funding from the Framework Programme or other project-based funding sources would make KICs extremely dependent on the success of individual teams and would therefore be very unstable. High expectations that industry will fund EIT are not justified as longer-term funding from industry in collaborative institutions only occurs when a limited number of partners are involved.

It is possible to create a new funding source for innovation, for an EIT or for other activities that support innovation, if the Community would follow the Canadian example and establish an Innovation Fund by transferring parts of the Community budget monies that at the end of every year remain unspent to this Innovation Fund, instead of returning them to the national treasuries. The European Parliament should advocate this. It would be another test of the governments’ willingness to live up to the Lisbon ambitions.

OTHER INNOVATION POLICIES AND THE EIT

Apart from its insufficient financial basis, the weaknesses of the EIT as proposed by the Commission derive from its institutional set-up. Policies to promote innovation in areas such as IP, procurement, regional innovation strongholds or capital markets are important to create the right environment and incentives for innovation and cooperation between public and private partners. But they do not address and therefore cannot redress the institutional weaknesses of the EIT as proposed.

As for IP policies, some national governments might wish to decide to break out of the stalemate regarding the European Patent and head in some way towards the right direction. A grace period or something having a similar effect such as a provisional patent application should be introduced immediately to accommodate for the rapid advances in areas such as the life sciences.

Overall, policy development in innovation should address more explicitly the use of e.g. environmental regulations and the European problems of entrance into markets and rapid growth of companies after their initial stages.
An alternative Cluster EIT: Multiple physical European Institutes of Technology in specialized areas

An option that deserves serious consideration in the light of our analysis is to create a cluster EIT. That is, to gradually create up to maybe 20 European Institutes of Technology, each of which would have of the order of 300 scientific and engineering staff without PhDs and an annual budget of up to 70 M€. Each would have its own multidisciplinary theme derived from problems identified by a Board as the major drivers for industrial development for the next 10 to 20 years. On the Board industry would be strongly represented but also academia, politicians and civil society. Competition would lead to the selection of proposals from strong regional or national consortia that would base such an EIT in a particular area at one or a very small number of universities or research centres which will provide academic backing, with constantly new generations of eager young persons, and the social environment of a city. High-level core faculty and infrastructure, a large number of visitors including from industry, many PhD students and postdocs, and shared technology transfer facilities with the host institution, are some of the other characteristics of this model, which is not dissimilar to for example the Cold Spring Harbor Lab in the US. Exciting possibilities to improve graduate training will also result.

The funding scheme would entail 1/3 core funding, 1/3 structural matching from regional or national sources, and 1/3 funding from public and private competitive sources. The proposed Innovation Fund suggested earlier might provide the 500 M€ or so required for the core funding for some 20 institutes. If less central funding is available, then gradually building up the number is an option; another is that the available central funding could perhaps trigger one or a small number of countries with high ambitions to be key players in the global knowledge economy to take over the scheme and provide the remainder of the core funding.
1. **INTRODUCTION, STUDY ASSIGNMENT AND STUDY APPROACH**

The European Parliament (EP) commissioned this independent study review to obtain an independent critical input and analysis regarding the feasibility and potential impact associated with the development of a European Institute of Technology (EIT). The study bases its review on recommendations made by the Commission by analysing the issues of feasibility and impacts from the point of view of the following three major policy areas where the EIT acts as:

- a member of the European higher education landscape;
- a major research establishment;
- a major source of innovation and technology transfer with significant industrial impact.

The European Commission (EC)’s proposal to establish an EIT has provoked a multitude of reactions. The multitude and variety of these reactions are in part due to the proposal’s evolution. The most current November 2006\(^1\) Commission proposal is substantially different from the original which proposed the development of a European institute of higher education based on the Massachusetts Institute of Technology (MIT) model. An assessment of the feasibility and the impact of the EIT must begin with the identification of problems the EIT is assumed to address; an understanding of what essential characteristics are currently envisaged for the EIT; and, an understanding of what outputs and impacts are expected from the Commission’s definition of an EIT. This first chapter attempts to provide this analysis after a brief overview outlining the way in which the authors of this report have addressed the subject.

This study adopts an approach based on a comparative analysis of existing organizations and instruments to gauge the EIT proposal. After all, many good examples of both instruments and institutions supporting innovation and technology transfer in higher education and research in Europe and abroad already exist, and they should therefore be taken into consideration. This study is thus ‘experience-based’ but it takes into account relevant policy studies. It is also more operationally, institutionally and historically oriented than other studies and selective towards key issues. The study does not attempt to be comprehensive on detailed features of the EIT proposal. For example, this study will not review the precise differences between the various and rather abstract organizational models that were outlined in the Impact Assessment accompanying the proposal for a Regulation. Instead we will argue that only a few basic models for the EIT exist.

Many explicit comparisons will be made between instruments and institutions located in the United States (US) and Europe. The purpose of studying the feasibility of the EIT is not meant to simply copy American solutions or imply that all elements of the US systems of higher education, research and innovation are the best worldwide.

However, since the EIT proposal, the Lisbon strategy and, the overall approach to innovation\(^2\) of the Commission find their rationale in the gap that exists between the US and Europe, it is highly relevant to study the US system. For the US systemic performance arguably accounts for the gap. The second reason to study the US approach to higher education and research is

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\(^1\) Proposal for a Regulation of the EP and the Council establishing the EIT, COM (2006) 604 final/2.

simply based on the fact that the original intent of the Commission’s proposal, as is exemplified by the EIT acronym, was to create an institute based on the MIT model, implying that American models exist Europe could copy.

This study will also focus its analysis on Asia’s institutional initiatives for higher education and research. The current rise of high calibre institutes of research and education throughout Asia pose a challenge to Europe. We believe that Europe can learn from these developments. That said, it is important to note that the success of countries so different in size and development stage as China, Singapore, Japan and India, supports our belief that there is no single ‘continental’ answer to the challenges Europe and its countries face with respect to growth and innovation. It is also important to note that answers will not be found in the realm of numbers given the fact that the large Asian countries will anyhow outperform Europe. The economics of comparative advantage tells us that this need not be a problem. However, if Europe wants to see scores of Europeans among the world’s academic, business, social and political leaders, some new approaches towards excellence and innovation must be developed.

The main goal of this study is to take the most recent Commission proposal at face value, analyse it in as precise and concrete terms as possible and, from this analysis draw conclusions based on its potential impact on the following three areas that the EIT proposal identifies as inseparable: graduate training, research and innovation. Defining the EIT as an institution that must be operationally competent in all three areas at the same time is, from an analytical point of view, a constraint that might negatively impact the EIT’s ability to make any significant change. Two other proposed characteristics, namely the proposed goal for the EIT to be established at a rapid pace and, to act as a decentralized organization, might pose similar constraints to the EIT’s effectiveness. But they too are part of the assumptions that underlie this study.

In Chapter 13, we briefly discuss an alternative proposal that, by removing one or more of these constraints, might be more successful than the existing EIT proposal. We also discuss an alternative source of funding for innovation in Chapter 11, given that our analysis determines that the proposed funding model is not realistic.
2. **Europe’s underperformance in innovation and growth is not homogeneous**

2.1 **European weaknesses**

The most recent proposal from the Commission outlines the following four European weaknesses\(^3\) that the EIT proposal is designed to address:

- Europe has a limited capacity to convert knowledge outputs into commercial opportunities (note: this is considered its main weakness);
- On the whole, countries in Europe do not sufficiently promote innovation and lack entrepreneurial culture in research and education;
- Critical mass at the level of the EU is lacking with respect to human, financial and physical resources;
- In general, there are insufficient rewards for performance and excellence.

Another, fifth weakness is ‘highlighted’ in the Commission’s report and in a way put forward as the defining characteristic of the EIT. It reads:

- There are not enough integrated approaches, where education, research and innovation/technology transfer reinforce each other in order to tackle the four weaknesses mentioned.

Other problems could also be mentioned such as the lagging R&D investments in Europe’s private sector. But the sole establishment of a European Institute of Technology would hardly address this particular problem. Brain drain from Europe to the US is still a problem, the reasons for which certainly have to do with the weaknesses mentioned above. An effective EIT would therefore also mitigate the brain drain. That said, it is still highly desirable to assess the Commission’s EIT proposal on the basis of its original intent: to create a new instrument to enhance innovation through a more intense collaboration between universities, research institutes and firms, and to act as a state-of-the-art first rate example to those institutions responsible for higher education and research in Europe. And if they are found to be valid the weaknesses as outlined above -- the first two of which address innovation and the last three of which point out characteristics associated with Europe’s higher education and research institutes -- no doubt justify important improvements in the functioning of institutions of higher education, research and innovation (or rather the support of innovation, as we will detail). The validity of each weakness is not questioned greatly. But Europe is not a homogeneous environment and as such, a more detailed perspective is necessary to properly assess whether the EIT as proposed by the Commission can be a genuine solution to these problems.

2.2 **Several European countries outperform the US**

Evidence found in many reports supports the above five statements which define weaknesses in the European system of higher education, research and innovation.\(^4\) However, it should be noted that these statements are based on ‘averages’ for Europe as a whole.

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\(^{3}\) COM(2006) 604 final, section 1.1

While much of what the statements outline may be true, it is important that the analysis is taken one step further to obtain a better understanding of what, for example, a lack of critical mass actually means and what measures can be taken to improve it. A fair assessment of the EIT, as a ‘European solution’ to a ‘European problem’, must take into account the substantial differences in performance of its countries and actors. The 2006 Innovation Scoreboard provides useful data which summarizes the innovation performance of the EU member states and the EU as a whole. It also provides comparative data for the US and Japan.

The Innovation Scoreboard is based on the Summary Innovation Indicator (SII): a composite index made up of specific indicators to capture three Innovation Inputs and two Innovation Outputs. Inputs include Innovation Drivers (e.g., human resources, ICT penetration), Knowledge Creation (e.g., investment in R&D) and Innovation and Entrepreneurship (e.g., the number of innovating SMEs, collaboration with innovators, early-stage venture capital, etc.). Outputs include Applications (e.g., high-tech employment, high-tech exports, sales of new products, etc.) and Intellectual Property (e.g., various patent measures, trademarks and designs). It is worthwhile mentioning these indicators given the fact that several of them are relevant when describing the envisaged output of the EIT.

Figure 1<sup>5</sup> depicts the current performance and average growth rate of countries on this Summary Innovation Indicator for 2006.

Using the SII as a yardstick, measurements indicate that several of the smaller European countries and Germany perform significantly better than or as good as the US and Japan. While it is true that significant differences in innovation performance also exist within the US, it is rare that a federal initiative is used to remedy such differences.

Federal R&D expenditures are heavily skewed towards the Eastern and the Western part of the US, as are private R&D investments, with the notable exception of the MidWest where the major car manufacturers spend large amounts on R&D. Part of the reason for these regional differences is that many of the US states are much less inclined to become more like California or Massachusetts and realistically assume that they have their own unique advantages and strengths.

2.3 Specialisation and differentiation are important

This points to an important aspect of European (national and EU) policies for promoting growth and innovation. In many cases these policies tend to ignore the benefits of specialization and differentiation, offering European solutions when national ones would be more appropriate and/or offering national solutions when recognition of the regional differences and support for regional solutions would be more appropriate. We argue that, whatever its impact might be, the EIT should definitely not be mixed up with policies aimed at ‘catching up’ and/or creating strong regional clusters throughout the EU.

Indeed, regional strongholds currently exist across Europe. The recent data on the innovation performance of European regions clearly show that examples of strong regional performance demonstrating unique specializations, exist throughout Central and Eastern European countries.

Fig 2 Regional Innovation Performance

Finland continues to act as a good example, as a country but also due to its several strong innovative regions. More general economic data clearly show that the European economy as a whole consists of several core-periphery systems, the cores of which continue to attract people, investments and companies. The existing system of ‘cores’ is, of course, not entirely stable; there are always opportunities for new cores to develop.

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6 Hollander, H, 2006 European Regional Innovation Scoreboard (RIS 2006), Maastricht 2006
7 E.g. Brakman, S et al, New economic Geography, Empirics, and Regional Policy, CPB The Hague (2005)
Examples where new core regions have developed include Grenoble, France or Barcelona and the Basque country in Spain. The success of the two Spanish examples is due in part to their judicious use of European structural funds. However, it is important to note that the Sapir Report of 2003\textsuperscript{8} underlined the danger associated with the indiscriminate use of structural funds. They have too often not resulted in really exploiting the different growth potentials of regions and, therefore, of Europe as a whole. Structural funds have been part of the fabric of EU expansion essentially since the EU-12, i.e., when huge GDP differences had to be taken into account and cohesion became one of the building blocks of the EU. A universal focus on innovation, which is part of the philosophy underlying the structural funds 2007-2013, is appropriate only if it leads to strengthening regional specializations and institutions, including universities and research centres, in locations where there is a real potential to create ‘natural’ regional clusters and anchorages. That said, the practice is often a ‘national averaging out’. But even if this were not the case, it is evident that with the EIT Europe intends to address a different problem: namely, the ability to perform at the highest level worldwide.

2.4 European universities: attitudes rather than low formal ‘innovation’ performance?

Recent data depicting the ‘innovation’ performance of European universities suggest that insufficient contributions to growth and innovation may be more related to the way in which university education is perceived than to underperformance on formal measures of technology transfer, such as patents or licensing revenue. These results need to be taken into consideration when developing the EIT and when assessing the impact the EIT might have on these less tangible aspects of the underperformance of the European university system. University patents are one example. Recently Mariani et al\textsuperscript{9} investigated university patent data in greater detail than previously researched. OECD statistics used to date indicate that the US does incomparably better than Europe. Mariani et al. studied a random sample of EPO patents and tabled the employers of inventors against the date the patents were taken. Results indicated that the percentage of patents taken by inventors at universities in Europe is similar to US percentages. This suggests that staff at European universities may be as prone to apply for patents as their US counterparts. Data are not clear on whether differences in managing patents may result in varying degrees of exploiting patents in the US and Europe. Insufficient area-specific data also posed a problem as this might hide differences in performance between fields. However, it is important to note that the US and Europe have some significant differences in the patent process. In the US system, inventors are able to apply for a patent for up to one year after their research has been published. This is not the case for inventors in Europe where such a grace period does not exist. In many areas where the urgency to publish is particularly high (e.g. the life sciences) European researchers may choose to publish their research results and then apply for a patent in the US. In such cases the US system of patenting provides US researchers and inventors definite advantage over their European counterparts.

Arundel and Bordoy\textsuperscript{10} found that based on two indicators (i.e., licenses executed and start-ups), publicly funded research in Europe is more successful than in the US. They also

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\textsuperscript{8} Sapir, A, et al, \textit{An agenda for a growing Europe}, Brussels (2003); prepared for the President of the European Commission.


determined that European license revenue as share of research expenditure did not lag far behind the US. However, it is important to note that license revenue from government research institutes is quite high and that outcomes might easily be skewed by incomparability of data.

In any case, based on these formal indicators the performance of US and European publicly funded research is not a ‘black and white’ issue.

Definite differences exist between the attitudes of American and European students, teachers, parents and most likely, society as a whole. Two interesting phenomena illustrate this point. A survey at the ETH Zurich showed that while 8% of the first year student population considered setting up their own company, only 2% of the original 8% was still interested in doing so by the end of their studies. This decline in interest might be a phenomenon that is indirectly related to the common continental European belief that a university education is not complete with a bachelor’s degree, but requires at least a master’s degree. In the US more than half of the student population end their academic career after their first degree. These social phenomena have significant and completely different impacts on their respective academic environments. In Europe, many students study in an academic environment that is focused on training the next generation of professors. This is especially true for graduate students in science or engineering. The majority of American students and American universities consider university study to be a means to start a career elsewhere. One consequence of this difference is that far less US universities offer graduate education, especially at the PhD level resulting in a high concentration of R&D in a small number of US universities, which is one reason why student and staff mobility is higher in the US than Europe. That said it is important to note that mobility amongst European students and staff is also on the rise.

2.5 Funding from industry for universities is not the problem

A word also needs to be said about industry funding. There is a general expectation amongst university administrators, funding governments and industry (though often its actions do not reflect its words) that the share of industry funding for university research received through contracts must and will rise considerably. A comparison between the US and Europe is sobering.

In the US, industry research contracts account for 6% to 7% of all university research. In Europe the percentage is slightly higher. It does not look likely therefore to expect much larger contributions to Europe given the fact that the US figure has remained stable without increases over the years. Of course, this finding is based on a comparison of averages: many universities in the US and in Europe have higher performance rates, as might the EIT. But the more important question is, is it from industry’s point of view desirable to strive for large funding from industrial R&D contracts? Apparently, the answer is a clear no. The share of industry in overall R&D funding at MIT is of the order of 15%, at Stanford less than 5%, and at another icon, Caltech, less than 2%.

It is federal funding on which they rely. Clearly the value for industry does not correlate at all with huge industrial research contracts. It is rather because these institutions do things
different from the shorter-term needs of industry but remain in touch with the problems of industry, that they are valued. This seems to make short shrift with any hopes of large amounts of industry funding for an EIT that wants to be in the league of the MITs or Stanfords.

2.6 Performance in the triangle: myth or reality?

Finally, we must also consider whether there is indeed a shortage of integrated approaches where education, research and innovation/technology transfer reinforce each other.

The metaphorical phrase, ‘performance in the triangle’¹⁴, used throughout the Commission proposal, is not very precise and little evidence of its occurrence can be found without explaining what it means. Closer inspection of actual practice suggests that it does not refer to a single ‘integrated’ activity. The issue is rather whether individuals or institutions do what they are supposed to do with a mind-set that is open to the three elements of education, research and innovation/technology transfer. We suggest that it can refer for example to combining not training with research, in addition to paying attention in training to entrepreneurial and business development skills, as well as focusing research activities in the context of a programme co-defined by companies and with an aim to create a technology base for future innovations. But this is not uncommon at all throughout Europe. Many universities currently practice it and there are many examples in many European countries where co-operative ventures between universities, research institutes and companies are doing precisely this. That said, we suggest that there are still four lessons to be learned.

First, in most cases, success depends very much on committed and experienced individuals to turn institutional arrangements into actual successes. This contrasts with a tendency in many countries in Europe as well as in the EU to focus on establishing those arrangements per se as the ultimate solutions. Secondly, bureaucratisation and a general disbelief in the success of simple solutions, transform many of such arrangements into complex rather than simple approaches. Thirdly, countries and institutions throughout Europe constantly ‘re-invent the wheel’ instead of deliberately looking to other countries for examples of good institutional practices and solutions. Fourth, often it is not understood that success in the area of technology transfer from academic or public institutions is not accomplished overnight. It is not only the creation of a top tier institution such as the MIT that takes decades to accomplish. It is not different for the successful development of the spin-off instruments. Well-known and established examples such as the Cambridge Science Park or the Leuven Research and Development organization prove the point.

The Commission’s argument that the existing instruments of the EU, such as the Joint Technology Initiatives under FP7, combine two but not all three of the elements (i.e., training, research and innovation) begs the question whether a European institution or instrument can provide a solution to the perceived lack of complete integration any better than the existing approaches found throughout the EU.

Relying once again on the example of the US where no similar federal US institutions or instruments exist, one may be inclined to respond with a negative answer.

¹⁴ ‘Triangle’ bears a close resemblance to and may have been even derived from an equally diffuse concept, namely the ‘Triple Helix’, though this refers to a partying together of academia, industry and government.
2.7 Conclusions

The relative weakness of Europe to convert knowledge into commerce and critical mass or to reward entrepreneurship and excellence in research and education is not a problem that is the same for all countries, all regions or all institutions. Ignoring this fact might result in the easy assumption that a European level institutional solution is necessary in cases where national or regional approaches might be more appropriate.

Based on the Summary Innovation Indicators of the Commission’s Innovation Scoreboard, several of the smaller European countries and Germany perform significantly better than or as good as the US and Japan.

National differences in innovation performance obscure regional strongholds which are often based on specialization. The 2006 Regional Innovation Scoreboard highlights several instances in the new member states. Both national and European policies should strengthen such strongholds, learning from the US that there is wide variation in the types of research and innovation performance throughout the various US States. Overall growth, catching up and specific national measures should reduce GDP disparities. The EIT should not be judged in the framework of such policies. Compromising its goal of excellence will render the initiative useless.

Many individual European universities perform quite well with respect to formal indicators such as patents or executing licenses or start-ups, so much so that Europe on the whole does not fare badly compared to the US. However, European students’ and universities’ attitudes towards entrepreneurship or a career outside academia, particularly in the fields of science and engineering, are less favourable than one would desire. In fact, statistics indicate that of the 8% of first year students studying at the ETH Zurich who considered setting up their own company, only 2% were still interested in doing so by the end of their study.

Income secured from industry contracts for university research in Europe equals 7%, a percentage that is slightly higher than that secured in the US, though of course large differences between individual institutions exist. MIT (~15%), Stanford (<5%) and Caltech (<2%) demonstrate that industry income is not the measure of being highly valued by industry and society.

Finally, a more down-to-earth view of what the EIT proposal refers to as ‘integrated approaches towards education, research and innovation’, demonstrates that at a practical level more is being accomplished by many universities and research establishments than an abstract analysis would indicate.
3. **DISTILLING THE PRECISE NATURE OF THE COMMISSION’S EIT PROPOSAL**

3.1 **Essence of the EIT**

The proposed EIT is made up of a number of Knowledge and Innovation Communities (KICs) and a Governing Board, tasked with the selection of areas in which the EIT will be active and the specific Knowledge Communities that will receive funding. It is also the Board’s responsibility to maintain quality and to assist the KICs in carrying out their activities. While the tasks of the Governing Board are important, the actual output of the EIT will be the responsibility of the Knowledge and Innovation Communities.

In order to highlight all of the operational characteristics to be assumed by these KICs (i.e., who shall be partners? What activities will they engage in? What is the nature of their partnership? What is the size of a KIC?), a summary defining these KICs is provided by combining several phrases from the latest Commission proposal.

Knowledge and Innovation Communities are excellence-driven, long-term partnerships between closely co-operating (parts of) educational institutions, research institutions and companies that work in critical areas to produce, disseminate and exploit new knowledge products. The EIT will encourage and promote innovation at the Community level through research and by exploiting its knowledge outcomes. KICs will undertake innovation and investment activities, cutting-edge research and master and doctoral education. In addition, they will disseminate best practices concerning governance of innovation-oriented organizations and the development of partnerships between education, research and business. A KIC might be comprised of 100 academic staff, 300 researchers and 600 technical and support staff. In addition there could be 600 Master students and 400 PhD students. The annual budget of each of the 6 KICs envisaged for 2013 can be calculated to be in the order of 135 M€ (including student grants).

The formulation of what a KIC is does show that there is a need for critical discussion, especially of what one can expect a KIC, and by implication the EIT, to actually do as regards training, research and innovation. The legal aspects will be briefly analysed in chapter 10. At this point, it suffices to indicate that whereas article 2 on Definitions states that a KIC is a joint-venture of partner organizations, we will adopt the term ‘partnership’ as is used elsewhere in the Commission proposal. It is our opinion that the legal connotation of the term ‘Joint-venture’ is too well defined and circumscribed.

When considering **training and research**, the answer is clear: a KIC will provide training and will carry out research.

More important to our discussion is to consider what the EIT is supposed to do with regard to **innovation, exploitation and investment**. The Commission’s proposal states that a KIC will undertake innovation activities, the EIT will encourage and promote innovation, the EIT will exploit the outputs of knowledge outcomes and, a KIC will undertake investment activities.

In today’s world, the terms innovation and investment are used very generally. However, in terms of an economic and business context, one should adhere to the precise meaning an economist would normally subscribe to these terms.

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From an economist’s point of view, an innovation is something new that is successfully introduced on the market, e.g. a product, process, system, service, organizational model or marketing instrument. Speaking in precise terms about innovations, incidentally, does not at all exclude that a particular KIC addresses a societal problem such as renewable energy. Finding solutions relevant to this particular problem, however, does not amount to finding one ‘societal’ innovation. Rather, numerous smaller or bigger specific innovations will contribute to tackling such a societal problem, each of which will not be different from the ‘ordinary’ ones which the wording seem to imply. With the exception of public agencies, innovations are generally, if not always, produced by individual companies. The underlying invention or technology base, or more generally, the knowledge base that is tapped into for the particular innovation, can be developed by a university, a research institute, or a collaboration of firms, or a combination of firms and universities. But the collaboration, as is well known, usually does not, nor is generally allowed to extend beyond the pre-competitive research and development stage. After this stage, it is common for individual companies to take over. The stage of inventions and the stage where a technology base is created often involve the development of intellectual property, which is then shared by or divided up between, and sold to individual companies which then start to exploit it. Investment in innovation activities, product, or process development and production, is part of the normal business activity of a firm that is assisted by its financial partners (e.g., venture capitalists, banks, etc.). It is only during the final phase of the first stage (i.e., inventions, developing a technology base) when an invention is beginning to be developed into an innovation, that one comes across funding of or investment in inventors and very early business start-ups through the provision of seed capital or early-stage venture capitalists.

In short, ‘the production of innovations’ should be reserved for the companies that turn an invention into an innovation. A KIC itself, and thus the EIT as such, is unlikely to be engaged in this process. Of course, the companies participating in a KIC definitely should engage in innovations and preferably do so while interacting with the KIC. The same holds for ‘the exploitation of knowledge outputs’ which is the result of ‘investment activities’. This is what companies are designed for. A KIC or the EIT will possibly manage an IP portfolio, with a hold or at the very least, with a policy on holding patents, and then license these and earn income from them. In the case of universities, licensing revenue is seldom substantial given that it is dependent on the odd lucky number. The fact that a KIC as envisaged in the latest proposal, is comprised of a large number of partners, companies, universities and research institutes, stresses the fact that its role and the EIT’s role ends after it has actively developed a technology, a knowledge base, or an invention and when it has acquired and managed an IP portfolio. Some of the KICs may move to provide seed capital, given the very positive results in the UK where the government has financially encouraged universities to create seed capital funds by using a portion of their own funds (i.e., the University Challenge Seed Fund which has now been incorporated into the Higher Education Innovation Fund). But this is where the ‘buck stops’.

The question as to which organization should manage the IP portfolio, be it the KIC or the EIT, will be discussed briefly in Chapter 10.

16 In the context of the EIT the focus is on technological innovations that have their basis largely in a technological and, increasingly, ultimately in a scientific invention. Organizational or marketing innovations are but a few of the other types of innovations underlying economic growth today. But the argument here on who is actually responsible for innovations does not depend on these differing areas of innovation.

Outlining the role of different organizations with respect to the process of developing innovations is not a retreat to a linear view of innovation. Innovation is inherently non-linear, cutting across a variety of fields and disciplines and across many different fields of specialization requiring multiple feedbacks between for example, basic scientists, engineers and marketing departments. But if the ‘product champion’ (i.e., the person responsible for the initiative and the organization of the process) is not part of a company whose goal it is to exploit this particular potential innovation, then success is almost impossible whether it is a start-up or an established company. The universities and research institutes, and the EIT, must provide a fertile environment so that the required interactions can take place. This includes instilling a frontier attitude among professors, teachers, support staff and students, so as to encourage them to recognize that there is a world outside their sphere that waits for their innovation and/or that provides the forum where they can apply the knowledge they are building up. Their interaction with industrial scientists and engineers in a KIC will certainly contribute to this.

When speaking of the potential European weaknesses that are at the basis of the Commission proposal, the above detailed analysis has the additional advantage to demonstrate that the types of activities one is really talking about for the EIT are not uncommon to many universities and research institutes. While there is always room for improvement, there remain many very good examples.

3.2 Envisaged outputs and impacts

The direct impact of the EIT is the result of the following concrete direct outputs summarized as:

- Graduates;
- Scientific publications and other direct research outputs;
- Technological and other useful knowledge;
- Inventions;
- Intellectual property (e.g., patents, trademarks, designs, plant breeders rights, etc.);
- Spin-off companies.

Nota bene.

A non-negligible part (150 M€ annually after three years) of the budget proposed for the EIT is for ‘Improvement of innovation/research/education capacity’. There is no mention elsewhere in the proposal what activities are going to be funded from this budget line, and/or whether they will be carried out by the KICs who would seem to be the only plausible candidates to do so. It is therefore not possible at this time to translate this budget line into concrete outputs and impacts.

The proposal mentions that in addition to the direct impacts there will be an important indirect impact associated with the EIT. Using the terminology of the Commission’s proposal:

"It (the EIT) will become a reference for managing innovation through new forms of collaboration among the Knowledge Triangle partners, and a reference for modernizing higher education and research institutions, through its activities and outputs, and through its governance. It will be a flagship to inspire better performance of other actors and networks."
The term ‘Managing innovation’ seems to imply again that the EIT is involved with the production of innovations. We suggest using it in a more limited sense, namely, managing the new forms of collaboration that are mentioned in the proposal. The other parts are clear.

Therefore, the indirect impacts associated with the EIT can be subdivided as follows:

- Improved performance and modernization of the European higher education institutions through its activities, outputs and governance;
- Improved performance and modernization of the European research institutions through its activities, outputs and governance;
- Improved performance of European companies by offering a reference for new forms of collaboration with higher education and research institutions;
- Improved performance of networks of partners from these categories by offering a reference for new forms of collaboration between them.

Here one might add two other benefits associated with the indirect impact of the proposed EIT, namely,

- Increased innovations in European industry through EIT graduates, technological knowledge, inventions and IP;
- Increase of future academic and industrial leaders who have the added experience of working in an environment that encompasses both academia and industry.

The EIT will have to achieve both its direct and indirect impacts largely through its quality. Indeed, the underlying assumption is that it will deliver the highest quality possible in Europe. If this were not the case, then it would be impossible to achieve the indirect impacts. As regards the direct outputs and their associated impact, it is important to note that they are affected by the size of the EIT. Considerable as the envisaged annual budget in 2013 will be (i.e., ~ 900 M€) and as large an organization as a KIC may appear (i.e., 1000 staff and 1000 graduate students), it nevertheless represents only a tiny fraction of Europe’s R&D and innovation efforts. This proposed budget and size of a KIC would also be considerably smaller than MIT’s with its annual budget of 1.4 B$ (exclusive of the Lincoln lab’s budget), or the Swiss system of federal technology institutions with its annual budget of 2 BSF. So, also with respect to the direct outputs, the ambition of the EIT is not in the first place to add ‘numbers’ but to add new, higher quality. Put otherwise, the ambition is that the EIT will be better than any other institution in Europe, maybe with the exception of a few small and highly specialized entities.

Further analysis will determine whether the EIT can realistically have the expected impact by producing these potential and expected outputs, and if so, under which conditions. The analysis will focus on the KICs, which will be assumed to function relatively independently. As mentioned, the EIT’s impact will in the first place be dependent on the success of the KICs.

### 3.3 Organizational models for the EIT

Our analysis suggests that there are three basic organizational models that an EIT can base its development on. The first plan is based on the physically concentrated model as depicted by the MIT in the US. The second plan proposes a fully decentralized model, where there is a partnership of teams from existing universities, research institutions and companies located throughout Europe, and a strong central management and programme function included that
would distinguish the decentralized EIT from a network. This is in fact, the model adopted by the Commission.

The third plan is referred to as the cluster model which is a set of separate, physically concentrated institutes which could either be based at or closely linked to existing universities or research establishments.

The Commission itself, more specifically the impact assessment that accompanies the latest proposal, mentions the following five models:

- a centralized EIT;
- a distributed EIT;
- an integrated EIT;
- a labelling/funding instrument;
- Status quo.

The first option is relatively straightforward. It is based on the original idea of creating a European MIT. The degree to which it would resemble the real MIT is not relevant. The organizational model is clear: it provides the outline for a new leading institution which for all intents and purposes would resemble a graduate university. We will not undertake a detailed analysis of the model’s potential impact, given it is not the option that the Commission chose under pressure from the European Council. That said, there are more than political problems associated with this option. The development of an institution that is of the calibre of the MIT requires a large team of committed and experienced university leaders, a huge amount of money and a long period of time over which it can develop.

The distinction between the second and the third options is less apparent. In our view they are both variants of the fully decentralized option. The following lists the three main differences between the ‘distributed’ and the ‘integrated’ option as referred to in the Impact Assessment:

- In option 2, but not in option 3, the strategic choices a KIC faces would be delegated to the KIC;
- In option 3, but not in Option 2, there would be strong co-ordination among the KICs;
- In option 3, but not in option 2, there would be an opportunity for the EIT as a new European level institution, to help resolve key constraints in Europe, such as degree recognition or EU level IP regulation.

Other differences are relatively intangible. Option 2, for example, is alleged not to lead to models that would integrate the ‘knowledge triangle’ any differently than what is currently practiced.

Are these three alleged differences sufficient to justify two different options? It would seem that the strategic issues of a KIC need to be resolved by the KIC itself. The KIC would interact with the Governing Board given that strategic issues would likely involve finances. Neither complete delegation, nor the absence of delegation would seem possible. It is also not evident that a great deal of co-ordination would be required between those KICs that focused in totally different subject areas. In both options there would be a new European institution, hence the chances of influencing the types of challenges mentioned, do not seem to

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differentiate strongly between these two options. Whether an EIT would have any impact, is another question, which we will come back to in Chapter 9. Our conclusion is that there is no good use for making a distinction between the two decentralized options.

Option four, a funding instrument and mechanism that awards a label or a brand, is as we will argue in Chapter 13, a realistic option if it is focused at large centres to be established at existing universities or research institutes. Any other approach to implement a funding instrument would be very difficult to distinguish from the Framework Programme itself, and more particularly from the ERC. A serious financial hurdle exists for all cases: of the proposed 2.4 B€ budget only 300 M€ have been allotted. A funding instrument of 300 M€ over a 6 year period will have no leverage to reach the 2.4 B€ mark if the money is given to a highly dispersed network of teams. Why would national governments or national research councils jump at an opportunity to provide leverage funds? Why would national research councils? The latter have their own schemes within the European Science Foundation, and their first priority is not to support innovation. It is also important to note that there is no known example of a company that contributes 50% to a fund with no built-in guarantees to ensure that R&D relevant to its individual purpose is carried out or which they would not have substantial control over.

Option five, i.e., the status quo, is automatically dismissed in the Impact Assessment, which is understandable if it would imply that nothing is being done to improve the performance of existing European institutions and instruments of graduate education and research and innovation promotion, so that they can meet better the challenges of a knowledge society. Yet, generally speaking, strong economic arguments exist for the continuation and additional support of existing and emerging regional knowledge clusters (see Chapter 4). Improvements in graduate education are also necessary and possible from within existing institutions. Similarly, if the analysis of the EIT’s impact proves that its impact is insufficient, then it would be worthwhile to briefly explore whether other instruments exist that would meet for example, the need for more long-term funding of research and innovation while simultaneously promoting close interactions between universities, research centres, companies and society. The condition is that these instruments are designed to be an opportunity and a challenge to existing institutions rather than a threat which the proposed EIT for many of them is. Chapter 13 proposes as an alternative a series of Interdisciplinary Centres of Advanced Science and Technology, which is a type of cluster model for an EIT to be established through a vehicle that in many respects resembles a funding instrument with a brand name attached.

3.4 Conclusions

The Knowledge and Innovation Communities (made up of 100 academic staff, 300 researchers, 600 technical and supporting staff from universities, research institutes and companies, 600 Master students and 400 PhD students with an annual budget envisaged for 2013 at ~ 135 M€) are the ‘workhorses’ of the EIT. These widely dispersed communities will conduct research, train students and support innovation. Contrary to the Commission’s proposal, the Knowledge and Innovation Communities will not produce innovations, given that we believe that the production of innovation is the core activity of companies especially those companies that participate in a KIC. The universities and research institutes as well as the EIT, must provide a fertile environment so that the required interactions with industry can take place.

The direct impact of the EIT, then, is the result of concrete direct outputs:

- Graduates;
- Scientific publications and other direct research outputs;
- Technological and other useful knowledge;
- Inventions;
- Intellectual property (e.g., patents, trademarks, designs, plant breeders rights, etc.);
- Spin-off companies.

The indirect impact of the EIT can be subdivided into:

- Improved performance and modernization of the European higher education institutions through its activities, outputs and governance;
- Improved performance and modernization of the European research institutions through its activities, outputs and governance;
- Improved performance of European companies by offering a reference for new forms of collaboration with higher education and research institutions;
- Improved performance of networks of partners from these categories by offering a reference for new forms of collaboration between them.

In addition two more should be expected from an EIT:

- Increased innovations in European industry through EIT graduates, technological knowledge, inventions and IP;
- Increase of future academic and industrial leaders who have the added experience of working in an environment that encompasses both academia and industry.

It is important to realize that the EIT has to become the best institute for higher education and research in Europe to accomplish the proposal’s ambition that it becomes a strong reference point for the existing best European universities and research institutes. Indeed, its various direct outputs must be better than those of the best-in-class institutions since quantitatively its eventual overall annual budget of 0.9 B€ only equals that of top-ranking European universities and is much smaller than annual budgets of the top US research universities.

Three basic organizational models exist. A fully centralized EIT on one location is the first. The Commission proposal opts for the fully decentralized one where research, training and supporting innovation in one KIC is carried out by a large number of teams across Europe. We propose a third option, a cluster model for the EIT. This option consists of multiple institutes or KICs – to derive the terminology of the Commission’s proposal – but each being physically concentrated at one or only a very small number of adjacent locations. The various institutes are knot together only by a funding instrument and a brand name.
4. ECONOMIC ANALYSIS OF KNOWLEDGE PRODUCTION AND THE NATURE OF AN EIT

4.1 Joint production of knowledge and the evolution of public and private R&D in Europe

Is it possible to discuss the type of EIT that would be considered most desirable if we review what we already know about the interaction between public and private actors throughout the process of knowledge generation? We believe that it is possible as will be discussed throughout this section. Activating existing excellence and creating local and regional poles of attraction for cooperation with industry is the key to success.

Knowledge production is typically characterized by so-called ‘joint production’: private and public knowledge investments are characterized by strong complementarities and, from a geographical perspective, strong agglomeration features. The rapid catching up of private R&D investments in many continental post-war European countries\textsuperscript{19}, particularly by large domestic firms located in their home country, often went hand in hand with national public R&D investments. The gap in private R&D funding within the US (US firms, however, still carried out much more R&D due the huge public military R&D budgets) was largely closed in the early 1980s and in several of the most R&D-intensive European countries\textsuperscript{20}. Technical high schools and universities were often closely integrated into this privately led knowledge investment growth path.

The internationalisation and Europeanization of production put an end to the domestic over-concentration of the domestic R&D of these large firms and to the close ties between local private and public research institutions, initially in production-and market-related areas, later on in more fundamental research.

Since then the gap between Europe and the US in R&D performed in the private sector has grown again. More R&D activities are now concentrated elsewhere in the world, particularly in the US and more recently with the influx of investments in Asia.

The fragmentation and dispersion of funding among European universities and other public research institutes in Europe as well as their national embeddings mentioned in Chapter 6 and 7 are basic reasons why their capacity to attract European and foreign firms for joint knowledge production is diminished. Public research institutions were not able either to provide sufficient stimulus for the renewal of private R&D. In short, Europe suffered from the fragmentation of the relatively closed national ‘joint production’ R&D systems.

The internationalisation of private R&D has gone hand in hand with the ‘crowding out’ of fundamental, basic research. Few European firms are still involved in fundamental research and even when this is the case, firms rely heavily on external, mostly public, sources of fundamental research.

Firms increasingly ‘shop’ on the world market for access to basic and fundamental research and to choose the best locations to locate their R&D laboratories, the selection process of which involves consideration of locations with an efficient number of high-quality and dynamic universities and public R&D institutions.

\textsuperscript{19} There were of course important differences between countries with the UK (which through higher military R&D spending was then always at a higher level, the EU-6, several Scandinavian countries and Switzerland leading the developments.

\textsuperscript{20} Contrary to J-J Servan Schreiber’s fear of “Le défi américain” (1976), Europe was actually rapidly catching up with the US in R&D investments over that period.
In a way, many universities and research institutions have become less capable of securing these possibilities for new ‘joint production’ arrangements due to the fact that national accountability demands over the past few decades have resulted in systematic performance assessments that favour traditional indicators of academic performance. In terms of the number of publications per researcher or per million of Euros spent on public R&D, Europe does do as well as the US, though it falls behind in the number of publications in top ranking journals. Slightly exaggerating, one might say that applied research was ‘crowded out’ of the university environment.

The national embedding of universities and research institutes has to some extent impeded specialization and concentration across the borders in Europe, especially when those national research policies focused on same or similar fields of priority (i.e., life sciences, nanotechnology, information technology, new materials). From a European perspective, the combination of such policies is not optimal to the quest to reduce fragmentation or to increase the quality and concentration of Europe’s research efforts. The resulting tendency to have the many relatively small research groups in Europe tackle the problem of critical mass through the formation of increasingly large networks sponsored by European funding programmes does not help, if for no other reason than the extremely high transaction costs.

The opposing ‘crowding out’ trends in private and public research warrant the development of a policy to encourage public fundamental research institutions to play a much more dynamic role as local attractors of private R&D activities and generators of private firm research renewal.

An EIT that encourages existing excellence within universities and public research institutions and helps to establish local and regional poles of attraction for, and thus interaction with, industry, would support such a policy provided it was large enough. Nowadays, the interactions across various European ‘national’ systems of innovation will be taken care of quite naturally: in contrast to the past strong local players have an international outlook and thus seek vital connections elsewhere. A completely decentralized EIT that works with local teams of groups will only marginally contribute to the regional poles of attraction. If deemed feasible, the creation of a centralized EIT (i.e., based entirely on MIT’s structure) would naturally strengthen only one pole. A centralized plan for the EIT has not been chosen; moreover it will take a long time to establish, the monies required are not available and it is unclear whether this type of EIT would have a real impact on existing European universities and research institutes. Instead our analysis suggests that it would be worthwhile to consider a cluster model for the EIT referred to in Chapter 13. It also underlines the importance of creating a more careful alliance between the EIT and other initiatives such as the ERC and the Joint Technology Platforms or the underlying European Technology Platforms.

4.2 The human capital side of joint knowledge production

The question that we address in this section is whether establishing the EIT, and the particular form of an EIT, is relevant to the availability and renewal of highly educated and qualified

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21 To underscore the importance of poles of attraction, it can be noted as a parenthesis, that the concept of “national systems of innovation”, developed by authors such as Christopher Freeman, Charles Edquist, Bengt-Åke Lundvall and Richard Nelson (many of them European) seems to be able to explain to a large extent differences between countries in innovation strength.

22 With only a couple of exceptions in areas of so-called “big science” where the use of large instruments and other expensive infrastructures warrants ultimately close cooperation between different countries scientific communities.
research staff. If the people do not exist, then the expenditure of more monies will merely lead to a tighter labour market for S&E with a private sector ‘poaching’ personnel from universities and research centres. This is exacerbated by the European problem of an ageing population.

Increasing the S&E work force is dependent on the annual recruitment of new cohorts of highly-qualified scientists and engineers, which in turn will require lowering the barriers that prevent youth from choosing an education in science and engineering during their educational ‘pipeline’ from primary school to graduate education. It also means that the profession of researcher must appear attractive and dynamic as should the local environment.

Currently, European countries, as well as other countries, are trying to address the problems associated with the ‘pipeline’. However, for the purpose of this paper we would just like to make the point that the Southern and Central and Eastern European countries will no longer be able to indulge in the slight measure of solace as they could perhaps previously. In the southern European countries catching-up and high unemployment rates among youth has contributed to the considerable expansion of the number of universities and polytechnics, which in turn led to an increase in the number of students attending institutes of higher education. This was only a partial boon as there was no proportional increase in demand from the private sector. The new Member States from Central and Eastern Europe have a long standing tradition of delivering highly qualified scientists and engineers, especially in the fields of hard sciences. Their lack of experience is primarily related to commercial and financial access to worldwide market opportunities. That said, foreign direct investment has been quick to pick up on the unused human capital knowledge potential. It is also important to note that many scientists and engineers and students left or did not choose careers in those areas which resulted in dramatic reductions in the science and engineering work force. This is yet another example where long-term demographic trends are negative.

Making the researcher’s profession more attractive and increasing the dynamics of the local environment involves much more than providing jobs to science and engineering graduates within regional clusters of knowledge providing activities. Physical, social, local, and cultural factors such as those which attract, in Richard Florida’s words, ‘the creative class’ are crucial. Labour mobility is and will continue to be a critical factor even though the European situation is improving. The barriers to labour mobility across European countries and between the public and the private sector still appear to be more significant than those associated with emigration to the US (e.g., differences in pension systems, rules and regulations governing university appointments, and use of foreign languages in higher education teaching).

Of course, increased mobility of highly qualified persons will question the European ideals of social cohesion.

The problem of increasing the work force in science and engineering is therefore a national and a regional one: both national and regional policies have to get aligned to create or

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25 See for example David, P. “ERA visions and Economic realities: A cautionary approach to the restructuring of Europe’s research system”, EC STRATA Workshop “New challenges and new responses for S&T policies in Europe”, Brussels, 22-23 April 2002, mimeo, for a detailed analysis of the possible regional effects of the European Research Area as a result of mobility effects. These effects might appear to be negative, but the comparison with the US shows that unequal ‘innovation performance’ does not mean unequal GDP per capita figures.
strengthen local and regional poles of attraction. The well-known distinction between on the one hand knowledge which is codified or ‘commodified’, can be traded, or is embodied in new products or machines, and on the other hand knowledge that is tacit, embodied in the brains of individuals, in their competences, in their schooling and training, in their years of life-long experience, underscores from the human capital point of view the importance of local and regional poles of attraction. Tradable knowledge loses on average rapidly much of its commercial value. Tacit knowledge is difficult to transfer and brings to the forefront the local growth dynamics aspects of joint knowledge production based on the ‘co-location’ advantages of the physical agglomeration of human knowledge capital. It illustrates why even in our current Internet world with easy access to codified knowledge, scientists, researchers and highly skilled employees still like to cluster together in similar locations.

For the centralized, decentralized or cluster models for the EIT the human capital argument leads to the same conclusions as in the previous section. Under the prevailing conditions the cluster model has the greatest potential to strengthen the local/regional agglomerations of joint knowledge production in the research areas chosen, and with the help of regional authorities turn such high tech hotspots into attractor poles for knowledge workers. An EIT following the cluster model and thus embedded within Europe’s regional diverse landscape will, moreover, offer the opportunity for attracting sufficient regional funds to enhance its feasibility. It also fits the broader vision that ultimately the success of Europe’s regional knowledge attractor poles will determine whether Europe has any chance of achieving its Lisbon ambitions. An EIT that creates more critical mass through several centres of gravity, or as we will call them later European Institutes of Technology in Field X in Europe, will follow and strengthen the force lines of specialization mentioned in chapter 2.

4.3 Conclusions

Knowledge production is ‘joint production’: private and public investments in knowledge have strong complementarities and geographically strong agglomeration features.

The formation of relatively closed national ‘joint production’ R&D systems coupled with the fragmentation and dispersion of funding among European universities and other public research institutes located throughout Europe, has diminished Europe’s ability to attract European and foreign firms that have left to seek external international for joint knowledge production opportunities.

The ‘crowding out’ of fundamental, basic research by private firms, has been paralleled by a ‘crowding out’ of applied research by universities. National competitions in the same priority areas (e.g., ICT, life sciences, etc.) are not optimal to increasing quality and concentration or to reducing fragmentation.

The human capital argument, which is heavily based on making the researcher’s profession more attractive, equally involves increasing the dynamics of the local environment. As this requires work on the physical, social and local cultural factors, both national and regional policies must become more aligned to support the local and regional poles of attraction, which could in turn help to increase labour mobility.

A decentralized EIT that works with local teams or groups will only marginally contribute to regional poles of attraction. A centralized EIT would strengthen one pole, if time, money, champions, etc. are available. However, it would unlikely have a real impact on the existing European universities and research institutes. Under the prevailing conditions, the cluster model has the greatest potential to strengthen the main local/regional agglomeration aspects of joint knowledge production within the research areas turning them into attractor poles for
knowledge workers. A cluster EIT will attract regional funds to enhance its feasibility and will fit the broader vision that ultimately the success of Europe’s regional knowledge attractor poles will determine whether Europe will achieve its Lisbon ambitions.
5. THE NEED FOR AN INSTITUTIONAL ANALYSIS AND A BRIEF HISTORY OF EUROPEAN INSTITUTION BUILDING IN HIGHER EDUCATION AND RESEARCH

5.1. The EIT in an institutional landscape of higher education, research and innovation support

The EIT must operate within the context of institutions and instruments against which its performance will be assessed and its influence determined. This section will analyse the characteristics of the higher education sector, the research sector, and the domain of industry, innovation and technology transfer. This will be done at a national and European level. ‘System’ characteristics concerning the sectors as a whole and data from the individual institutions should help provide concrete insights into some of the major challenges Europe faces. The main goal, however, is to develop a concrete basis to assess the way in which the EIT could make a contribution to the necessary improvements. Data from individual institutions based on size, scope, collaborations or, position from a global perspective, provide a gauge for the development of the EIT’s characteristics (i.e., for its size, its scope, its position as a European institution, its output and its impact). Comparisons with the US and other regions will help clarify both challenges and possible solutions.

5.2. Some lessons from European history

Recent Communications from the Commission, 2005\textsuperscript{26} and May 2006\textsuperscript{27}, illustrate the increasing attention given to higher education for implementing the Lisbon goals, exemplified for example by the November 2005 Hampton Court Summit under the UK Presidency. They demonstrate, as is enshrined in the EU Treaty that responsibility for (higher) education rests with the member states, and as is well known from examples in Germany, further devolution of responsibilities for institutes of higher education and for regulations often occur in countries with federal legislation. There have however, been attempts to move in the opposite direction in both higher education and research.

The idea to create a European Institution to complement the development of Europe in the field of higher education was considered as far back as the 1940s\textsuperscript{28}. In 1955, Hallstein, the German Secretary of State, promoted the development of a full-fledged European University in the context of the Euratom Treaty: the same Treaty that would provide for the grounds for the establishment of the Joint Research Centre. However, while the Joint Research Centre was realised within a clear logic, namely, the integration of the nuclear industry in Europe, the concept of a European University was never further developed let alone realized. While there was strong support from the European Parliament, the opposition was stronger, especially in France where there was a preference for collaboration of existing universities within the then, 6 member states.

Intergovernmental attempts during the 1960s only led to the decision, in 1969, to participate in a European University Institute which was formally established in 1972 at Florence, Italy. This Institute is now largely providing PhD training in the fields of economics, social sciences, history, culture and law.

\textsuperscript{26} Communication from the Commission on Mobilising the brainpower of Europe, COM(2005) 152 final
\textsuperscript{27} Communication from the Commission on the Modernization Agenda for Universities, COM(2006) 208 final
\textsuperscript{28} Largely based on information on website of the European University Institute
http://www.iue.it/About/CreationOfEUI.shtml
From the point of view of the EIT proposal, an interesting and less frequently recalled episode in the history of proposals for institutes of higher education and research occurred with the attempt to establish an International Institute of Science and Technology (IIST). The IIST was proposed in 1960 in the context of NATO, and there was a heavy US involvement. The arguments associated with the proposed creation of the IIST were different and perhaps stronger than those that underlie the idea to create tertiary education institutions within the context of the European Communities. At that time the perceived shortage of manpower in areas considered vital to respond to the Soviet challenge and the new model of MIT and its industrial surroundings in the form of Route 128, were central to the argument. The final proposal which came from a high-level working group that was led by the previous MIT president Killian and established by the NATO Science Committee of October 1961 (publicly released only a year later), promoted the creation of an institute for graduate education and research that would house five interdisciplinary centres and a centre for advanced study in emerging areas of study that required large-scale facilities or a large number of smaller scale equipment. The size was not that much different than what the Commission now envisages for a Knowledge and Innovation Community, which might be considered small unless viewed in the context of much smaller tertiary institutions, individually and as a system, which were common to the era. The majority favoured a one-campus model, but they had an alternative that consisted of a collection of widespread departments (themselves centralized) and a central administration. However, it was not to be. Resistance among the scientific communities in Germany, France and the UK and underestimated European performance (e.g., the area of molecular biology, proposed as one of the departments, had just been established largely in Cambridge, UK), coupled with the difficulty associated with US involvement, destroyed the proposal in 1963-1964.

No further attempts were made to develop specialized university institutes; however, attempts have been made in the area of research. Between 1965 and 1974 discussions regarding the principles of a community R&D policy were initiated by the PREST Working Group, chaired by the French Délégué Général pour la Recherche Scientifique et Technologique Maréchal, and established in 1965 within the Medium Term Economic Policy Committee to examine community policies for scientific and technological research. After some political disruptions (e.g., the May 1968 veto on Britain’s accession to the Communities) the PREST Working Group continued as the Aigrain Committee. The Aigrain Committee’s proposals were now limited to, or some might believe diverted to, the coordination and eventual establishment of the intergovernmental COST programme and its first seven concerted actions. In 1972, Spinelli became Commissioner, when he took off from where Maréchal had to give up and tried to establish a Community Policy. Included was a proposal to create an organization which was in several respects, the equivalent of the American NSF.

Its approach would be more top-down including for example, the selection and funding of centres of excellence or the supervision of national investments in large research facilities. Backtracking to some extent, Spinelli and Dahrendorf, the two who dealt with industry and, technology and research, respectively, in the new Commission when Britain finally became a member of the Communities, in the end proposed what would become the four European Council decisions of 14 January 1974. These decisions were concerned with co-ordination, the establishment of CREST, the development and implementation of the Communities’ own R&D Policy and Budge, and the first foresight exercise E+30.

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29 Tindemans, P. *Institutional weaknesses of Europe’s STI system*, in Europolis, Strata HPV1-CT-1999-00002. Original sources to be found there.
The European equivalent of the National Science Foundation (NSF) was not realized until the decision was made to establish and make operational by 2007, the European Research Council. It was replaced by another initiative not from Member States but from academies of science (in particular the Royal Society played a critical role by convening the meetings), research funding and research performing organizations, such as the Centre National de la Recherche Scientifique (CNRS) and the Max Planck Gesellschaft (MPG). In 1974, the European Science Foundation was founded with an insignificant and limited budget and a completely different role (i.e., a focus on coordination).

The European international research organizations that have been established since the 1950s (e.g., CERN, the European Space Agency (ESA)), are all based on intergovernmental cooperation and varying legal foundations. The only area where large scale research facilities and programmes are community-based is in the field of thermonuclear fusion, where the EURATOM Treaty provided the rationale and the instruments.

Interestingly enough, there was another attempt to create an institute similar to the proposed EIT in the late 1980s. At this point in history, the European Technology Institute (ETI) was an idea that originated from the European Round Table of Industrialists (ERT). The ERT initiated a working group from its members whose purpose it was to create an institute to develop leading-edge technologies, similar to MIT in the US. A complete plan was developed at the time, but no agreement could be made amongst the ERT members on the mode of financing. That MIT depends heavily on US federal funding for its research, may explain why industry couldn’t agree.

5.3 Conclusions

A first lesson to be drawn from the many attempts to create European institutional solutions in higher education and research – that is solutions linked to the formal political European system - is that a rationale to do so was lacking. That rationale could be the need for an institution with a truly European nature which underlies for example the European University Institute in Florence.

Secondly, success was possible only when not only a strong rationale existed, but also a legal basis and implementation instruments in the Treaty. The case of large research facilities illustrates the point: a clear rationale exists, and should have led according to the principle of subsidiarity to a legal basis, but the Member States did not accept it. The ERC is maybe the first instance where external pressure convinced reluctant ministers and an equally reluctant Commission to create a new institution. The rationale in this case is provided by the success of the US federal funding system.

The rationale for establishing an EIT as a European institution should therefore be closely scrutinized; if it turns out that the rationale is weak, the absence of evidently applicable legal instruments in the Treaty would constitute a serious hurdle.
6. INSTITUTIONAL ANALYSIS OF HIGHER EDUCATION IN EUROPE

This section focuses on the European institutions of higher education. A comparison with the US system and the major developments in Asia confirms a need for substantial adaptations to the existing European situation. However, one should not underestimate the overall performance of the European institutions and the drives for system reform that are currently in place. The non-university research establishments will be reviewed later.

The analysis of European higher education from the perspective of the EIT should perhaps begin with the bold statement that no one would propose to set up an American Institute of Technology with similar aims as the EIT, because the American research universities, in combination with non-university research institutes, are already meeting these goals.

6.1 US-Europe in higher education

So what are the critical differences between the US system of higher education and the European system? Over the past couple of years, a large number of studies on higher education have been produced and published in Europe, the arguments of which are largely similar. We focus on the following four key elements and/or differences.

The first difference, easily missed, is that there is no European system of higher education. The Bologna process with its focus on a common degree structure, credit point transfers and mobility, is for the first time, introducing systemic features in European higher education institutions. That said, there is still a long way to go, as is clear if one summarizes the following essential elements of the US system. In the US,

- A common three-tier degree structure of bachelor, master, doctorate exists at the general universities with effectively a two-tier structure of bachelor and doctorate at the leading research universities;
- While admission standards vary from one institute to another, there is a uniform admission system based on national testing and individual student assessment through applicant submission of essays and/or intake interviews with applicants;
- While there is a wide variation in mission and quality, the underlying structure of higher education is simple. Basically there are colleges and research universities. There are several related phenomena. The bachelor degree is in general the final degree obtained by US students whereas students in Europe generally pursue further education after their bachelor’s degree (i.e., in the form of a masters degree, PhD degree or other professional certification). As a consequence there is a much greater concentration of research money in the American research universities;
- The accreditation system is also more transparent than the European processes of accreditation or recognition;

30 E.g. references 18 and 19.
31 R. Lambert, N. Butler, The future of European Universities; Centre for European Reform, 2006
32 A. Schleier, The economics of knowledge: why education is key for Europe’s success, The Lisbon Council, 2006
33 As Caracostas and Soete (1997) have argued this lack of a European higher education system is central to the failure to see the emergence of a European System of Innovation. It explains why the notion of National System of Innovation having become popular amongst policy makers in the 90’s following the concepts developed by Freeman (1987), Lundvall (1992) and Nelson (1992), remains first and foremost relevant to national countries or in some cases where higher education is organized at the sub-regional level (Germany, Spain, Belgium) regions.
- Mobility of students and staff is much greater in the US than in Europe.

A second distinction, vital to the success of training a large number of students at the tertiary level, is based on the differences noted in spending on higher education, where there is an expenditure of 1.1% of GDP in the EU-25 versus 2.7% of GDP in the US. The difference in US spending rates is attributed to the larger enrolment and higher expenditures per student in the US, the latter due to the large private expenditure on higher education.

Thirdly, there is the issue of autonomy, regulations and governance, as is stressed in the following quote taken from one of Schleier’s\(^{34}\) key recommendations: ‘Encourage universities to evolve so that their leadership and strategic management capacity matches that of modern enterprises, with appropriate strategic, financial and human resource techniques to ensure long-term financial sustainability and accountability requirements.’

The fourth factor to consider is based on concentration and excellence. From the point of view of the EIT discussion, the research universities are most relevant. A few key features account for most of the differences when taking into account the better than average European universities.

- Concentration in terms of research, high quality staff, students and funding, is the most outstanding factor. The figures are well-known. There are only some 150 American universities which award doctorates across a broad range of disciplines. Approximately 200 universities account for 95% of the research expenditure at US higher education institutions. Many more of the 4000 institutes of higher education located throughout Europe, conduct research and award doctorates. This is further reflected in the fact that in 2003 the EU-25 graduated 37,000 new PhDs in mathematics, science and technology, as compared to the 16,200 PhD graduates in the US, and 5,500 PhD graduates in Japan\(^{35}\). It is worth noting that the US system was not been built up through a specific design or plan. It has historically evolved through the combined ambitions of certain institutions and funding instruments. Currently the boundaries between the various categories of higher education institutions are still permeable - there are no gatekeepers. Money coupled with good people can act as the basis for upward drift.

- There is also a direct correlation of these numbers to the position of the leading US universities in the various rankings. Europe does reasonably well when one considers the number of European universities that rank in the world’s top 500 and top 100, but loses its standing in the top 50 (see table 2).

- A major factor that explains the concentration of research funding is based on the concentration of funding sources. Five federal funding agencies account for almost 60% of the total research expenditure of US universities. State funding and income from industry contracts each account for only 7%. Several huge private foundations and income generated by the individual universities make up the rest.\(^{36}\)

- The impact of these private foundations works essentially in the same direction as the federal funding sources because they combine a specific mission or research area with supporting work of very high quality. The Wellcome Trust is the only private

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\(^{34}\) Reference 24


foundation in Europe which more or less operates within in this major league when it comes to funding research, but its focus is of course on the UK.

- It is also worthwhile to note that the NSF and the National Institutes of Health (NIH) have played a crucial role over the past 15 years to stimulate larger concentrations of research and technology development. The NSF Science and Engineering Centres acted as the starting point, followed by the centres in life sciences and, nanoscience and technology. In addition, the Department of Defense Advanced Research Projects Agency (DARPA), has during most of its existence been a staunch supporter of risky, highly original research that has the potential to develop new technologies for the defence and the civil sectors.

Including some data for some individual institutions from both the US and Europe will help to put the issue of concentration and excellence in perspective and set some markers to define the challenge for the development of the EIT and at the same time assessing its potential impact. MIT in Massachusetts and Stanford in California are selected for the US with the understanding that quite a few more qualify as highly as these two. For Europe, Cambridge University in the UK, the Eidgenössische Technische Hochschule (ETHZ) in Switzerland and the Karolinska Institute in Sweden have been chosen, all of which have high rankings and might be considered appropriate sources to set the standards that the EIT is supposed to meet and even surpass.

Table 1 summarizes some relevant data on a few European and US universities

<table>
<thead>
<tr>
<th>Scope</th>
<th>MIT</th>
<th>Stanford</th>
<th>ETHZ</th>
<th>Cambridge</th>
<th>Karolinska (KI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budget, excl construction</td>
<td>1.4 B$^4</td>
<td>2.6 B$^4</td>
<td>750 M€</td>
<td>780 M€</td>
<td>440 M€</td>
</tr>
<tr>
<td>Number of students</td>
<td>10,200</td>
<td>14,900</td>
<td>12,700</td>
<td>17,800</td>
<td>8,000</td>
</tr>
<tr>
<td>Proportion undergraduate to graduate students</td>
<td>2:3</td>
<td>45:55</td>
<td>2:3</td>
<td>2:1</td>
<td>3:1^5</td>
</tr>
<tr>
<td>Budget for research</td>
<td>660 M$ sponsored R&amp;D</td>
<td>900 M$ sponsored R&amp;D</td>
<td>430 M€</td>
<td>285 M€^{6} research grants</td>
<td>370 M€</td>
</tr>
<tr>
<td>Contract research industry</td>
<td>~15%</td>
<td>&lt;5%^{7}</td>
<td>~9%^{8}</td>
<td>10-15%^{9}</td>
<td>~9%</td>
</tr>
</tbody>
</table>
1) 85% of undergraduates and 65% of graduates are in science and engineering; 15% of graduates in management

2) 55% (of graduates in science and engineering

3) half of students in science, medicine and engineering

4) excluding for MIT 0.6 B$ for the federal Lincoln lab, and for Stanford 0.3 B$ for the federal lab SLAC. However, one may compare, say, the inclusive Stanford budget of 2.8 B$ for an institution of 15,000 students with the 2 BSF for the overall Swiss ETH domain with 17,000 students and also several research institutes.

5) much smaller when excluding students for nurses, lab technicians etc

6) There is a problem in comparing research budgets as practices differ whether or not to include part of the salaries of faculty and the operational costs of the infrastructure such as labs. Most likely the figure for Cambridge for example underestimates the volume of research actually carried out.

7) Caltech, another US icon, is even at less than 2%.

8) includes income from licenses and technology transfer

9) 10% of research grants income comes from UK industry; there is another 5% income from overseas which no doubt includes some industrial income.

6.2 Some university developments in Asia

Current developments throughout large parts of Asia are occurring at an extremely rapid pace. Here we draw attention to one particular aspect, namely the focus of several Asian countries to create top tier universities as major drivers of education, research and technology transfer. It suggests one particular way ahead for leading universities in Europe, i.e., to create common admission and accreditation systems. An example to keep in mind is the Indian Institutes of Technology (IIT) which form a group of seven top-tier universities throughout India and its sister organization, the Indian Institute of Science located at Bangalore, which functions at a similar level.

The seven IIT’s, each of which have on average 2500 undergraduate students and 1500 graduate students, use a joint national competition, unparalleled in the world for its selectivity in admissions: only 2% of the undergraduate applicants are admitted.

The first IIT was inaugurated in 1951, with most of the others established around 1960. It should be noted that the ‘super status’ attributed to these Institutes today did not occur overnight. In fact, they did not start out as universities, but as institutes with a solid science background focused on technical training. For example, IIT Bombay was established in 1959 and became a university in 1976. The decision to create the IITs was the result of a series of recommendations from a committee that was set up in 1946 by a member of the Viceroy’s Executive Council. While the primary funding source came from government, many of the individual IITs received considerable support from international organizations such as UNESCO, or from foreign governments such as Germany.

In Japan, a three-fold reform of the university system has been put into motion. The first initiative has been the promotion of mergers among the 100 plus national universities where most of the graduate education and research is taking place resulting in greater concentrations and more co-operation between faculties and departments. The second initiative has been the change of the governance system to allow these national universities greater autonomy with more transparent and pronounced internal management systems. The third initiative to significantly increase the competition for funding, where the focus is not on small research grants, but on larger grants, will enable younger researchers to set up shop. At this point in
time, ten areas have been selected by the Japanese Society for the Promotion of Science, the society responsible for operating this scheme.

Singapore, which of course is of a much smaller scale than Japan, India, China or Korea, has also made significant efforts to improve its capacity in higher education and research. Many years of continued focus and drive towards excellence from government, the universities and the private sector have resulted in both the National University of Singapore and the Nanyang Technological University, ranking high as major centres of learning, research and innovation.

In all of these cases, (i.e., India, Japan and Singapore) highly selective systems for admission are in place. The ability to attract and thus, select the best students is indeed characteristic for all genuine top tier universities all over the world.

6.3 Europe’s score in university rankings

A popular way to determine the position of universities is through the university rankings. While defects are evident in the ranking, there is little doubt that those universities that rank very high are by all standards, top tier universities in many areas of research. It is also clear that by considering a larger sample one gets a reasonable impression of the average quality within regions. However, an important caveat is that the ranking does not yet rates excellence within institutions at the level of faculties, schools or departments. The Shanghai Jiaotong University ranking 2006 is used here as representative example.

<table>
<thead>
<tr>
<th>Among first</th>
<th>Americas</th>
<th>Europe</th>
<th>Asia-Pacific</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>8</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>25</td>
<td>20</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>50</td>
<td>39</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>100</td>
<td>58</td>
<td>33</td>
<td>9</td>
</tr>
</tbody>
</table>

Two conclusions are especially evident. European universities are underrepresented in the top 40 or 50 ranked universities, and are increasingly underrepresented the higher up one goes in the rating. However, an overview of the first 100 plus universities clearly suggests that European universities are rapidly improving their position, demonstrating that standards among universities in Europe have risen considerably over the past years. This is important because training large numbers of graduates and interaction with industry on a massive scale are highly dependent on large numbers of universities performing at a solid level, the major contributions of top tier universities notwithstanding.

6.4 Evaluative observations by way of conclusions: way ahead for European universities

There is a US system of higher education, but there are not federal universities. While there is of course no Asian system of higher education, it is clear that both the degree structure and

http://ed.sjtu.edu.cn/ranking.htm

37 A few universities have a Charter enacted by the US Congress. The reason is that they are all based in the District of Columbia where the US Congress plays, simply put, the role of a State Congress. Only Howard University, established right after the Civil War, and focused on education of American Africans, gets a direct federal funding contribution for maintaining its operations.
policies for mergers, excellence and autonomy, in several of the larger Asian countries are headed in the same direction as those developed at American top tier institutions. Attempts to create Asian institutes of higher education have faced similar hurdles as in Europe.

While there is little doubt that Europe will experience the development of new high-quality universities, some of which will evolve from existing ones, they will most likely be private or will be set up or supported by national governments. It is not unlikely that some of these private universities will be set up with a European character, student population and faculty in mind, especially when European countries would agree to develop European instead of national accreditation schemes. However, it is unlikely that they would be dependent on or closely linked to the European Union, given that the Treaty exclusively reserves responsibility for higher education to the member states. The process will hopefully be kept on the track of greater differentiation, larger concentrations of excellence, and more and more substantial competitive European level funding instruments for academic research.

A summary of the position and the way ahead for European universities, based on our overall analysis and the comparisons made in this section, leads to several pertinent statements.

Europe has several top tier universities of high quality offering excellence over a broad range of subjects. Where they differ from US equivalents is in their selectivity of admission, share of undergraduate and graduate students (apart from a few exceptions such as ETH Z), size of research budgets, and to a lesser extent, in their level of interdisciplinarity which might be related to the much narrower bachelor curricula in Europe.

Over the past 15 years, many universities have been actively engaged in projects to collaborate with industry and commercialise the knowledge that they developed. While many of these attempts have been stifled by bureaucratic transfer offices, it is safe to say that several very successful examples exist. A small selection of examples include initiatives in Leuven, Belgium with the Leuven Research and Development centre, in Cambridge, UK with the Cambridge University, in Stockholm, Sweden with Karolinska, in Zurich, Switzerland with ETH, or in Warwick, UK. Each of these initiatives is based on the drive and determination of individuals who were able to carry forward simple approaches over a period of several years (i.e., in the order of 10 to 15 years) to show success in terms of employment generated and capital created. European universities should be more active in institutional learning from these and similar examples.

The challenges for European universities as a whole are great: more concentration (which does not imply an increase in the sheer number of students as the US example indicates), larger differentiation, increased autonomy, increased selectivity of admissions, more flexibility within the internal organization and funding arrangements to stimulate interdisciplinarity, changing the mind-set of students and staff to include a focus on the outside world, which in turn would include more flexible employment regimes which for example would straddle the border between academia and companies are all paramount to success.

That said, one must recognize the substantial reforms that have already been initiated across Europe. Sure enough, these reforms did not uniformly occur across Europe, but neither were they limited to for example, the North-western region.

It is important to realize that all of these challenges must be met by the universities themselves and by national governments and policies. At the European level some very important conditions can be created, one of the most important of which, as our comparison with the US shows, includes increased European funding instruments for academic research. This is why the European Research Council (ERC) is regarded as such a critical institutional
innovation. Resembling the large US federal funding agencies, the ERC can provide a major boost to the European landscape if (a) it lives up to the challenge of being an independent, non-bureaucratic institute focused on excellence, and (b) if European governments will agree to increase its budget and give it the time to develop longer-term funding schemes without becoming impatient for its results.
7. INSTITUTIONAL ANALYSIS OF RESEARCH ESTABLISHMENTS IN EUROPE

7.1 Introduction

The European research landscape is more complex than the US one. Here we focus on the research establishments outside the private sector that is outside basically the industry research labs. Put simply, research in the US is being conducted at universities and university hospitals, and several closely related labs and at the large number of federally funded labs, some of which are operated by a federal agency (such as the NIH institutes) and most of which are operated by universities or private companies. The European research environment for an EIT is quite different. The following discussion attempts to categorize the various research institutes or organizations throughout Europe, indicating which categories are most relevant, least relevant or entirely not relevant to the EIT. This assessment will help identify from which categories a KIC would draw the most participants and will enlighten further discussion regarding the practical arrangements for the EIT. This overview is also necessary to assess the envisaged parameters (e.g., scope, etc.) for the EIT and its KICs so that its potential impact can be better understood.

7.2 Categories of research establishments

When discussing universities, research establishments and companies, one should not forget that much of the type of research central to the EIT discussion (i.e., the longer-term research that next to its relevance for industrial or societal problems, is suitable for graduate student training) is being conducted at universities. This will not change, and it will not negatively impact or limit the collaboration between researchers from universities, research institutes and industry for example in an EIT. After all, inventing the very concept of the ‘research university’ in the US was the major innovation of the twentieth century university universe. We will now focus on the research establishments outside universities.

Compared to the US, rather peculiar for Europe are organizations or groups of research institutes which to a large extent focus on basic or frontier research. Examples include the MPG in Germany, the CNRS in France (note: CNRS also operates many research units at universities) and parts of the Commissariat de l’Énergie Atomique (CEA) in France. Also, several European research councils and academies of science operate such research institutes. Another instance is given by cancer research centres throughout Europe which are often independent because of their close links with specialized cancer hospitals. Many of the individual institutes can be quite large therefore one must include them when assessing the potential impact of the EIT.

Again, rather unique to Europe are some of the very large contract research organizations. Some of the smaller ones are fully privatised; these are not unique for Europe, as one finds them all over the world, but these small entities are not highly relevant in the context of the EIT. However, the larger ones, such as the Fraunhofer Gesellschaft in Germany and the Organisation for Applied Research (TNO) in the Netherlands, are relevant given their commitment to a wide range of technology fields and total work force of approximately 5000 persons. These attributes gives them the critical mass in several areas and the ability to participate in strategic, longer-term partnerships with universities and companies. There are also examples of more specialized research centres such as the Interuniversitair Micro-Electronica Centrum (IMEC) in Belgium which employs approximately 1000 people in areas associated with micro-electronics and nanotechnology.
The international European laboratories are no different than their US counterparts as far as their role and performance to enhance Europe’s innovation performance are concerned. Like the National Air and Space Administration (NASA), ESA has strong connections to the space industry and is increasingly becoming engaged in programs to support spin-offs and to collaborate with high-tech companies. In any case, it is difficult to see what added value an EIT could have in the area of space technology. CERN, the European Southern Observatory (ESO), the Institut Laue-Langevin (ILL) and the European Synchrotron Research Facility (ESRF) are built around very large research facilities, and as such, could play a role in any new large European initiative, as neutron and synchrotron tools support many research areas relevant for industry. However, this would be less so for CERN and ESO. Another case in point is found in GENNESYS, a joint initiative between major nanoscience and nanotechnology centres located at universities and basic research organizations and the synchrotron and neutron facilities such as ILL and ESRF. Each of these centres could play a significant role in the EIT by offering use of their first rate facilities. The role of the European Molecular Biology Laboratory (EMBL) in the field of molecular biology is different: it does not have large scale facilities, and its role resembles more that of a very large university department or a basic research centre focusing on research, graduate and doctorate training, and increasingly on IP and the promotion of spin-offs. It has established a commercial arm named EMBL Enterprise Management Technology Transfer GmbH to identify, protect and commercialise the intellectual property developed in the EMBL-world, from EMBL-alumni and from non-EMBL third parties. EMBL also has its own venture capital vehicle. For assessing the impact of a KIC of the proposed size, EMBL’s size is relevant – note that approximately 1400 people work at EMBL.

At the national level one also finds research centres built around facilities, or at least having their origin in facilities, though the facilities in this case are, on average, smaller. Examples of this include the research centres gathered in the Helmholtz Forschungs Gesellschaft in Germany. Their role in an EIT context would be similar to the role play by the international laboratories.

### 7.3 Evaluative observations by way of conclusions

At this stage, one might be inclined to conclude that the European landscape of research establishments is very fragmented and that much greater concentration is required in this fragmented European landscape. Yet, it is not concentration into very big establishments that seems to be the main challenge. For in this regards the US example is less instructive and conclusive. In the first place very large research organizations exist also in Europe, partly with a mission-driven background (e.g., CEA in France). More importantly, the Federally Funded Research and Development Centres (FFRDCs) are not on average accredited with the better growth and innovation performance of the US economy (note that there are exceptions such as the Lincoln lab operated by MIT).

Size and critical mass are of course important. As more and more research becomes interdisciplinary and collaborative by nature, often requiring a variety of equipment, small research labs will become less able to compete at world level in the areas the EIT would concentrate on. To be clear, the individual research teams need not necessarily be large, but they should work in an environment where many research teams focused in related areas, exist. The EMBL illustrates the way that this is accomplished. It is, however, important to note that there are also limits to the size of a lab. While it is different when large-scale technology development is at stake, in many areas, such as the life sciences, nanoscience and
technology or materials science, laboratories with a population greater than 300-500 scientists, including postdocs and PhDs, do not necessarily offer substantial added value.

In fact, recent developments in the pharmaceutical industry where large research labs have been split up into units of this size (i.e., 300-500 personnel) further illustrate this point.

No doubt, some of the smaller national research institutes need to open up further, starting with an increased international performance assessment. They would also have to increase size to reach critical mass, which might be accomplished through mergers, including mergers with universities. Similar to the situation for universities, the national governments are in charge of taking the lead in this process, and much can be accomplished by reorganizing funding instruments at the national and European level.

Next to ‘opening up’, establishing closer links with universities or even merging with universities is a definite way to go. The German Max Planck Gesellschaft is now well on its way to work on this.

A public and transparent evaluation of the performance of the research centres or larger units located within these centres, including university departments, would help enormously. It would be especially important that action take place at the European level. The previous commissioner Busquin has started working on this, but there has been no follow-up. The level of detail cannot be too high for the exercise to be manageable. The global university rankings provide useful methodological suggestions.
8. INSTITUTIONAL ANALYSIS OF SUPPORT FOR INNOVATION AND TECHNOLOGY TRANSFER

8.1 Introduction

This section investigates the variety of institutions, programmes and instruments at a European and national level in which public and private parties collaborate to support innovation and technology transfer, which is the third area in which the EIT will be active. The aim is threefold. First, we explore whether lessons can be learned to effectively organize the development of a knowledge base for innovation, technology transfer, IP portfolio management or collaboration between universities and industry. Second, a basis must be established to assess the additional impact of the EIT in this area. Third, it is important to investigate whether the creation of an EIT would have substitution effects, or whether existing instruments would prove too attractive and would prevent the development or success of the EIT.

The discussion begins with the following major European instruments: EUREKA Clusters, FP6 Integrated Projects and FP7 Joint Technology Platforms. Next several national initiatives from a few countries are highlighted. This discussion does not attempt to be complete. Instead, its purpose is to better understand the variety of institutions and instruments for supporting technological innovation, and whether they tend to favour more localized or more dispersed solutions.

This discussion will also shed some light on the way in which companies collaborate with other companies, universities and research institutes. A detailed analysis of company R&D and innovation efforts in Europe is not necessary to assess the impact of the EIT. It is not in the same category as company laboratories. It does not compete with company laboratories as one might say, while it certainly is perceived to compete with universities and research institutes. It rather aims to improve the connections of universities and research institutes with companies. Of course, the EIT like any other institution or instrument focused on collaboration between public and private research, will have to cope with the low private sector expenditure on R&D. While the ‘co-production’ of knowledge between the public and the private research base is an important component of a knowledge society (see Chapter 4), the EIT cannot, however, compensate for the serious under-investment in R&D by European companies. The lower business expenditure on R&D, incidentally, cannot be attributed to the high service sector share in the economy (note: the service sector share in the US is higher), nor can it be entirely attributed to the fact that Europe’s industry sectors are on average, less R&D-intensive than the sectors which the US economy depends on. Significant differences exist within sectors\(^\text{39}\), which suggests that it is a company’s strategic choice how much to invest in R&D.

8.2 EUREKA Clusters

EUREKA generates large numbers of relatively small international projects. However, EUREKA also incorporates two main strategic initiatives, namely EUREKA Umbrellas and EUREKA Clusters. EUREKA Umbrellas are collaborations designed to aggregate and generate smaller projects within a specific area. EUREKA Clusters are long-term strategically significant industrial initiatives which are made up of many partners from first and foremost, large companies, as well as SMEs, universities and research institutes.

\(^{39}\) Chrysler, Ford and GM spent 2.9 %, 4.1 % and 5.1 % of sales on R&D in 2003.
Partners work together to develop generic technologies. They are to be found primarily in ICT where a total of 5 exist and more recently, in the areas of energy and biotechnology where one cluster each has developed. Each Cluster has a technological roadmap that defines its most important strategic domains. The Cluster’s specific goals are achieved through a variety of individual projects. On average these projects will be closer to the market than would be the case for EIT programmes, which fits with the aims of the EUREKA Initiative. EUROGIA, a 5-year 1B€ project, exemplifies this with its 20 partners all of whom are from a wide spectrum of market segments in the Oil and Gas Industry and have a common goal to initiate technological developments that would ensure the better management of fossil fuels. CELTIC is an 8-year, 1 B€ project founded by primarily large companies but now encompassing a large number of projects in which several ‘tens’ of smaller and larger firms, as well as public, semi-public or private research organizations and universities participate. CELTIC aims to strengthen European competitiveness in telecommunications through industry-driven collaborative R&D which should lead to the development of pre-competitive, comprehensive ‘Integrated Communication System Solutions’. The one that is most interesting from the EIT perspective is MEDEA+. This is the third successive project of its kind which incorporates all of the major European companies in micro-electronics, and now within MEDEA+ also includes key companies from the applications areas. MEDEA+ continues the strategic goal of the first research collaboration, JESSI, which was set up as a strategic initiative considered necessary to significantly strengthen the European micro-electronics industry. MEDEA+ is an 8-year 4B€ project. Like CELTIC, its core group consisted of primarily large companies and in addition two university institutes and one public research organization. Now hundreds of companies, many of which are SMEs, universities and research institutes are involved in MEDEA+ projects. Well-known universities and research centres in this area are also represented on the scientific advisory board and quite some co-ordination is achieved informally in this way. A clear view has also been developed on the institutional landscape for training and research and development in this crucial area, especially for CMOS scaling which are supporting the high-volume manufacturing of integrated circuits thereby significantly improving Europe’s position in the international market: note that Europe’s biggest three companies are now among the world’s top-ten. This system easily extends into the area of new functionalities in areas such as system-on-a-chip technologies, nanoscience and nanotechnologies.

This model of an institutional landscape for training, research and development in micro-electronics can uniquely serve as a test to determine whether the organizing principle of the EIT fits the view of the key players from industry, academia and research organizations.

Here is the picture that can easily be deduced from the two reports.

- Training and fundamental research in the broad area of micro-electronics and related nanotechnologies at major European universities is comparable to that carried out at some of the best US universities. However, some of the leading American universities such as MIT, Stanford, Harvard, and Berkeley, are better focused and have a larger critical mass than those found throughout Europe. That said, as long as critical mass per centre exists, it is better to capitalize on Europe’s diversity than to try and achieve perfect complementarity between the different centres. These European centres of academia should be leaders internationally if they

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40 Complementary Metal Oxide Semiconductor

41 MEDEA+ Scientific Committee, Assessment of European universities and research organizations in Europe (2002); Improving links between manufacturing & science (2005); http://www.eureka.be/thematic/AcShowCluster.do?id=2365
maintain a consistent and constant focus in their field of expertise, have a strong network, are equipped with good facilities for exploratory research, and have organized and funded access to the various infrastructures located at European competence clusters.

- European competence clusters are especially needed for up-scaling technologies in micro- and nano-electronics. They should be few in number (perhaps 3) and should be set up around existing locations, e.g. Dresden, Grenoble and Leuven. There state-of-the-art infrastructures should be operated by major applied research institutes.\(^{42}\) The cost of these infrastructures could be leveraged through linkages to industrial sites (e.g., Grenoble and Dresden) or by sharing the financial burden with a non-European region (e.g., the IMEC model in Leuven).

- For areas where ‘up-scaling’ is not (yet) the dominant issue, such as those related to adding functionalities and nanosciences and nanotechnologies, the crucial institutional features are, first, interdisciplinary campuses located around universities or large scale European facilities, where interdisciplinarity also implies co-ordination between materials research, devices and systems. Second, the large multidisciplinary R&D institutes in Europe can play an important role by understanding new markets, providing access to a broad range of pre-existing knowledge and by ‘impedance-matching’ with academia.

An EIT Knowledge and Innovation Community would need to fit in this picture, but given that it can only be a very small cross-section of this landscape, based on the numbers for the KICs, a preliminary conclusion suggests that it is not obvious how the EIT could add value in this important area. Putting aside the problem associated with size for a moment, one might try to carve out a niche further away from the market compared to the typical MEDEA+ projects. That said, it is difficult to ignore the reality that the universe is becoming very densely populated. An EIT may even be considered problematic if its operations did not strengthen the existing major centres, but instead disrupted the landscape by funding competing activities.

### 8.3 FP6 Integrated Projects

Our overview of the Integrated Projects as one of the new instruments operating under the FP6 is brief. The Integrated Projects will not formally be continued under FP7; however larger projects will continue to be funded. It is perhaps most important to note that the size of these projects never reached the scale originally foreseen. The budgets of the largest projects were in the ball park of 20 M€ over a 3- or 4-year period. None of these projects were in the league of the proposed EIT.

The Integrated Projects were meant to assemble the critical mass of expertise and resources required to achieve ambitious scientific and technological results, which were to include research, technological development, demonstration, knowledge management and transfer, promotion and training. A few examples follow.

CellPROM, with its 26 M€ budget over a 4 year period and 30 partners (9 of which are universities and 9 of which are research institutes), is the largest Integrated Project in the field of nanobiotechnologies. Its goal is to develop an automated device to imprint cells using nanoscale macromolecular templates.

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\(^{42}\) These are Fraunhofer Gesellschaft, CEA-Léti and IMEC, respectively.
There are four Integrated Projects in the field of biomass, each of which will run over a period of 3-5 years, with approximately 20 partners and a budget of 7-10 M€. Each of these Integrated Projects for biomass will have a specific technical goal (e.g. developing a process to produce clean hydrogen-rich synthesis gas at a certain scale and using very specific chemical process techniques). Each of these examples demonstrates that the purpose of the Integrated Projects is much more specific than the purpose of the EIT, that their scale is significantly smaller and that they do not really contribute to the significant enhancement of critical mass for any of the participants given the average annual project expenditure per participant. As a matter of fact, the lesson to be learned for the EIT proposal is not dissimilar to the analysis of the key players from the semiconductor industry. Achieving very specific results in 3 to 5 years is possible by assembling the necessary resources (i.e., ‘critical mass’) in a distributed way, though there is always the concern of having too high transaction costs when too many partners are involved. In order to maintain a sustained R&D and innovation effort in broad technology areas and large industrial sectors, a critical mass at the individual partner level is a required precondition to its success.

Technology Platforms are relevant to the extent that they have resulted in Strategic Research Agendas (SRAs). When time comes to identify the KICs it would seem logical to take a close look at these SRAs, as is being done for the Joint Technology Initiative, which are expected to start under FP7.

The Networks of Excellence will have a different relevance: when a theme for a KIC is selected, one might determine whether existing networks overlap in theme with a KIC and subsequently identify strong potential partners for the KIC. A KIC would, however, operate in a completely different way from a Network of Excellence and involve different partners, especially from industry. Therefore a KIC cannot become an analytic continuation of a Network of Excellence.

### 8.4 FP7 Joint Technology Initiatives

The Impact Study that accompanies the EIT proposal effectively states that the Joint Technology Initiatives (JTIs) as foreseen under FP7, are very similar to the EIT’s intent, other than the fact that they do not focus on training and by implication do not address the full integration of the three aspects of the ‘Triangle’. There will be a limited number of JTIs in areas where the scale and technical complexity require the development of a critical mass. The JTIs goal is to implement the strategic research agendas (SRAs) developed by the corresponding European Technology Platforms (ETPs) which were initiated under FP6. The ordinary collaborative projects under FP7 or other national or international funding sources will have to absorb those Technology Platforms that will not develop into a JTI. The JTIs would be legal entities based on Art.171 of the Treaty. The Commission clearly prefers the Joint Undertaking; however, the Article is open to the complete gamut of national or community legal structures.

So far the following six potential JTIs have been identified:

- Hydrogen and fuel cells for a sustainable energy future;
- Aeronautics and air transport;
- Global monitoring for environment and security (GEMS);
- Improved and new nanoelectronic approaches;

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43 SEC(2005) 800

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PE 382.188
- Innovative medicines for the citizens of Europe;
- Embedded systems.

Given that no JTI exists to date, one can only draw the following two preliminary conclusions when considering their potential impact on an EIT, or vice versa.

From what one reads it is clear that the complexity of the JTIs should not be underestimated. For GEMS it is possibly appropriate to create a dedicated institutional structure given that it is not only about exploring and developing new technological solutions but also about data management. But this is not as immediately obvious for the field of e.g., nanoelectronics. The question must be raised whether a JTI in the area of nanoelectronics would compete with a next phase or a parallel project to the EUREKA MEDEA+ project, where partners have already found an apparently useful approach. The Western Institute of Nanoelectronics in the US, which will be discussed in more detail in the next section, demonstrates a relatively straightforward organizational solution and yet is no less ambitious in its goal to maintain the US semiconductor industry’s leading position into the next technology wave. The fact that the JTIs for nano-electronics (e.g., ENIAC) and embedded systems (e.g., Artemis) are meant to strengthen and eventually integrate the corresponding EUREKA clusters MEDEA+ and ITEA\textsuperscript{44}, indicates that companies too support simplification rather than complexification of the European landscape.

Competition between a JTI and a KIC that is active in a closely related area will definitely occur, for funding, for people as well as for involvement of, the key players from industry, academia and research. As in the case of the EUREKA clusters, one might try to have a KIC focus on the longer-term, further-from-the-market parts of a Technology Platform’s strategic research agenda, which is by the way, the position that European industry takes. However, we are concerned that there would be too many initiatives that would compete to cover similar ground. It is more logical to assume that a KIC and a JTP would act on a mutually exclusive basis, which in and of itself raises a ‘thorny’ dilemma.

### 8.5 National programmes

Currently, all European countries have national programmes to promote innovation-oriented R&D and linkages between publicly funded R&D, higher education and industry. The EIT must be positioned also vis-à-vis these programmes. Many differences exist between the design of such programmes and the way they are implemented. But as their objectives are very similar, analysing a few of them suffices to better understand their rationale and diversity, and their implications for organising the EIT and for its added value.

Our remarks will emphasize how, if at all, the various programmes will address critical mass, excellence and geographical concentration, and the linkages between research, education and business.

Apart from its rather elaborate and differentiated institutional landscape, especially in the area of R&D, Germany has an extensive set of programmes that support R&D and innovation. Its programme to support competence centres\textsuperscript{45} is highly relevant for the EIT discussion given its underlying philosophy.

While competence centres can differ from one field to another field, they share the following common characteristic: they are ‘regional konzentriert, überregional agierend’. They bring together actors from higher education, research, industry, and government at a regional level.

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\textsuperscript{44} Van der Biesen, J. (Philips), private communication

\textsuperscript{45} Bundesministerium für Bildung und Forschung, http://www.bmbf.de/pub/kompetenz_mobilisieren.pdf
to increase competitiveness and to collaborate on a national and international level. The three Bioregions that received substantial support after a competition organized by the German Federal Ministry of Education and Research are among the well known examples. The successful promotion of Dresden as one of Europe’s largest concentrations in microelectronics referred to earlier, exemplifies the same principle. The Exzellenzinitiative\textsuperscript{46} to create higher peaks among universities may end up being somewhat less ambitious than originally intended, yet it moves in the same direction promoting geographical concentration to enable a stronger outward competitiveness and collaboration. Two components that are especially relevant include (1) the identification and selective support for 30 excellent research and education clusters at individual universities that demonstrate a strong co-operation with research institutes, polytechnics and industry and, (2) the support for no more than 10 universities each of which will receive approximately 20 M€ annually to raise their research profile. The first winners were announced in October 2006.

In a much less pronounced way, Germany is following the direction of the UK where the Research Assessment Exercise has led to a significant re-distribution and concentration of research funding among universities. A new competition, much smaller in scale, to strengthen the position of the winning universities in the area of technology transfer, illustrates many governments’ attempts to improve university-industry links as well as to increase more diversity within the university landscape. An important element within the UK Innovation policy is formed by the Knowledge Transfer Networks. These networks provide a structured forum to exchange information, stimulate innovation, develop new collaborations, facilitate knowledge transfer, but also to provide feedback on the community’s needs and desires to the government. As national entities, they do not focus on geographical concentrations. But then they do not aim to develop technologies or bring together a critical mass.

\textbf{Sweden} has perhaps the most explicit policy to stimulate innovation through innovation systems. Its official philosophy mirrors Germany’s, with VINNOVA, the Swedish Agency for Innovation Systems, whose aim it is to develop strong regional innovation systems, as well as strong national and international interactions. The support for VINNO Excellence Centres is one way this goal is pursued: they are to become leading international environments for R&D and innovation activities. VINNOVA is also co-operating with the Swedish Research Council to select and fund a limited number of Berzelii Centres at a variety of universities. VINNOVA’s ability to implement the complete chain from supporting problem-oriented research to setting up incubators and providing seed capital, demonstrates their systemic approach to innovation support. However, it is important to note that the scale at which VINNOVA on average funds projects and collaborations is relatively small. This is also true for its \textbf{Finnish} counterpart TEKES. Its emphasis on regional networking and increasing attention to the exploitation of R&D results rings familiar bells.

\textbf{Spain’s Catalonia} region demonstrates a strong commitment to higher education, research and innovation, like many regional governments do in countries with relatively large decentralization of political authority.

Its Research and Innovation Plan 2005-2009\textsuperscript{47} is a comprehensive and ambitious plan that involves the close co-operation of government, higher education, research establishments and private parties to position Catalonia as a leading research and innovation stronghold in Europe. This underlines that the regional potential in Europe is dynamic as discussed in Chapter 2. It also stresses the vital importance of building up a critical mass and establishing

\textsuperscript{46} Bundesministerium für Bildung und Forschung, http://www.bmbf.de/de/1321.php
\textsuperscript{47} Generalitat de Catalunya, Research and Innovation Plan for Catalonia, Barcelona 2004
close regional links and geographically concentrated instruments to stimulate innovation. An arbitrary selection of indicators demonstrates how truly ambitious and specific its aims are.

Table 3: Catalonia’s aim in higher education, research and innovation

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Catalonia</th>
<th>EU 15</th>
<th>2008 goal Catalonia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business innovation spending as % of GDP</td>
<td>2.42 (2000)</td>
<td>3.70 (2002)</td>
<td>5.20</td>
</tr>
<tr>
<td>Private sector R&amp;D as % of GDP</td>
<td>0.91 (2003)</td>
<td>1.30 (2002)</td>
<td>1.26</td>
</tr>
</tbody>
</table>

Among other initiatives Flanders, Belgium has created in 1995 the Flemish Institute for Biotechnology (VIB)48. VIB coordinates, strengthens and supports selected biotechnology teams at 4 universities in Flanders, with the idea that partnership with universities is essential for the creation of a stimulating environment for researchers and students. Its focus is on strategic basic research, technology transfer, as well as communication and outreach to the public at large. It operates on the basis of well-described and selected programmes that lead to clearly formulated outcomes in terms of scientific productivity and industrial and societal validation. VIB brings together 950 researchers and offers them the use of several tools and research and technical facilities. There is extensive co-operation with Flemish, European and non-European companies. A strong central team dedicated to technology transfer has been established, producing now after 10 years a steady and substantial stream of patents, licenses, and start-up companies. Its annual turnover is some 45 M€, not including salaries of participating university staff.

An excellent example of a regional concentration of companies, research centres and universities is found in Grenoble, France. In this case, the concentration of two large French research organizations, two major European research facilities and several international companies in micro-electronics are at the origin of Minatec, which will host 3500 public and private sector scientists and engineers in micro- and nano-electronics and nanotechnology. As a matter of fact, it is only one example of more than 60 Pôles de Compétitivité in France, all of which combine the efforts of companies, research and educational institutions to create local and regional sources of innovation.

Similar programmes to create competence centres for coordinating and strengthening capabilities and ensuring a more effective technology transfer within regions or smaller countries exist throughout Europe. In 2001, Switzerland established a variety of National Competence Centres for Research (NCCR). Each Centre of Competence is based at and managed from a university or other renowned research institution. A network links the research groups from this home institution with other teams throughout Switzerland. Research of outstanding, internationally recognized quality, actively fostering knowledge and technology transfer, training, as well as the promotion of women researchers are determining

48 www.vib.be
characteristics of an NCCR. An NCCR’s typical annual budget in the areas of interest for the EIT is approximately 10 M€, 40% of which comes from the government.

**The Netherlands** Leading Technology Institutes (LTIs) have received recently considerable positive attention from the OECD\(^49\) and the EU. Four LTIs exist with a focus on food science, metals research, telematics and polymers. We concentrate on the Wageningen Centre for Food Science. The result of a government-initiated competition, the Wageningen Centre was established as an institute under joint management of the participating companies, universities and research institutes. The Wageningen Centre combines breakthrough research with pre-competitive technology development to strengthen innovation competences in participating companies, and has explicit arrangements for establishing IPR. Like the VIB it is virtual but it has a strong Board and executive management function, it has a strong programmatic basis and there is a strong financial commitment from the partners (25% industry, 25% universities) and the government (50%). Its annual budget is approximately 20 M€, with a staff of approximately 200 fte and a goal to double its staff to approximately 400 fte.

Given that the Centre’s goal is similar to what the EIT should achieve, it is worthwhile to highlight a few points.

- The Wageningen Centre does not provide training in the form of degree courses but does train many PhD students whose formal education takes place at the participating universities.
- Almost all of the Dutch key players from the institute’s domain are involved. Increasingly they are joined by players from abroad, but its core remains a fairly concentrated cluster of players. One might say their model is focused on ensuring effective critical mass formation at a relatively small geographical scale (i.e., the size of the smaller countries in Europe, but the model would not be restricted to national configurations) and subsequently to involve key players from outside.
- There is no additional management layer overseeing the 4 LTIs and no general regulations (e.g. concerning IP). Regular evaluations are initiated by the government.

An American example illustrating similar principles exists in **California**. The US Western Institute of Nanoelectronics is a co-operation between UCLA, UC at Santa Barbara, UC at Berkeley, Stanford and 6 key semiconductor industry players. Co-managed by the 4 participating campuses and semiconductor industry sponsors, with 30 faculty members, many students and industry researchers working on the 4 campuses, and an overall budget of 250 M$ over 4 years, this will be one of the world's largest joint research programs to explore critically needed innovations in the semiconductor technology sector with a focus on nanoelectronics or spintronics. It is considered an innovative model for cooperative research, but it is clear that the model also exists in Europe. This model provides another good example of the need to organize a critical mass in a limited geographical area and to combine a commitment to provide inputs with direct management responsibility.

### 8.6 Evaluative observations by way of conclusions

Several large-scale co-operative schemes exist at the European level which companies, universities and research centres find attractive and effective for joint technology development underpinning future innovation, as long as transaction costs (bureaucracy, administrative overheads, politically correct partnerships, etc) can be kept in check. Some of

\(^{49}\) Public-private partnerships for research and innovation: an evaluation of the Dutch experience. OECD 2003.

\(^{49}\) "The four Leading Technology Institutes (LTIs) represent one of the purest forms of PP/P, both in their rationale and organization.
the large EUREKA clusters are examples. The Joint Technology Initiatives, which do not yet exist, also get so far a positive reception. Adding an EIT might result in overpopulation of the realm of instruments for large-scale cooperation between firms amongst each other and with universities and research institutes. An EIT KIC, a JTI or a MEDEA cluster could theoretically each be given a niche of their own on the chain from more basic research and development to market introduction; in practice, though, the instruments will very likely compete for partners.

Analyses made by the key players in e.g. micro-electronics and nanoscience and nanotechnology indicate strongly that the key feature of their desired European landscape is a series of strong, critical mass centres at existing universities or research institutes, and a very small number of large scale institutions to bridge the gap between academic research and company in-house technology development.

Countries have started to implement policies to introduce greater differentiation among their universities (e.g. German and the UK), but this is a realm for national policies in the first place, including the judicious use of Structural Funds wherever applicable. Funding instruments for academic research, such as the ERC, so far seem to be about the only realistic instrument at Community level.

Several examples have been given of national policies to promote innovation, which now invariably cover a broad spectrum: supporting problem-driven R&D, making sure that sufficient capital, including seed capital is available for the various stages of the innovation process, stimulating technology transfer and incubation are among the common elements. Often in conjunction with ever more explicit policies of regional and local authorities, these policies increasingly focus on regional concentrations of players in the innovation process as a basis for national and international coalitions.

Explicit attempts have also been mentioned (e.g. in Belgium, France, the Netherlands) to bring together public and private research in structurally funded strategic partnerships. Underlying these attempts is once more the conviction that critical mass (human resources, facilities) is necessary and that this is best realised in a fair degree of geographical concentration. The partnerships which are at the core of an EIT i.e., the KICs in the Commission proposal) should reflect this.
9. **THE POTENTIAL IMPACT OF THE EIT AS PROPOSED**

Assessing the impact of an EIT can only be done on the basis of a fairly concrete and specific idea of how the EIT would actually operate. It seems reasonable to assume that the primary focus has to be on the KICs, much less on the Governing Board. It also appears to be realistic to assume that synergy between different KICs, statements in the proposal notwithstanding, would at best be a second-order effect given the fact that KICs will cover specifically different fields and therefore involve non-overlapping groups of participants. This would considerably reduce the potential for synergy, other than that which might occur through common IP policies. Consequently, much can be learned from imagining how a specific KIC would look like and function.

9.1 **A Knowledge and Innovation Community at work**

One crucial parameter that determines how a KIC looks like is the scope or breadth of the area it will cover. It is useful to consider a few examples because the impact of a KIC is different if the scope is small or large. With this in mind, the life sciences would be considered too broad as would be genomics or even a more specific field such as cancer therapies and medicines. Materials science would be far too broad, and the same would even hold for the narrower field of functional materials. In this case, biomaterials might be a suitable theme. Energy, to provide a third example, is too indeterminate. Fuel cells, too specific and too application-oriented, both of which characteristics would be less conducive to a rich environment for education. Given the breadth of fields such as the life sciences, materials sciences or energy science and technology one should not attempt to assess the impact of the EIT on these fields. Such an assessment would be unrealistic.

Of course, the scope of the field very much compares with the size of a KIC. For this, we adopt the estimates of the latest Commission proposal, and translate them into assumptions about the resultant number of partners and implied average size of the teams that would be involved at the various premises. Let us assume that a KIC of 100 academics, 300 researchers, 600 technicians and other support staff, 600 master students and 400 PhD students brings together 15 universities or research institutes and 25 companies. A significantly smaller number of participants might lead to a more effective KIC, as will be discussed later, however a smaller KIC might be at odds with the premise that a KIC must be highly distributed. Similarly, it is safe to assume that the KIC’s partners must come from a variety of countries across Europe, given that a KIC consisting of one European nation’s (e.g., France) universities and companies would not support the idea of a European solution as defined in the proposal. While a ‘French’ KIC might not meet the proposal’s requirements it may be very effective, as will be discussed later when we deal with the cluster model for the EIT.

The above numbers imply that the average university team (note: the distinction between a university team and a team from a research institute is not significant) might be comprised of 7 faculty members, 7 researchers/postdocs, 10 PhD students and 15 support staff. A typical team from industry (i.e., a company team) would be comprised of 7 researchers and 15 technicians.

One must include a third dimension when specifying a KIC: namely, where within the range of R&D, would a KIC have its focus? In this regard it seems more important to ensure that the area is not too application-oriented (e.g., fuel cells) rather than to constrain it on the other side of the spectrum. That said, it is unlikely that one would choose astronomy, and where the field of life sciences is considered, one would not focus on systems biology.
But it is clear that in areas such as life sciences, ICT, nanoscience and technology or materials science, more basic, long-term research (sometimes referred to as frontier research) will become part and parcel of the activities of a KIC, especially if its aim is to work at the frontiers of science with a goal to secure Nobel prizes. We would like to stress that we are still following the goals the Commission’s proposal set out for the EIT, in particular its goal to set an example that is better than the current top tier universities in Europe. One could set different goals in order to promote innovations and establish a technology base for future innovations. But if the aim is to truly compete with the calibre of MIT, rather than with organizations with a different goal such as the Fraunhofer Gesellschaft, the EIT’s technology development activities must be carried out within the context of a scientific programme at the frontiers of current knowledge.

9.2 Assessment of the impact of a KIC on graduate education, research and innovation support

In Chapter 1 the direct and indirect impact of the EIT have been summarized as follows:

Direct:

- Graduates;
- Scientific publications and other direct research outputs;
- Technological and other useful knowledge;
- Inventions;
- Intellectual property (e.g., patents, trademarks, designs, plant breeders rights, etc);
- Spin-off companies;

Indirect:

- Improved performance and modernization of the European higher education institutions through its activities, outputs and governance
- Improved performance and modernization of the European research institutions through its activities, outputs and governance
- Improved performance of European companies by offering a reference for new forms of collaboration with higher education and research institutions;
- Improved performance of networks of partners from these categories by offering a reference for new forms of collaboration between them:
- More innovations in European industry through EIT graduates, technological knowledge, inventions and IP;
- More future academic and industrial leaders having the experience of working in an environment that encompasses academia and industry.

Let us first consider the direct outputs. The proposal considers a KIC to compare favourably to existing universities and research institutes because its concentration of resources and its close linkages to companies would result in ‘more’, ‘better’ and ‘more relevant’ graduates and knowledge outputs.
To make clear our intent, the impact analysis we provide includes both the short term and the long term. There is no cumulative effect associated with the impact of the EIT; it does not increase over the years. That is evident for the quantitative aspects. No scientific proof exists to discount cumulative effects as regards the qualitative impact, which is more or less synonymous with the indirect impact of the EIT. A good example, however small, could guide countries within the next 5, 10 or 15 years, to adopt different policies for higher education and research, and to move towards concentration, differentiation or higher selectivity. However, in Chapter 9, subsection 9.3, we will argue that such a result is not likely.

9.2.1 Graduate education

Ten PhDs, resulting in an annual production of ~ 3 PhDs, in a field like cancer research or biomaterials, is not a large number for any top tier European university. Neither is the combined annual KIC production of 40-50 PhDs as compared to the total output of European universities. The real argument to support a low output of PhDs would derive from the quality of these PhDs.

There is clearly a potential benefit for the research component of a PhD education, given a PhD student can profit from completing stints of his/her work at partner institutions. However, opportunities to carry out parts of one’s PhD study at one or more external universities or research establishments are not uncommon nowadays. No high quality PhD research in subject areas where one would find a KIC is being conducted in isolation. In fact, the better the quality and the reputation of the faculty at a university or institute, the better their connections to the premier research centres on a global scale are.

The course component of a PhD education would not benefit greatly from a KIC as course study is typically broader than the area of study offered at a KIC. As such, successful completion of the course component of PhD study requires a faculty which a university can, but a KIC cannot, provide.

Generally one can say that students look for to a ‘place’, a university or a large research institute, where they are able to find a large number of stimulating faculty, a rich course offering and a variety of other facilities and opportunities to expand their scope and enhance their capabilities beyond the narrow focus of their specific research topic. This holds a fortiori for education at the Masters level. Furthermore, being part of an alumnus of such a university or institute is of considerable value to both the graduate and, increasingly to the institution. One only needs to look at the importance of the financial contributions from alumni contributions to universities and research institutions throughout the US.

The fact that students look for a unique physical environment has a major implication for one aspect of the EIT proposal: namely, the supposed appeal of an independent EIT degree would have. As the world gets smaller and smaller, as research is being carried out and published in international communities, and as the Bologna process forges ahead in Europe, the formal requirement to recognize a foreign PhD is no longer a serious issue. The value of a PhD degree is, apart from the individual quality of a particular PhD student which is easily recognized by peers in the given field, by and large commensurate with the internationally recognized quality of the university or more specifically, the department or school of the university which confers the degree. This makes the discussion of joint degrees or European degrees increasingly less relevant (note again, that there is no such thing as a US degree).
Naturally a university of inferior quality would be pleased to offer a joint degree with an institution of superior quality; however, it is difficult to see what benefits a good institution would incur by engaging in a joint degree program. As such, we believe that an independent EIT degree would not be valued because it would be a European degree in contrast to a degree conferred by a university from a specific country, but only because an EIT degree would be considered the pinnacle in its field. The problem with the latter consideration is that the EIT would not be able to provide a considerable part of the PhD training. In addition, when one would limit the discussion entirely to research PhDs for which the EIT might perhaps suffice, there is again the question associated with institutional incentives. Why would it be attractive for a top tier European university to cede its powers to confer PhD degrees to an EIT? The best one might expect is support from the scientific community and employers to value a joint ETHZ-EIT degree as superior to an ETHZ degree alone. However, given the limited benefits in terms of quality, this is not likely to occur.

9.2.2 Research

Essentially, the assessment of the quantitative impact within the area of research is similar to that which has been discussed regarding graduate education. Well-known data depicting the amount of research publications in Europe and the US supports the fact that European researchers are no less productive than American researchers. Therefore, additional quantitative output reflects the number of researchers added to the research community, a number which is relatively small, both per partner and for the field of a KIC as a whole. It is more difficult to predict whether the establishment of KICs would result in a higher number of publications in high-impact journals, where in most fields, the US holds an advantage over Europe. While the relatively small quantitative impact of such an increase would not close the gap anyhow, it is important to try and assess whether a KIC as a gathering of a considerable number of successful teams, would provide significantly improved conditions conducive to research with results significant enough for publication in high-impact journals. Experience and bibliometrical studies suggest that a stimulating physical environment of critical mass with high quality students and staff is the best predictor for high quality research, a fact that is reflected in the hiring practices of academic departments and research institutes. It is of course possible that researchers from such an environment would have an even stronger motivation to collaborate with their peers from different universities or companies found within a KIC and that this collaboration might result in better publications. That said, one should not underestimate the degree of co-publishing that already takes place. One should also be reminded that research in science is highly competitive so the effects of large networks or more formal communities should not be overestimated.

9.2.3 Supporting innovation and technology transfer

Clearly, creating an additional vehicle for industry-university-research institute collaboration is useful, which the examples of several national instruments illustrate. The question is whether the particular form of a KIC which, as suggested, combines tens of teams across Europe, would offer more than would the mere strengthening of individual universities or research institutes and their connections with companies. Companies from all over the world associate themselves with the MIT Industrial Liaison Programme. In Europe, the same occurs

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50 Deliberate attempts to improve the quality of higher education in countries where for historical reasons traditions have been abandoned or not yet established are of course an exception, as the situation in several developing countries demonstrates.
in Belgium at IMEC. Each of these examples stresses the importance of localization. Longer-term relationships between firms and universities and research institutes do not usually involve many players. Localization is also important too when considering technology transfer and start-ups. A KIC with partners located throughout Europe is unlikely to provide best-practice technology transfer services across Europe. Such services are either built up at a particular university or institute, or between limited numbers of institutions located within a limited geographical area as the Flemish VIB demonstrates. Partners could definitely learn from their colleague teams within a KIC. The problem, as the numerical decomposition of a KIC shows, is that the teams will likely be too small to have an institutional impact. The VIB with its 1000 persons will have an impact on technology transfer and spin-offs in its 4 partner universities all of which are located within a small geographical area. A KIC of the same size, scattered across Europe and involving many more players, will face a much tougher challenge.

As a consequence it is difficult to imagine that a KIC would lead to more technologies, more IP and more spin-off companies than dedicated programmes that are located within proximity of a very strong institution or strongly organized partnerships between a more limited number of partners.

### 9.3 Synergy between different KICs and the reference role of the EIT

One should not expect synergy between different KICs in the form of interdisciplinary cross-fertilization. In most cases the disciplines and areas of research will simply be too far apart, and where they are close, an independent KIC should be created given that it will be difficult enough to organize the interactions within one KIC. The synergy would have to come from adopting best-practice project management methods, evaluation procedures or IP (as an example) management methods. On the other hand, if one brings together the ‘best-in-class’ players, and that is what a KIC will do, one would expect that they are not bad at these sort of activities anyhow. So in a very good estimate, one may safely assume that the effect of the EIT will equal the sum of the impact of the individual KICs. That is of course separate from the more intangible impact that would be associated with the reputation of the EIT as the ‘place’ where things happen. We have already argued that in the area of graduate training, an area considered vital because it concerns future generations of the best and the brightest, it is unlikely that the EIT would establish a reputation that would outclass the top tier universities in Europe.

Given that a KIC will involve partner teams which within their university, research centre or company will not be significantly larger than any other team, it is unlikely that the EIT will have a large impact on institutions or institution-wide practices. One will not learn how to govern a university or a large research centre from running a KIC or from the way in which the Governing Board runs the EIT. As argued above, the same would be true for an institution-wide technology transfer service.

Not only would several participating universities and research centres already have an effective technology transfer service, the KIC would develop a service of a different make-up due to its dispersed nature. This would therefore be of limited value as a model a localized institution which is generally more active in a much broader set of areas.

When providing a conclusion regarding the reference role of a KIC or the EIT one needs to bear in mind that the EIT as proposed is designed to be a role model for the very best universities, research centres or companies, not for the average ones. It is clear from our analysis of the EIT’s impact and the existing institutional landscape that such a role can only be limited.
Moreover, there is bound to be competition between establishing a KIC and for example, a EUREKA cluster or a Joint Technology Initiative, and this will not help to make the EIT as currently envisaged, the outstanding reference point for organizations in science, technology and innovation.

Therefore it cannot be expected that the EIT’s impact on a more systemic level will be large. As such, it will not greatly assist the universities and national governments in their quest for reforms to lead to increased differentiation, concentration, autonomy and better governance.

9.4 Conclusions
The European Institute of Technology (EIT) as proposed by the Commission combines the following three objectives: graduate training, research and innovation, which we have argued should be read as, support for innovation. Its purpose includes being ‘best in class’ thereby becoming a reference for the reform of higher education, research and collaboration with industry. Each of the EIT’s that are at the core of the EIT will be comprised of teams made up of several universities, research establishments and companies that will be based throughout Europe. In addition, there will be a Governing Board supported by a small administrative headquarter that will be used for the KIC selection and evaluation process and for the setting of overall policy. The first KICs should according to the Commission’s proposal be operational by 2009. The concept of KIC as in the reference proposal of the Commission with the specific characteristics as outlined above (i.e., the combination of training, research and innovation support; the fully decentralized nature; the rapid pace at which it is created and made fully operational) raises serious questions regarding its feasibility.

When one compares the proposed size and budget of the EIT: i.e., an eventual annual budget of 900 M€, 115 M€ of which should come from the Community budget as core funding with the budgets of large American and European research universities at 1 to 2 B€, major research organizations such as EMBL at 120 M€, and IMEC with a 200 M€ turnover rate and regional concentrations of R&D such as Minatec with its proposed employee base of 3500 fte, it becomes clear that the proposed KICs with their average budget of 135 M€, will not provide for a uniquely large enterprise given their dispersed nature. There is clearly a need here for a more seriously thought-over financial basis for such KICs based on mixed public and private funding but allowing for differences amongst the various KIC fields in the relative contributions of public and private funds.

There is no question that there is a need to modernize and improve all levels of graduate training in Europe (i.e., not only for PhD students). That said, it is important to note that a KIC does not provide the proper environment for such training. Students choose for a ‘place’, a university or a large research institute, where they can find a large number of stimulating faculty, a rich course offering and a variety of other facilities and opportunities to expand their scope and enhance their capabilities to extend beyond the narrow focus of their specific research topic. This holds a fortiori for education at the Masters level. Furthermore, being part of an alumnus of such a university or institute is of considerable value to both the graduate and, increasingly to the institution. One only needs to look at the importance of the financial contributions from alumni to universities and research institutions through the US. The ability to create a unique, specialized ‘place’ or environment where people wish to migrate to is paramount to the success of the EIT.

Quantitatively speaking, a KIC would not make a significant contribution to the number of graduates within a specific study area. With respect to the granting of degrees, this report argues that the value of each degree is intimately linked to the reputation of the university that
confers them. An EIT as proposed cannot offer through the KIC format, an environment equivalent to those provided at top tier research universities. Therefore it is unlikely that a joint degree from a participating university and the EIT would add any substantial value to the degree received from the university alone.

The analysis of the size of the teams participating in a KIC indicates that no significant increase in the overall research output of any given field would result. European researchers are already productive and so any additional output would therefore be more or less proportional to the additional number of researchers. It is hard to predict whether a KIC would lead to a substantially higher number of publications in high-impact journals. Once again, experience suggests that a stimulating physical environment of critical mass with students and staff of high calibre is the best predictor for this. While researchers may be more strongly motivated to collaborate with their peers in a KIC, one should not underestimate the degree of collaboration and co-publishing that already takes place. It is also important to note that research in science is highly competitive and this limits the desire of researchers to form large networks or more formal communities.

Considerably stronger output from industry-university-research institute collaboration and subsequent support for innovation, including technology transfer, is not likely either. In terms of numbers, the differential that a KIC would add is not large enough. Longer-term relationships between firms and universities and research institutes will not involve that many players. A KIC with partners throughout Europe is also unlikely to provide a best-practice technology transfer service across Europe. Such services are either built up at a particular university or institute, or between limited numbers of institutions located within a geographically limited area.

The report points out that there may be significant substitution problems. In several important fields where a KIC would most likely be considered, instruments already exist or are under construction to promote collaborative research, technology development and technology transfer. EUREKA clusters are a case in point, where partners may not see the advantage of being replaced by a KIC. The Joint Technology Initiatives currently being formed under the FP7 would also appear to compete with any potential KIC given the fact that the differences between these two entities are not clear enough. We note, but do not simply adhere to the views expressed by some companies that a KIC will complement rather than compete with such initiatives.

The limited impact that a KIC, hence the EIT, would have on the quality of graduate training, research and, industry-university-research institute collaboration, coupled with the substitution effects, suggests that the EIT through its KICs cannot easily develop into a reference for the existing top tier universities or research institutes in Europe. Its dispersed nature would not assist the universities and national governments in their quest for reforms leading to for example, increased differentiation, autonomy and better governance, or for more effective technology transfer practices.
10. **LEGAL ASPECTS OF THE EIT AS PROPOSED**

10.1 **Legal basis, legal nature, legal issues for effective functioning**

From a legal point of view three different areas must be considered. Is there a basis in the EU Treaty to establish the EIT? What will be the legal nature of the EIT as an institution? Does the functioning of the EIT or its constituent parts result in certain issues of a legal nature?

The Commission proposes to establish the EIT on the basis of Article 57, paragraph 3 of the Treaty. The Commission is empowered by this provision to take any useful initiative to promote the coordination of the actions of Member States where such coordination is necessary to promote the competitiveness of the Community’s industry, for example, through fostering better exploitation of the industrial potential of policies of innovation, research and technological development.

This does not seem to pose problems with one major exception. Legal experts are of the opinion that it is highly doubtful that a Community institution would be able to confer degrees given that Article 149 of the Treaty states that the primary responsibility for education rests with the member states and explicitly excludes harmonization of national legal provisions for education. This Article would require that every member state grant the EIT the authority to provide academic degrees that are the equivalent to national standards. Regardless, we have argued that a degree received from the EIT would not have great added value.

As regards the legal construction, it is therefore not advisable to establish the EIT as a Community institution. As the example of the ERC illustrates, there are more reasons to establish an EIT as an independent organization. Indeed, few national governments would consider establishing an institution that would also have the function of a higher education institution as part of their government structure.

Another option mentioned is to create a Joint Undertaking on the basis of Article 171 EU Treaty. That option, originally deriving from the EURATOM Treaty but incorporated in the EU Treaty, is strictly meant for the execution of Community Research, Technological Development and Demonstration (RTD&D) programmes. The Joint European Tokamak (JET) in Culham, which is the mainstay of the Community’s thermonuclear fusion plans, is a well-known example. GALILEO, also know as the European counterpart to the GPS system, has for its 4-year R&D phase been established as a Joint Undertaking under Article 171 EU Treaty. Though the Joint Undertaking of Article 171 is not really defined in terms of its organizational structure (the EURATOM Joint Undertakings were prescribed in a very detailed way) the GALILEO example shows that it may not be the independent structure that would be desirable. GALILEO has been founded by the European Community (represented by the Commission) and ESA. Companies may join later, but their shares are strictly limited. The Commission and ESA will always each have at least 40% of the voting rights in the Administrative Board of GALILEO. Underneath is an Executive Committee where one finds again representatives of the Commission and ESA. Only at the next tier one finds the Director who is the CEO. That is not all: formally not part of GALILEO is a Supervisory Board in which the Member States essentially instruct the Commission Representative in the Administrative Board what she/he has to think and do.

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51 The JET Joint Undertaking was ended in 1999 when the facilities were transferred to the UK Atomic Energy Authority. JET is now a programme operated at JET under the responsibility of the European Fusion Development Agency (EFDA).
Trying to apply these ideas to the EIT raises in the first place the question who would be members of an EIT Joint Undertaking. If the Commission is a member the distinctly unattractive idea of a Supervisory Board of all EU Member States looms around the corner. As the KICs would involve many universities, research institutes and companies, involving them all will be impossible; making a selection will be equally impossible. Neither is running an institution a conceivable task of representative organizations such as UNICE and the European University Association (EUA). Having one or a number of authoritative (and maybe rich) personalities or private foundations establishing the EIT is not impossible and would resemble the way several of the important US universities have originated. But this would not easily lead to a Joint Undertaking under Article 171 EU Treaty. Such founders are unlikely to resort to a structure of which the statutes and the organizational structure of a Joint Undertaking under Article 171 EU Treaty have to be approved by the Council of Ministers and the European Parliament. Indeed, it will be politically rather difficult to support anyone of such initiatives and have substantial EU support going into it, rather than into another which might come up. Hence, a Joint Undertaking is not a favourable legal construction for the EIT.

Article 171, to be sure, does not only talk about Joint Undertakings. It actually says ‘the Commission may set up Joint Undertakings or any other structure necessary for the efficient execution of Community RTD&D programmes’. However, the condition is that statutes and organizational structure have to be approved by Council and Parliament, leaving many of the aforementioned problems in place.

A third option is to establish the EIT as an intergovernmental organization such as CERN or ESA. It would appear that few governments would be inclined to move in this direction either, given that the need to have special international personnel statutes and other amenities no longer exists outside the diplomatic realm.

To create a European Economic Interest Grouping (EEIG) is also not a likely option, given that an EEIG is expressly intended to facilitate the economic activities of a number of its members who are existing economic actors in at least two Member States. A similar problem arises as was realized in the case of the Joint Undertaking: namely, who will be the members? In this case, further complications arise given that the members are collectively in charge of the EEIG. Therefore the activities of the members of the EEIG are central; and do not include those of the EEIG which exist only to produce better results than what the members alone can achieve. It is also clear that the EEIG has been designed as a tool for the co-operation of companies, although it is legally possible for institutions dealing with education, research and technology transfer to create an EEIG.

But there are many ways the EIT could be set up by using one of the national constructions available in the country where its headquarters are to be established. We have not looked any further into these details as they will not pose great difficulties and therefore will not make a significant contribution to the assessment of the impact of the EIT.

The internal legal aspects require further detailed considerations. One issue to consider is whether a KIC should have its own legal personality. Given that a KIC is supposed to operate independently and in a very structured way, it would seem likely that a KIC should have its own legal personality. If not, one of its partners would have to be the coordinator and lend legal personality, just as in the case of an ordinary Framework project. But this would be too weak for the KIC to be a longer-term structural partnership. The large number of partners that are likely to be involved in a KIC will make establishing its own legal personality a fairly complex but not impossible challenge. Part of the complexity derives from the fact that the KIC will have to be established on the one hand by its partners, and on the other hand will have to define its legal relationship to the EIT very carefully.
Other questions arise such as: Will all personnel involved in a KIC be employed by the partner it is a member of or will a KIC also employ its own personnel, as is the case in the Flemish VIB? Will the academics and other researchers involved in a KIC still be teaching at their university, or will they be working on a full-time basis for the KIC?

There are also questions surrounding the issue of intellectual property rights. Will they be owned by the EIT, by the KIC, by the partner organizations, or by the inventors? The guiding principle here is to make such arrangements that intellectual property is used by companies including affiliates whether from inside or outside the EU, and not to turn it into a cash cow for the EIT. Income from royalties and licenses turns out to represent only a few percent of the total sales. As such, central ownership by the EIT and/or by a KIC might not be the best or first option to consider. A number of solutions can be derived from the large body of experience at several individual institutions and national and European collaborative programmes and institutions.

10.2 Conclusions

Establishing the EIT on the basis of Article 157, paragraph 3, does not seem to pose problems. However it is doubtful whether a Community institution can confer degrees, as Article 149 EU Treaty confirms the primary responsibility of the Member States for education. That said, it has been argued that an EIT degree would not have great added value anyhow.

It is not advisable to establish the EIT legally as a Community institution. Like the ERC it is far preferable to establish any EIT as an independent organization. Indeed, few national governments would consider establishing an institution of higher education as part of their government structure. The Joint Undertaking option (or any other structure) on the basis of Article 171 EU Treaty runs into the problem of determining who shall be members of the Undertaking, and the fact that structure and organization have to approved by Council and Parliament bodes ill for simplicity and independence. An intergovernmental organization such as CERN or ESA is already for a long time no longer the favoured solution of governments who dislike international personnel statutes and similar amenities. Instead the structure of the EIT can follow one of the national constructions available in the country of its headquarters. To create a European Economic Interest Group is not evident as an EEIG serves to facilitate the activities of its members which are existing economic actors that, moreover, in the first place are thought of as companies.

The internal legal aspects require further detailed consideration. The report touches upon a few issues, some of which are complex, such as the legal nature of a KIC. It is our belief that complexities associated with the internal aspects are all surmountable, as the experience in large European collaborative structures have shown.
11. **FUNDING MODEL AND FUNDING SOURCES FOR THE EIT**

11.1 *Is the funding model realistic and sustainable?*

The funding model foresees income from three sources to cover the expected costs of 2,367 M€ over the first 6 years. A central budget of 309 M€ will be provided by the EU. Contributions from local and national authorities, enterprises, and from venture capital or bank loans are estimated to provide 527 M€. Community programmes such as FP7 or the Structural Funds should provide the remaining 1,531 M€. Of the 309 M€ central EU contribution to the overall operational expenditure (note: capital costs are apparently either translated into annual costs, or assumed to be born by the participating institutions), 44 M€ will be allotted to the Governing Structure and 265 M€ to the KICs. The table below summarises the income and expenditure expectations of the Commission’s proposal.

*Table 4: EIT’s income and expenditure expectations*  

<table>
<thead>
<tr>
<th>Operational Expenditure</th>
<th>Total 2008-2013 (M€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Governing Structure</td>
<td>43.5</td>
</tr>
<tr>
<td>KICs</td>
<td>1,628</td>
</tr>
<tr>
<td>Grants for Master and PhD students</td>
<td>145</td>
</tr>
<tr>
<td>Improvement of innovation/research/education capacity</td>
<td>550</td>
</tr>
<tr>
<td>Total operational expenditure</td>
<td>2,367</td>
</tr>
<tr>
<td>Income</td>
<td></td>
</tr>
<tr>
<td>Local authorities, Member States, Enterprises, EIB, Venture Capital</td>
<td>527</td>
</tr>
<tr>
<td>Community programmes (competition)</td>
<td>1,531</td>
</tr>
<tr>
<td>Community (directly to EIT)</td>
<td>309</td>
</tr>
<tr>
<td>Total income</td>
<td>2,367</td>
</tr>
</tbody>
</table>

This funding model for the EIT does not appear to be feasible. An institution in the area of education and research with a core funding of only one eighth of its overall budget would not be sustainable, as there would be insufficient incentive for partners or national governments to provide matching funds.

It is unlikely that venture capitalists would be interested in funding much of the activities of the EIT. Referring to the analysis in Chapter 1 about the EIT’s role with respect to innovation, venture capital will only finance existing or new companies that wish to commercialise the results that a KIC produces.
The EIB will most likely be interested in investments for large scale infrastructure, which must be established at one of the partners thereby turning this partner into a type of core institution, which might be at odds with the decentralized nature of a KIC.

Exorbitantly high expectations for industry funding are not justified either. Longer-term substantial funding from industry in collaboration with institutions is only possible when fewer partners are involved. And as we argued in chapter 2 it is not necessarily desirable from industry’s point of view to strive for large funding from industrial R&D contracts. The data on the share of such funding in overall research budgets at MIT (~15%), Stanford (<5%), and Caltech (<2%) give an unequivocal answer. It is federal (i.e., public) funding on which they rely. An EIT that wants to be in the league of the MITs or Stanfords will not be valued for its capacity to attract huge amounts of industry research contracts. This seems to make short shrift with any hopes of large amounts of industry funding for an EIT. So either one keeps true to the intention of the EIT, i.e., to consider MIT and the like as examples, and thus competitors, or we are aiming at totally different, more short-term oriented functions for which large amounts of industrial money might be forthcoming.

Acquiring large amounts of funding from the Framework Programme would make KICs extremely dependent on the success of individual teams and therefore be very unstable. The same argument holds true for other funding sources that would not provide grants to a KIC as a whole, or to large parts of it. Moreover, it is ‘old wine’ in ‘new bottles’, and industry as well as universities would count their matching funds, in cash or in kind, as part of the investment. This, by the way, makes short shrift with the suggestion that one might make up for the too small quantitative impact of a KIC by treating the 135 M€ budget effectively mentioned in the Commission’s proposal as money to be matched by participating institutions and companies. Put otherwise, one cannot realistically expect an initial central investment of 300 M€ to lever not 2.1 B€ but almost twice as much, assuming 50% matching.

Other Community programmes that have been mentioned do not seem the most likely financiers either, especially if the high ambition towards excellence is maintained. The Community Innovation Programme, the European Social Fund and possibly somewhat less than the European Regional Development Fund, have objectives that do not sit well with the type of partners and activities that one would bring together at a KIC.

One might argue that the funding problem could be solved by substituting the EIT for a number of existing initiatives, such as the JTIs. In the next section, we will argue that there is a possibility of ‘freeing up’ additional money for innovation in the EU. It is also clear, and advisable in our view, to use more tax incentives to bring in additional private-sector money. However, our impact analysis shows that the funding problem, serious as it is, is in fact only a secondary one. The EIT with its assigned objectives and within the constraints in which it would have to operate, will have a modest impact at best on Europe’s innovation and growth performance.

11.2 European Innovation Fund: alternative funding source for innovation

Whatever the merits of the EIT, there is a good case to increase the funding for innovation related activities within the EU budget. After all, in a peculiar move quite contrary to the primary importance attached to innovation, this area of funding suffered the most in the final decisions made under the new financial perspectives 2007-2013. As such, the European Parliament should consider advocating the creation of a European Innovation Fund. This could be accomplished fairly easily if one adopts the funding mechanism that the Canadian government has used to create the Canadian Foundation for Innovation. The purpose of this Foundation is to co-fund large-scale equipment and infrastructure. This would be different for
our proposal where the idea is to finance the core funding of the EIT, and especially in the form we think is viable, namely the cluster model for the EIT, which is dealt with in Chapter 13.

The Parliament should suggest copying the way in which the Canadian Foundation for Innovation sources its money. Each year monies are left over from the EU budget due to under-spending by the Community which is the result of it not being able to run deficits. These are rather large amounts amounting to between 3 and 4 billion euros over the last years. Instead of returning these monies to the Treasuries of the member states, Parliament should advocate to use them to create a European Innovation Fund. There is a clear precedent here. The Globalisation fund (500Million€) was created on the basis of such a withdrawal. While such a redirection of unspent surpluses would require the agreement of all member states and the formal approval of ECOFIN, it would at the same time represent the clearest test of the real political priority given in Member States to the Lisbon aims. It would, in our view represent a unique opportunity that could not be rejected on serious grounds by the member states, as they can never draw up their own budgets based on calculating in these repayments. Canada has been able to accomplish this goal for funding for innovation and we believe that the European Union can too – in fact, it would be easier for the European Union to do it as Canada can run deficits.

11.3 Conclusions

The funding model proposed by the Commission for the EIT does not seem feasible. An institution for education and research with a core funding of only one eighth of its estimated budget will not be sustainable given that it would not be a sufficient incentive for others to provide matching funds. Acquiring large amounts of funding from the Framework Programme or other project-based funding sources would make KICs extremely dependent on the success of individual teams and therefore very unstable. High expectations that industry will fund EIT do not seem justified as longer-term funding from industry in collaborative institutions only occurs when few partners are involved.

It is possible to create a new funding source for innovation, an EIT or for other activities that support innovation, if the Community would follow the Canadian example and establish an Innovation Fund by transferring parts of Community budget monies that at the end of every year remain unspent to this Innovation Fund, instead of returning them to the national treasuries. The European Parliament should advocate this. It would be another test of the governments’ willingness to live up to the Lisbon ambitions.
12.1 Innovation policies mainly from the perspective of compensating for EIT’s weaknesses

Many policies are needed to create a climate conducive to growth and innovation. They are well-known and the recent Commission 10-point Memo on stimulating innovation and the related strategic priorities for innovation action at the EU level adopted by the Council in December 2006 mention most of them.

From the point of view of an assessment of the feasibility of the EIT the issue, however, is not to list and elaborate on all of these policies. Rather, the question must be answered whether they can compensate for the moderate impact the EIT as proposed is assessed to have, and whether some of them are essential for the success of an EIT.

The analysis presented in chapter 9 shows that the impact of the EIT depends very much on the size and the institutional form chosen. These cannot be compensated for by perfect policies for e.g. human capital, state aid rules and tax incentives, procurement, lead markets, intellectual property rights or industry. All of them would of course enhance the impact of the EIT, but so would they enhance the performance of other institution for education, research and supporting innovation. The EIT would not seem to have a differential advantage in this regard.

We will consider some of the strategic priorities, as well as a few other areas, to illustrate their potential impact on the EIT.

Intellectual property protection is in many situations vital. The crucial issue that needs to be addressed here is the European patent. The real breakthrough awaits Member States to live up to their continuously repeated pledges about the Lisbon strategy, and create a European patent with a strongly reduced number of languages and litigation and protection procedures valid throughout the Union. In the meantime individual countries should be taking steps in the right direction by giving up language monopolies for example. A second area where progress can be made has been touched upon, namely introducing something that materially resembles the grace period of e.g. the US system. A grace period offers a specific period of time in which a patent application may be filed in spite of the previous disclosure of the invention by the inventor/applicant. In areas where science advances very rapidly and academic rewards depend therefore on rapid publication, such a mechanism is crucial, even if there are disadvantages, a main one being the adverse affect a general grace period would have on legal certainty. European industry has favoured therefore as an alternative the introduction of a provisional application. This requires only a description of the invention and is less expensive. A final application has to be submitted within the following twelve months. The priority date of the later ‘proper’ application is fixed at the date of the provisional patent application. Introducing regulations similar to the provisional application in the European Patent Convention is already many years under discussion, but not yet materialized. This should be a priority. As a note in passing we would like to point out that in adapting IP regulations to the requirements of modern innovation, Western countries should not close the eyes to the grave unbalances the current global IP framework poses to developing countries.

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52 E.g. Ph. Aghion, A primer on innovation and growth; Bruegel policy brief, 2006
53 MEMO/06/325, 13-09-2006
It is clear that none of these improvements of the patent system would redress the institutional weaknesses of the EIT as proposed by the Commission.

Making public procurement work for innovation is another strategic priority listed. The one area where public procurement has proven its validity, defence, is not mentioned, however. The reasons are evident, but until a more unified approach can be adopted at European level, procurement can hardly be a major driver at a European level. But as regards the EIT, also a stronger European level procurement approach will not address the institutional weaknesses of the EIT proposed. It could probably have a major impact on individual physical institutions as the major defence labs at MIT and Stanford, mentioned in table 1, demonstrate.

Also in the list is helping innovation in regions. That is very much in line with our analysis in chapter 2. But creating stronger regions as such will not make the concept of widely dispersed KICs work any better. We will argue in the next chapter that an alternative form for the EIT, a cluster model, would profit from and support a strong focus in Structural Funds on strengthening regional innovation strongholds.

It is remarkable that the strategic priorities do not include regulation in the broad sense of the word. Environmental regulations, though not liked by industry, have been proven to capable of generating innovative approaches with sometimes, though not always, reduced lifetime costs of the products involved. Maybe even more important are regulations that might impact entrance into markets and rapid growth of companies after their initial stages. Labour market regulations, mobility obstacles, bankruptcy regulations, and many more are relevant here. Also the support measures for wider availability of venture capital and the new Community Framework for State aid for R&D and innovation would have benefited if they would have been put forward in this perspective. For the EIT in the form proposed by the Commission, however, the conclusion is once more that they would not matter for making it function better.

Finally, the Multiannual Programme of Enterprise & Entrepreneurship, in particular for SMEs 2001-2006 is worthwhile mentioning as another instance of the supporting environment that the Community has been creating for innovation. It focused on information – an interface between European institutions and local actors –, on financial instruments to improve the functioning of financial institutions, and on policy development on how to further improve the environment for enterprises. Companies that would participate in any form of university/research institute/industry cooperation would benefit of this type of schemes, they would have no leverage to help the EIT as proposed overcome its limitations.

12.2 Conclusions

The weaknesses of the EIT as proposed by the Commission derive from its institutional set-up, apart from the insufficient financial basis. Policies to promote innovation in areas such as IP, procurement, regional innovation strongholds or capital markets are important to create the right environment and incentives for innovation and cooperation between public and private partners. But they do not address and therefore cannot redress the institutional weaknesses of the EIT as proposed.

As to IP policies, some national governments might decide to break out of the stalemate around the European Patent and go some way in the right direction. Also a grace period or something having a similar effect such as a provisional patent application, should be introduced urgently to accommodate for the rapid advances in areas such as the life sciences.

56 See e.g. reference 51
Overall, policy development in innovation should address more explicitly the use of e.g. environmental regulations and the European problems of entrance into markets and rapid growth of companies after their initial stages.
13. **AN ALTERNATIVE TO THE EIT AS PROPOSED**

As the proposed characteristics of the EIT impose serious constraints on its feasibility, it might be worth investigating what could be realized if some of the characteristics were removed. An additional political issue relates to this. If the first KICs must start in 2009 and if true excellence is the only determining factor for participation, then it is highly unlikely that partners will predominantly come from the Central and Eastern regions of Europe or from some of Southern European countries. Existing linkages between companies, universities and research institutes will form the basis. However, the industry base in Central and Eastern Europe and in parts of Southern Europe is still weaker, and linkages with companies elsewhere are smaller in number. Therefore excellence in academic research from Southern Europe will continue to be underrepresented.

In this final chapter we consider an alternative to the proposed EIT which could be filled in by changing the constraints.

13.1 **A Cluster EIT or Multiple European Institutes of Technology**

Investigating the cluster model for the EIT means moving away from the realm where initiatives abound, such as the EUREKA clusters and the future Joint Technology Initiatives or the ERC. A physical infrastructure is required to seriously promote true excellence in research and training and in many respects, technology transfer. Many examples of the latter are known, some of which have already been mentioned. The idea is to use the EIT as a brand name for a flexible number of very high quality research institutes, each of which could be called the European Technology Institute for Field X. Each European Technology Institute for Field X would combine the following characteristics:

- Their themes will be derived from major problems identified by industry as drivers for future industrial development (10-20 years ahead);
- They will be highly interdisciplinary;
- They will have a very high calibre of core faculty of critical mass, and an infrastructure to support experimental work of outstanding quality;
- There will be facilities and funding for a significant number of postdocs and PhD students;
- Many visitors from all over the world, from academia and industry will be accommodated;
- Depending on their field, a variety of collaborative schemes with companies can be set up;
- They will be based at one or a very small number of universities or possibly research institutes where they will be provided with the academic backing, an exciting environment with constantly new generations of eager young persons and a dynamic social environment associated with a busy smaller or larger city;
- They will offer conferences and a variety of innovative training schemes for PhD students, master students, talented undergraduates, but also for experienced scientists, including those from industry;
- They will benefit from the host-institution’s technology transfer activities, and will engage in outreach activities to society at large.
Compared to the current proposal for the EIT, these European Institutes for Technology would offer exciting opportunities to improve graduate education. Very high level research will be possible. The European Institutes for Technology will also become vehicles to assist the process of differentiation among universities, as it would be a challenge for existing institutions to host such an institute. If one wants to take a concrete example the Cold Spring Harbor Laboratory in the US (or for that matter the Scripps Institution, or the Salk Institute) would in several ways resemble what we have in mind. But there are equally traits of, for example, the VIB in Flanders though the EITs would from the outset have to attract a very international group of scientists and students.

13.2 The Cluster EIT: Operational Principles

A few operational principles are important. Industry involvement begins with industry playing a major role in identifying which problems will be drivers for long-term industrial development. At this point, one must be realistic. While many small and medium size companies will be involved in the functioning of such an institute, the identification of the major problems driving industrial development will largely be the result of consulting larger companies. By approaching identification of problems in this way, few issues will be missed. Identification will be led by a Board on which representatives from companies and academia will sit but also politicians and civil society organizations. There will be no limitations set for the type of themes as industrial development is also responding to societal problems, such as health, securing food production, energy security or dealing with environmental concerns.

A competition between universities and/or research centres would be led by the Board to initially establish one institute per theme (note: more might be considered at later stages).

The size of each Institute does not need to be completely fixed, and a detailed analysis of the requisite size for the particular area chosen is necessary. However, to suggest a ball park we would recommend that approximately 300 scientific and engineering staff, (including visitor’s positions and postdocs, but excluding PhD students) would be an appropriate indication. Annual budgets, not including buildings which would be provided by the host institution, would be approximately 60-70 M€, with a lower bound of 30 M€ to ensure critical mass. An overall budget of 1 -2 B€ per year for these European Technology Institutes will then correspond to the ambition to establish 20 institutes over a period of several years. The number at this stage is of course not even an approximation. It would not make sense to think in terms of only three of these institutes, nor would one be inclined to establish 50 of them.

The funding model for each Institute is based on a combination of reasonably long-term funding and competitive funding. The core funding which serves to leverage matching funds, and together with these matching funds provide sufficient long-term funding would have to be in the order of one thirds. That would trigger another one thirds from matching by the host institution and local or national funding agencies (on the same basis as the core funding). The remainder is to be acquired from all sorts of competitive funding sources, including contracts from industry. There is no holy grail as to the percentages, only experience. Assuming that matching funds at best will double the core funding, and that 50-60% of the budget must be secured for a reasonably long-term, brings one to the 30% of core funding. As mentioned, the Commission proposal for the EIT has not got sufficient leverage by far.

The table below summarises the financial aspects of the proposal.
Table 5: Financial aspects of Cluster EIT

<table>
<thead>
<tr>
<th>Number of EITs @ 70 M€</th>
<th>Total annual budget (M€)</th>
<th>Core funding</th>
<th>Local, regional, national matching funds</th>
<th>Competitive funding from public and private sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>350</td>
<td>115</td>
<td>115</td>
<td>120</td>
</tr>
<tr>
<td>10</td>
<td>700</td>
<td>230</td>
<td>230</td>
<td>240</td>
</tr>
<tr>
<td>20</td>
<td>1400</td>
<td>460</td>
<td>460</td>
<td>480</td>
</tr>
</tbody>
</table>

The successful creation of the European Institutes of Technology is critically dependent on the availability of the core funding, which amounts to an approximate 500 M€ per year. While it would be perfectly natural for the European Community to make these funds available, it is equally clear that the current provisions for the EIT originate from a different reality.

There are three options.

1. Start with the available budget and create a small number of institutes, increasing the number of institutes as more funds come available. The latter may not be before 2014 when the next Financial Perspectives period starts.

2. Identify new sources of funding, such as the Innovation Fund as proposed in chapter 11.

3. Use the available Commission’s funds as an incentive to find out whether they would be sufficient to trigger one or a small number of countries who have high ambitions to become key players in the global knowledge economy to take over the scheme and provide the remainder of the core funding. Such a country or small number of countries would most likely impose some conditions on the role of its or their institutions. However, as long as the competitive nature of the scheme and a very high standard of quality are maintained, this would not create an insurmountable problem.

The cluster model for the EIT has two strong additional advantages. First, the cluster model provides a non-confrontational forum for existing universities to work from. They are challenged to compete for an EIT for a specific area and they would not lose any control over the research teams that would become a part of the particular EIT. They may of course lose teams to an EIT elsewhere; however, this type of transmigration is a form of healthy competition in science.

Secondly, the cluster model can contribute to a natural geographical balance. As mentioned in chapter 2, specialization has resulted in creating strongholds across Europe. For with the availability of Structural Funds, the more recent Member States of the EU will be able to compete at a par. Of course using Structural Funds on top of a Community core funding might perhaps create some problems with anti-cumulation restrictions, but this is a matter of balancing the various contributions.
13.3 Conclusion

Another option that deserves serious consideration in the light of our analysis is to create a *cluster EIT*. That is, to create gradually up to maybe 20 European Institutes of Technology, each of which would have of the order of 300 scientific and engineering staff without PhDs and an annual budget of up to 70 M€. Each would have its own multidisciplinary theme derived from problems identified by a Board as the major drivers for industrial development for the next 10 to 20 years. On the Board industry would be strongly represented but also academia, politicians and civil society. Competition would lead to the selection of proposals from strong regional or national consortia that would base such an EIT in a particular area at one or a very small number of universities or research centres which will provide academic backing, with constantly new generations of eager young persons, and the social environment of a city. High level core faculty and infrastructure, large number of visitors not in the last place from industry, many PhD students and postdocs, and shared technology transfer facilities with the host institution, are some of the other characteristics of this model, which is not dissimilar to for example the Cold Spring Harbor Lab in the US. Exciting possibilities to improve graduate training will also result.

The funding scheme would entail 1/3 core funding, 1/3 structural matching from regional or, national sources, and 1/3 funding from public and private competitive sources. The Innovation Fund suggested earlier might provide the 500 M€ or so required for the core funding for some 20 institutes. If less central funding is available, gradually building up the number is an option; another is that the available central funding could perhaps trigger one or a small number of countries with high ambitions to be key players in the global knowledge economy to take over the scheme and provide the remainder of the core funding.
14. **OVERALL CONCLUSION**

The proposed EIT as institutional solution to Europe’s perceived weaknesses in converting knowledge into commerce ignores the fact that European excellence in research, graduate training and technology transfer is far from homogeneous both across member states and across regions. In this, the EU is more similar to the US than different from it. Ignoring this fact leads one to assume too easily that a European level institutional solution would be effective. The Commission’s proposal for an EIT, apart from its legal and financial weaknesses, suffers in our view from its extreme decentralised approach. In the view of this report such a decentralised network approach amounts in financial terms to little more than an additional “saupoudrage” of funds over very widespread Knowledge and Innovation Communities. Quantitatively, a KIC would not make any significant contribution to the number of graduates or the research output in a given field. A KIC cannot provide an environment for training graduates equivalent to the one given by top tier research universities. Degrees from these universities will continue to be valued more than an EIT degree, even ignoring the legal hurdles the latter is likely to face. The spreading of additional funding over the many participants in a KIC will not lead to research excellence: a physical environment with a critical mass of high calibre staff and students is in our view absolutely essential. Concentration and a smaller number of partners are also characteristic for long-term partnerships between universities, research centres and industry. Best-practice technology transfer services, too, are best built up at a particular institution or in a geographically limited area. These conclusions to which must be added the substitution effects between the EIT and for example JTIs or EUREKA clusters, imply that the EIT will not develop into a reference for existing top tier universities or research institutes, nor help universities and governments to further reform the European university system.

Economic analyses of knowledge systems, and in particular of the virtuous interaction between higher education and in particular graduate training, research and technology transfer to and cooperation with industry highlight the importance of strong local agglomeration effects. Many of such centres of research and graduate training excellence, or of best practice technology transfer services do exist in Europe. An EIT should ideally build on those regional “hot spots” of excellence. We conclude therefore that what we have called a *cluster EIT*, covering a number of areas of crucial importance for Europe’s future, might appear more effective and appropriate for Europe. Such a cluster EIT combines for each area features of physical concentration of graduate training, research, industry cooperation and technology transfer in one or only a small number of locations with an active networking between such well recognized centres of excellence. How small small is, will depend on the field; the concentration might be high with only a very limited number of such centres, or lower with more centres involved across Europe. Here too, as in the case of the European landscape, the research landscape is far from homogenous.

To illustrate our point, let us refer at one extreme to the field of micro-electronics (and moving into nano-electronics) where in Europe a very small number of world class regional strongholds exists in which public and private parties have concentrated many of their research activities (in this case e.g. Crolles/Grenoble, Louvain/Eindhoven, Dresden). If, as is the case here, centres of excellence need the availability of sophisticated but very expensive research equipment and strong company in-house technology development, it would not make sense to dilute this concentration.

At the other extreme one might think of the life sciences with their ever wider spectrum of applications in health, agriculture and food, environment, energy etc. The industrial
environment is as a consequence also very diverse, form giants on the world scale, such as drug firms or energy companies to a variety of large, smaller and medium firms trying to build their future on the new promises of the life sciences. In such a field there is room for a wider diversity of world class research centres in Europe, specializing in different sub-fields but all competing at world level.

It seems to us that a cluster EIT which eventually could comprise a few tens of centres of excellence for all the areas together offers a unique potential for aligning regional, national and European ambitions and policies. For the first time, moreover, cross-border regions boasting strong public and private knowledge competences would have a genuine and strong incentive to jointly exploit the potential of their transnational region.

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