Measuring Third Stream Activities

Final Report to the Russell Group of Universities

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April 2002

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Executive Summary

Overview

Universities are seen by many to be increasingly significant sources of knowledge and capabilities within the knowledge economy. Policy-makers and analysts alike have begun to pay more attention to the ways in which university-based capabilities and activities can contribute to social and economic development.

Since their inception, although universities have contributed directly and indirectly to much of the decision-making in wider society, this function has not been 'core' to their mission in the same way as the first two streams of university activity – research and teaching. Now however, developments in this field have reached the stage where university 'Third Stream' or 'Third Mission' contributions are seen as important and distinctive in their own right, deserving of specific policies and resources to ensure their effective functioning.

This report sets out to design a system of indicators of Third Stream activities. Although the development of many of the suggested indicators is at an early stage, the suggested framework could be used to inform university management and government funding decisions. We hope it will also inform the wider debate that is necessary to improve the understanding and management of this complex topic.

Why this report?

We have reached a key moment in the development of university Third Stream activities in the UK. Various government initiatives are aimed at encouraging universities to invest more in this area, bringing significant new funding opportunities. Many universities are seeking to gather information on their Third Stream activities so as to ensure their effective management, and to underpin their funding bids. The government has shown signs of making funding for Third Stream activities a permanent feature of the university funding landscape. It is important that such funding decisions would are enlightened by information about the performance of Third Stream activities.

This report was commissioned by the Russell Group of Universities to inform its thinking, and the wider debate, in this area. The report is the result of a short but intensive and interactive study undertaken by SPRU (Science and Technology Policy Research), at the University of Sussex.

The report provides an analytical framework and a comprehensive set of indicators that may assist in the tracking and management of university Third Stream activities. To our knowledge it is the first attempt to construct such a set of indicators and as such, it is an early contribution to what will doubtless become an on-going series of developments in this area.

What is the university 'Third Stream'?

Universities have been founded principally on two sets of activities: teaching and research. However, universities have always made contributions, both directly and indirectly, to decision-making in the wider society; this is their 'Third Mission'. Third stream activities are therefore concerned with the generation, use, application

and exploitation of knowledge and other university capabilities outside academic environments. In other words, the Third Stream is about the interactions between universities and the rest of society.

Policy developments

Many governments around the world now feel that the role of universities in the emerging knowledge economy is of growing significance. This emphasis on the value of universities to economic performance is reflected in many policy and academic debates, focusing on university *commercial* activities.

Third Stream activities have risen to the fore in recent policy debates about UK higher education policy. The UK government is committed to harnessing the economic potential of universities and to this end, it has launched a series of programmes to increase Third Stream activities in UK universities. The 2000 White Paper on Science and Innovation describes universities as the "dynamos of growth" in the knowledge-driven economy. In particular, universities are seen to have a role in regional economic regeneration. Yet there is much more to the relationship between universities and the rest of society than merely commercial activities.

Beyond commercialisation

Universities make contributions to government and civil society as well as the private sector, assisting not only with economic performance but also helping to improve quality of life and the effectiveness of public services. Any approach to university Third Stream activities that focuses purely on university commercial activities is likely to miss large and important parts of the picture.

Universities perform a wide range of roles, responsibilities and activities. They cut across different economic, political and social networks. The report argues that the measuring of their Third Stream activities needs a *holistic* approach that examines the main channels that bind universities to the rest of society. We have developed a comprehensive conceptual framework for understanding the web of interactions that span universities and the rest of society.

Designing effective indicators

The design of effective indicators for Third Stream contributions calls for the development of a methodology that is feasible in terms of time and resources, and is based on a set of metrics that are:

- **S**imple
- **M**easurable
- **A**ctionable
- **R**elevant, reliable and reproducible; and
- **T**imely

Such SMART metrics have to be underpinned by a relatively simple model representing the *main* ways through which universities engage potential non-academic users and beneficiaries.

Previous analytical frameworks have tended towards complex theoretical systems that are difficult to operationalise. Even when the theories can be related to sets of indicators, these are often difficult to collect, and relate to variables that are not necessarily "actionable" as required by the SMART approach. Instead, our approach

will be based on a simple conceptual framework, outlined below, which emphasises the identification of the processes of diffusion, exploitation and use of research results and of the broader capabilities existing within universities.

A conceptual framework for analysing Third Stream contributions

In order to develop indicators for Third Stream activities, we need to have a framework for understanding the ways in which universities benefit society. An analytical framework detailing the different mechanisms through which universities can engage in Third Stream activities can then be used to structure and analyse a broad set of indicators.

Our starting point lies in current theory emphasising the variety of ways, many of them *indirect*, in which research and other university activities affect economic performance and society at large. The effects are not linear, but are often based on iterative, organic and self-reinforcing processes. Focusing on the efforts to commercialise IP would only capture a subset of direct effects. Instead, we emphasise the identification and measurement of the wide range of processes through which universities engage society and economy at large.

Our analytical framework starts with a basic distinction between what universities have (capabilities) and what they do (activities):

- Research universities have *capabilities* in two main areas: (a) knowledge capabilities and (b) physical facilities. These capabilities are developed as universities carry out their core functions of teaching and research.

- Using the means at their disposal, universities carry out three main sets of *activities*; they: (1) **teach**, (2) **research**, and (3) **communicate** the results of their work. All these activities can be considered Third Stream when they engage or target non-academic communities.

The figure below summarises the different Third Stream activities structured according to this framework. The top half of the figure represents the capabilities that universities have, while the lower part refers to the activities that universities do. The figure depicts a broad definition of the range of activities that shape and influence the relationship between universities and the rest of society.

Conceptual framework for analysing Third Stream activities

Associated Third Stream activities
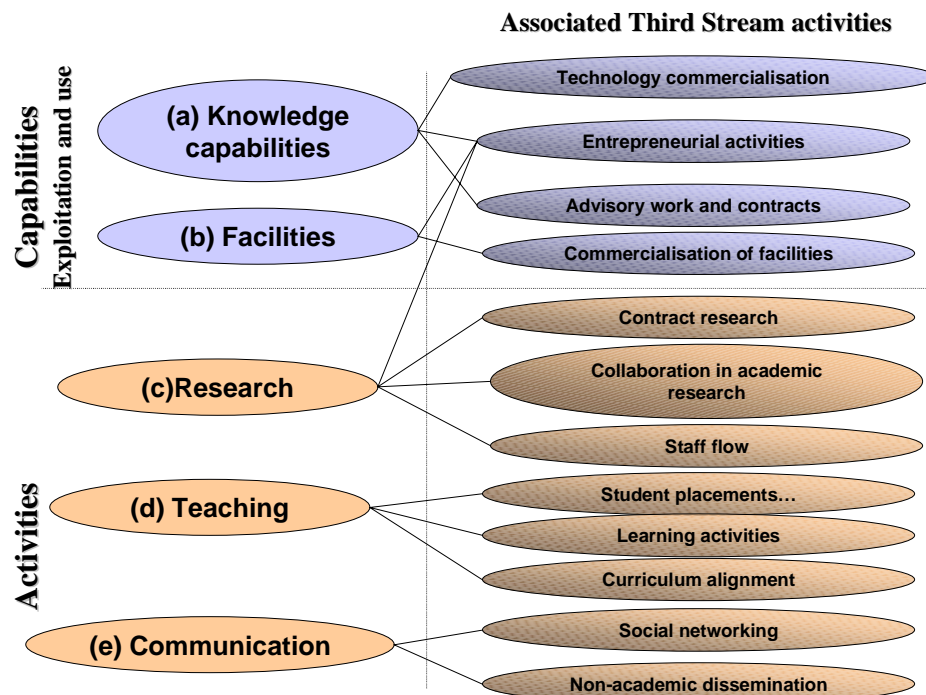
The indicators

Using this framework of 12 categories of Third Stream activities, we have analysed the strengths and weaknesses of 65 indicators. For a selection of 34 indicators we have also provided an indication of how the data would be collected (i.e. through existing information systems or new instruments), and the likely feasibility and costs associated with such data collection.

Assessing impact, or activities?

We have chosen to focus on indicators of Third Stream *activities*. Some argue that instead, indicators should focus upon the *outcomes* or *impact* of Third Stream activities. The argument is about whether indicators should measure the effort that organisations invest in engaging with non-academic users, or the results of such efforts in terms of societal or economic impact. Focusing only on the measurement of activities can lead to a concentration on developing processes with little regard to their ultimate outcomes. On the other hand, attempting to measure the impact of Third Stream activities is difficult for the following reasons:

- **Identifying additionality** is a complex problem that affects *any* attempt to measure the impact of human activity, yet would be necessary if impact measures were to be used.
- **Impact assessment and timing**. It has been widely argued that the impact of academic research is long-term and often indirect. So when is it a good time to measure impact?
- **Halo effect and skewed impact distributions**. The use of impact measures may yield biased results because academic work that gains visibility tends to receive additional attention just because of such visibility. This is usually known as the "halo effect".

- **Serendipity, and luck**. The outcomes of research and innovation activities are by their nature unpredictable, and luck or serendipity are important elements in determining outcomes/impacts. Should the lucky be given more public funds?

- **Influence of factors beyond universities' control**. Impact assessments need to focus on the benefits accrued by non-academic actors. Universities are poorly placed to assess such benefits, since these are beyond their control and often beyond their knowledge.

For all of these reasons, linking funding to the impact of previous Third Stream contributions is problematic. Therefore, our approach is mainly activity-based. Some direct impact measures that are easily identifiable and attributable (as in the case of income streams received from some Third Stream activities) are included as a way to weight for the value of the activity. In any case, we focus on those fundamental elements that universities can see and do for themselves rather than on their long-term societal and economic impact.

Focusing on the performance of activities allows us to overcome the problems associated with impact assessment and to propose a feasible process of indicator development. Besides, this approach is consistent with the government's aim of encouraging universities to invest time and effort in Third Stream activities, an area in which universities are seen not to have made enough investment in the past.

As we have seen, another reason to support an activity-based approach is the high degree of uncertainty involved in both research and innovation. Government quite simply has to accept some inefficiency, so that while some activities may in themselves not turn out to be as effective as others, undertaking them will lead to 'learning by doing'. It is important however, to avoid setting up an incentive system that would encourage actors to accumulate "countable" activities without regard to their quality and value. A Third Stream measurement system has to focus on activities whose definition is sufficiently narrow as to encourage targeted activities likely to generate value, and be combined where possible with direct impact measures that can provide an approximate indicator of success and value. At present, the only such measures that are available relate to the revenue streams generated by some of these activities.

Challenges of analysing Third Stream activities

There are considerable challenges that need to be resolved before a system for Third Stream measurement can be judged as being fully developed:

- There are considerable differences between universities and across disciplines in the ways that research influences society and the economy. This variety makes it difficult to develop a universally applicable model to Third Stream measurement.

- There is little enthusiasm in UK universities for a new measurement system.

- Some Third Stream activities are carried out outside the university system – either informally or through department-level arrangements that are not necessarily reported to, or recorded by, central university management. Such informal and invisible activities are therefore hard to track.

Dealing with variety

One of the key aspects of the report is a discussion of how best to account for the "variety of excellence" amongst the University sector in the proposed measurement system. We propose three different models, each containing a different degree of flexibility. The first treats all indicators and universities equally and assesses every university according to each of the indicators in the 12 broad categories outlined above. The second model allows individual universities to weight the importance of each of the 12 categories according to their own goals and strategies. The final model involves the creation of three or four different archetypes of universities and would then allow each university to select the appropriate archetype, in order to be measured against other universities of the same type.

For each of these models the report contains a discussion of strengths and weaknesses as well as practical implementation issues. We recommend the adoption of the second model.

Collecting the indicators

We have tried to take into account practical considerations for collecting and using the proposed indicators. In particular, we have followed a set of simple guidelines in the selection of indicators, as follows:

- use existing data where possible
- use existing university procedures to generate data
- limit the cost of data collection
- limit intrusion on individuals
- avoid indicators that relate to specific groups of decision-makers
- select a limited set of key indicators for each category
- provide indicators across all of the categories of Third Stream activity.

Developing a funding allocation process

The current system for allocating funds to support Third Stream activities is based on project-based competitions and judgmental decision-making. Although the removal of judgement is not a requirement of evidence-based policy, there could be considerable benefits from ensuring that judgements are made on the basis of significant evidence. Our aim is to move towards an evidence-based allocation of Third Stream funding. The development of a measurement system for Third Stream activities provides an opportunity to create better-informed policy choices.

The development of the measurement system will need to be supported by an explicit government requirement for universities to collect Third Stream information. At present, government expects universities to bid for Third Stream funding and in the process, provide information about its activities in different but relevant areas. The government is considering taking this process a step further and instigating a process of systematic Third Stream measurement to inform funding decisions. Universities will then have to collect indicators if they want access to these resources: initially, funding will drive data collection. However, as data collection systems become established, the process is likely to reverse: measurements may eventually drive the funding allocations.

We suggest that a move towards an evidence-based allocation system take place over a four-stage implementation process.

Stage 1. Development of a measurement system - In Stage 1, the indicator system will be developed while funding allocations remain largely determined by the judgement of a panel. The information input to this panel will be university plans, local and regional development reports and other assessments, as is currently the case. In particular, universities will be required to submit a 4-year Third Stream Plan detailing their Third Stream strategy is such a way as to allow the panel to assess its quality. Further, the panel may decide to retain the Third Stream Plan as an input to the decision-making process throughout the following stages. In addition, sector stakeholders need to agree a set of indicators to be collected by all UK universities. The government would need to provide funding to meet the costs of data collection. Stage 1 is likely to take place over two to three years, involving considerable development in the indicators and in systems for indicator collection.

Stage 2 – Mixing evidence with judgement – In Stage 2, the initial data collected will be available to the funding panel. Since some of the indicators are easier to collect than others, it is anticipated that at this stage only some of the indicators will be available to the panel. Yet this information will still provide a critical input. Further refinements may be required, as the first generation of indicator collections often generates unexpected difficulties.

Stage 3 – Evidence-driven judgements – In Stage 3, considerable information should be available on Third Stream activities. The panel could use the data to generate different scenarios for the distribution of funds, using various indicator weights. The scenarios could be discussed by the panel and more widely. Funding allocations would then be based on decisions about the appropriate set of rankings and funding formulas. At this stage, it will be possible to develop a formula that could be carried forward into future rounds of funding.

Stage 4 – Formula-based funding – By Stage 4, it would be possible to use a formula to inform funding allocations. One way of doing this is to group universities on a scale according to their scores and distribute funding to each group, following processes similar to those used for the RAE. This approach does not remove judgement in the allocation process; even the formula itself would be based on judgements about what is important. Furthermore, the Third Stream panel would be responsible for overseeing the development of the formula and its application, retaining control over final funding allocation decisions and ensuring that allocations respond sensibly to emerging challenges. The panel could also provide support to universities suggesting potential avenues of development to improve their Third Stream performance, advise government policy, and publish 'good practice' guides for universities to follow.

The future: Next Steps

The development of a Third Stream metric system will take considerable time and resources, and its potential linkage to funding mechanisms will be most effective if organised as a multi-stage process over a number of years, rather than trying to achieve it in one step. We anticipate an iterative process, involving indicator definition, collection, analysis and further refinement. This report is an early step in this larger process and, although we have tried to consult widely, the report is by definition not informed by the learning-by-doing that will take place during the initial stages of measurement and reporting. Instead, we offer a framework and a road map – the *enabling works* for the development of a system of Third Stream

measurement. The report recommends some initial steps to launch the process, including the creation of an inter-university working group with government representatives to agree and develop an initial list of common indicators, and an associated data collection manual.

Acknowledgements

Introduction and objectives

The main objective of the study is to develop a set of metrics and indicators of university external and commercial relations (so-called *Third Stream* activities). This report was commissioned by the Russell Group of Universities to help influence government policy and shape university management.

Third Stream activities are mainly concerned with the generation, use, application and exploitation of knowledge and other university capabilities outside academic environments. In other words, Third Stream activities are about interaction between universities and the rest of society. The study will propose a structured group of indicators and metrics that can be used, both to assist university officials to monitor and manage Third Stream activities, and provide a set of metrics that will aid government in the distribution of Third Stream funding.

The commercialisation of the Intellectual Property (IP) owned by universities is an important component of Third Stream activities, but only one amongst many other functions that link universities with society. Furthermore, the generation of revenues from commercialising IP cannot be considered to be the main driver for universities to engage in such activities. The Russell Group of universities are involved in commercialisation primarily as a means to generate public value, and only secondarily as a means to raise funds. In fact, there is increasing recognition that if universities were to focus their Third Stream activities on the maximisation of revenue through commercialisation mechanisms, they would likely deliver less value to society (Florida, 1999). Our approach to indicator development reflects this outlook.

The development of a measurement system for Third Stream activities will take considerable time and resources and its potential linkage to funding mechanisms has to be organised as a multi-stage process rather than a one-step action. We anticipate an iterative process of indicator development lasting several years, involving indicator definition, collection, analysis and further indicator refinement and development. This report is an early step in this larger process. It explores the issues to be resolved, develops a framework of analysis, and discusses the types of indicators that are potentially available.[1] It concludes by identifying a set of guidelines to help shape the development of a Third Stream measurement system, and its potential linkage to funding mechanisms.

The process of linking metrics to funding decisions can be separated into three main steps:

1. *The development of indicators and a measurement system.* This is the main focus of our report. This stage includes the development of metrics, the specification of clear and consistent guidelines for collecting them, and the development, if required, of survey instruments. This stage will involve

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[1] These indicators are not specified in full detail. Our objective is to introduce potential sets of indicators, but in many cases further work will be necessary to reach the precise definitions needed in order to make them operational.

considerable up-front investment in the creation of new indicators and their collection.

2. *Data analysis and scoring mechanisms.* The collected indicators need to be analysed and in order to link them directly to funding decisions, translated into scoring and ranking systems reflecting performance levels in Third Stream activities.

3. *Development of a funding allocation system.* The results of the data analysis and any resulting scores attributed to the universities have to be fed into a funding allocation process. The resulting data can be added to other information offered to a decision-making panel, or be mechanically translated into a funding allocation using a "funding formula".

This report focuses on the first of these steps. It does not attempt to provide a fully articulated model for Third Stream activity measurement but rather, offers a framework and a road map for the development of such a system, exploring the potential avenues for data collection and management. Additional effort will be required to enable any system of measurement to be implemented.

The report does not provide any new data on Third Stream activities in UK universities nor does it offer a survey instrument for collecting such data. Our intention is to perform the *enabling work* for the future development of a structured system of Third Stream measurement.

The government has a wide range of policy objectives in relation to the Third Stream activities of universities. These include: supporting small and medium sized enterprises, encouraging involvement in community and social development, enabling urban regeneration, encouraging regional development etc. In this report we do not present metrics that would account for these different objectives, but rather establish a generic framework for analysing Third Stream activities. As a data gathering system is established, scoring models can be developed to focus on specific government policy goals. However, given the changing nature of such goals, we have focused on the elaboration of a generic set of indicators, which can later be refined and used in different policy contexts.

Our approach is mainly *activity-based*. We focus on what universities do rather than on the societal impact of what they do. Fully-fledged impact assessments need to focus on the benefits accrued by actors outside the influence or control of the university sector.[2] Besides, as discussed below, many of these impacts are highly uncertain, and when they occur they tend to be unevenly distributed and indirect.

Our focus on activities is also justified when linking measurement to funding decisions. The government wants to ensure that Third Stream funding involves support not only for existing activities, but also for the development of new capabilities. An incentive system linked to activities that need to be encouraged is likely to have an effect in shaping and promoting the accumulation of capabilities in the target areas. Such a system calls for a regular activity measurement allowing for

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[2] Only some direct impact measures that are easily identifiable and attributable (as in the case of income streams received from some Third Stream activities) are included as a way to weight the value of the activity.

longitudinal performance analysis. However, it is important to avoid setting up an incentive system that would encourage actors to accumulate "countable" activities without regard to their quality and value. A Third Stream measurement system has to focus on activities whose definition is sufficiently narrow as to encourage targeted activities likely to generate value, and be combined when possible, with direct impact measures that can provide an approximate indicator of success and value. At present, the only such measures that are available relate to the revenue streams generated by some of these activities.

This study is based on an understanding of the complexity of universities' Third Stream activities and an appreciation of the changing role of the university in UK society. Our starting point lies in current theory emphasising the variety of ways, many of them *indirect*, in which research in all areas of activity affects economic performance and society at large. The effects are not linear, but are often based on iterative, self-reinforcing processes, distributed unequally across research initiatives.[3] Further, in addition to research and the dissemination and application of its results, universities carry out a wide variety of activities that can have economic and social impacts. Our main emphasis is on the identification and measurement of the wide variety of processes through which universities engage society, moving well beyond a narrow focus on commercial activities that are relevant only to a subset of academic disciplines with clear industrial applications.

The report is organised into three main sections. **Section 1** examines the background to the introduction of a Third Stream measurement system and analyses some of the issues and problems that need to be addressed. **Section 2** contains our conceptual framework for the analysis of Third Stream activities. This framework articulates a holistic view of the interactions between the university sector and the rest of society. In **Section 3**, this framework is used to organise our analysis of potential indicators. The section examines the strengths and weaknesses of different types of indicators, and from a long list of candidates we present a preliminary list of indicators that could form part of a measurement system. The section ends with a discussion of how the measurement system could be developed and deployed, and eventually linked to a funding mechanism. We present several models of indicator analysis, which would allow universities a degree of flexibility in their approach to Third Stream assessment. In the conclusions, we set out our main findings and recommendations in the form of a series of guidelines for future Third Stream indicator development.

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[3] These issues have been analysed in several SPRU studies (Martin et al. 1996; Salter et al., 2000; Scott et al. 2001), and have been translated into evaluation and impact assessment methodologies (Molas-Gallart et al. 1999; Hawkins et al. 2000).

1   Section 1: The context

1.1   Policy developments

Universities have to find a balance between a wide range of different roles and responsibilities. Teaching and research activities are central tasks, but increasingly universities have been called upon to play a more direct role in supporting economic development and have a direct impact on society. For instance, the recent White Paper on Science and Innovation sees universities playing a central role as "dynamos of growth" in the emerging knowledge-driven economy, "not just creators of knowledge, trainers of minds and transmitters of culture, but [...] also major agents of economic growth" (Department of Trade and Industry, 2000: 27).

To address this challenge, new mechanisms are being considered to calculate the level of core funding for universities. So far, the Research Assessment Exercise (RAE) determines levels of core research funding and student numbers still drive core funding for teaching activities.[4] Additionally, government departments have long been encouraging universities to strengthen their links with society and improve their direct contribution to the economy, beyond their traditional involvement in vocational education. The promotion and development of these links are broadly known as "Third Leg" or "Third Stream" activities, to be added to the two streams of teaching and research. Since 1999, HEFCE and DTI have allocated Third Stream resources to universities through discrete calls for tenders under a number of different schemes set up to support seed funding and entrepreneurial activities. These include the Higher Education Innovation Fund (HEIF), the Higher Education Reach-out to Business and the Community (HEROBC) initiative, and the University Challenge and Science Enterprise Challenge schemes. This bidding-based resource allocation prevents institutions from managing such funding sources on a long-term, strategic basis. Therefore, different stakeholders are now investigating the possibility to develop permanent Third Stream funding mechanisms, thus reducing dependence on bidding and its associated uncertainty and inefficiencies. The objective is to provide a platform of core funding to help universities develop organisations and practices to promote the transfer of knowledge and skills and implement strategic approaches to their relations with business and society.

The distribution of core "Third Stream" funding across universities could be supported by a formula that reflects past performance in the activities that the funding stream is trying to encourage. The formula would require the selection of a battery of quantitative indicators, and therefore calls for the measurement of a set of Third Stream activities and their results. As discussed below, this is a task fraught with difficulties. The development of new metrics linked to funding streams can lead universities to focus on the activities that are being measured, and overlook activities that are difficult to measure regardless of their overall importance to society. Furthermore, when the indicators are proxies for the variables that are being measured, universities may attempt to reach goals for each one of the indicators in a

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[4] The Teaching Quality Assessment does provide an indicator of the quality of the teaching programme, but it does not have a direct impact on levels of funding.

fragmented manner, and in the absence of an overall Third Stream strategy. Therefore, the development of an assessment and monitoring strategy for Third Stream activities cannot be based on a mechanistic application of measurements and associated funding formulas. Instead, a process needs to be defined to link the development of indicators and data sets to decision-making processes that allow for the interpretation of such indicators and their refining.

In this context, the emergent policy issue is how to assess, measure and support the broad range of Third Stream activities undertaken by UK universities. There is considerable variety among universities across the UK. Each university has taken a distinctive approach to finding a balance between its different roles and responsibilities. Some universities see themselves as primarily research-oriented, whereas others focus almost exclusively on teaching. The official UK government policy is to promote a 'variety of excellence', allowing each university to choose its own distinctive strategy. In developing indicators of university activities, it is necessary to appreciate the inherent variety of the university system. Yet we should note that the different roles and activities are, to a degree, interdependent. For instance, the exploitation of research outputs (one of the elements of Third Stream) depends on quality innovative research being carried out (Second Stream), students are often active in research and therefore Second Stream performance will benefit from quality teaching (First Stream); good innovative research is also likely to have a positive impact on the quality of teaching, and so on. Faced with mutually reinforcing sets of activities it is important that universities pursue balanced strategies addressing all three streams of activity and that university funding mechanisms do not push universities towards exclusive focus on one of the main streams of activity to the detriment of the other two.

The last two decades of the 20th century were periods of considerable experimentation in university management and higher education policy. More such experiments are likely in the coming years. Limits to growth in overall higher education funding and student enrolment are heightening the competitive environment among universities. In this environment, universities are coming into direct competition for new sources of funding and it can be anticipated that UK universities will continue to expand their commercial activities.[5]

In the context of these changes, Gibbons et al. (1994) and others have argued that some parts of the university system are outmoded. They suggest that the traditional model of segregated knowledge production has broken down, and is being replaced with a more fluid and dispersed model in which universities have become one actor among many overlapping, interdependent knowledge producers, thus questioning the distinction between academic and non-academic work. Further, Etzkowitz et al. (2000) have suggested that universities are freeing themselves from public control and becoming actors in their own right in the knowledge marketplace. They describe the emergence of the *entrepreneurial university*, which raises significant funds from the private sector and acts as a spur for economic development.

A series of studies of entrepreneurial universities suggest that commercialisation activities can stimulate economic development and that there are considerable

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[5] Yet it is highly unlikely that in the medium term these sources of funding will replace traditional mechanisms of funding.

opportunities for increasing university-industry interaction (Clark, 1998). Creating such opportunities via consultancy or other mechanisms can benefit both universities and industry. Ormerod argues that there can be strong complementarity between research, teaching and consultancy; integrating these activities can create a virtuous circle of social engagement, new research ideas, and opportunities for developing new teaching programmes (Ormerod, 1996). The key issue is to find the balance among these different goals and to explore what new mechanisms are available for balancing traditional concerns with emerging opportunities.

Central to the arguments on the changing nature of the university is the US experience. Policy-makers in the UK and elsewhere have been attracted to the apparent success of leading US universities who have been seen to develop substantial income sources from the private sector. The UK government has been actively trying to promote what it sees as leading edge practice from the US.

There is however, an open debate in the literature about university-industry links as to whether the US presents a model for other countries to emulate. In a recent paper, Pavitt cautioned against adoption of the US system in the UK. Pavitt argues that the strength of the US system arises from a combination of strong industrial demand for research from universities, high levels of sustained public funding for basic research and a flow of foreign students into the US higher educational system. It is the high quality of US research that acts as the magnet for industrial interest. It would be a mistake to ascribe the US's apparent success in university impact on the economy simply to its strategy for commercialising research or the existence of university technology transfer offices (Pavitt, 2001). Further, Richard Florida argues that current commercialisation pressures in the US are undermining the social and economic impact of universities, creating new tensions between public and private interest (Florida, 1999). Florida suggests that attempts to commercialise university research might shift the university away from its primary mission of research and teaching, fatally undermining the economic contribution of universities to economic development. Florida argues that greater attention to using universities as pools of talent and skills is required.

Furthermore, existing indicators of university-industry interactions suggest that the UK may in fact outperform the US in key areas. For instance, the proportion of R&D funding in the UK higher education sector derived from industry is higher than in the US (Salter and D'Este et al. 2000). A recent study also indicated that the UK system is on a par with the US in terms of the number of spin-off companies and other measures of entrepreneurial activities arising from universities (Charles and Conway 2001).

The debates about the role of the university are ongoing and will not be resolved here, but they do suggest that there is a need to find a balance between the different goals of the university sector. For instance, the discussions on the merits of commercialisation have tended to ignore the wider social impact of universities' Third Stream activities. Universities contribute to social and economic development through a wide range of activities that fall outside the direct commercialisation of university research results. It is necessary to take a holistic approach to the assessment of Third Stream activities, aiming at considering the total contribution of universities to society rather than relying only on narrow indicators of commercialisation. To do otherwise would focus attention on only one of the

mechanisms through which universities engage society and on the limited set of academic disciplines that are commonly associated with commercialisation activities.

1.2 Measuring Third Stream activities: Issues to be resolved

The contribution of universities to the economy and society is multifaceted and complex. The main challenge of the study is to identify the types of Third Stream behaviours and processes that need to be encouraged and align them to a set of indicators and metrics. Yet the collection and administration of such indicators and their use as the basis for the distribution of funds pose several challenges. This section discusses the main problems that need to be resolved in the development of a measurement system for Third Stream activities. These concerns will act as a guide to selection of indicators and the development of new indicators.

1.2.1 Differences across disciplines

The ways in which knowledge can be applied and used outside academia vary from area to area. First, there will naturally be differences between applied disciplines (like mechanical engineering, business administration or medicine) and fundamental theoretical disciplines (like theoretical physics or philosophy). While in the former direct channels of application may exist, in the latter the impact of academic activities on the economy and social welfare is likely to be more long-term and indirect. There are also disciplines that are directly linked to emerging areas of economic activity, where market entry barriers are low, and where a direct connection can be made between scientific activity and the exploitation of scientific discoveries through industrial start-ups and university spin-offs. These forms of exploitation are common in science-based emerging sectors such as biotechnology and information technologies. In more mature sectors, where barriers to entry are very high, academic discoveries of direct relevance to industry are likely to be protected through patents, and then commercialised. Patenting and patent commercialisation activities are more common in sectors such as pharmaceuticals (Mowery et al. 2001). In many other academic activities the use and exploitation of the capabilities generated in academic institutions can occur through the application of skills and tools to specific societal problems. Such channels of diffusion and application are common in, but not unique to, the social sciences. Furthermore, many of the activities of Medical Schools could be classified as Third Stream; in particular, the linkages with university hospitals and the role that these hospitals play in the training of future doctors and in the running of research projects.

These differences across sectors pose substantial difficulties when trying to develop metrics for *all* Third Stream activities across *all* areas. A system of metrics that focuses or favours a specific set of mechanisms is bound to yield results that will give better performance scores to the disciplines that use these mechanisms. Comparing Third Stream performance across universities with different disciplinary focus can become a problem of comparing apples and pears, as performance across different sets of activities is measured and combined.

1.2.2 Differences between universities

There is no one model of the successful university. Each university is a product of a distinct process of social, economic and intellectual development, and finds its own

balance between teaching, research, and a wide set of Third Stream activities. Developing a set of indicators will require a degree of flexibility in how the indicators are applied to different types of university. It is hard to imagine a single set of indicators that can be applied equally to universities as different as say, Central Saint Martin, a leading programme of art and design, and Imperial College. A model set up to yield performance scores in Third Stream activities will have to have some mechanism in the indicator system that will allow universities to be judged against specific subsets of goals, rather than against a single model. The system of indicators should allow for a 'variety of excellence' to emerge.

1.2.3 Organic nature of university-industry interactions

The relationships between university and industry are often subtle, informal and linked to personal exchanges between individuals. Past studies have found that many of these interactions are often immune from direct influence by policy or management interventions (Mowery et al. 2001). They arise out of common or overlapping interests between the two groups and take place through a series of informal, negotiated exchanges. This organic nature of interaction limits the ability to find suitable measures and instruments to shape behaviour. It is possible that there will be no one-to-one matching between policy actions and interaction patterns.

1.2.4 Third Stream and Second Stream activities are not independent

A direct relationship between research performance and the application of research results has been established in the literature (Hicks et al. 2000). Therefore, the capacity of organisations to engage with non-academic users is dependent, among many other factors, on their capacity to generate new knowledge of potential interest to users. In other words, we should expect performance on Third and Second stream *not* to be independent from each other. This observation does not affect the development of indicators to measure performance in Third Stream activities. However, when these indicators are taken as the basis for developing funding formulas to be added to Second Stream funding, the possible level of dependence between both sets of measures must be taken into account. Interdependent funding formula across both streams could be interpreted as double counting of specific research-based activities when distributing funds. Yet it is worth noting that there is no reason why, and no evidence that Third Stream *activities*, rather than their results, are correlated with research performance.

1.2.5 Public funding of commercial work

This issue relates to the use that is being made of Third Stream performance measures as a basis for establishing financial rewards. Although Third Stream funding would probably be distributed as core university funding, and its purpose will be the development of Third Stream activities and associated infrastructure, universities are likely to distribute these funds to the department and units that have contributed to the attainment of the performance score. If Third Stream funding is distributed to departments and groups in direct proportion to their level of contribution to the institution's score, it could be argued that their Third Stream activities (some of which will be commercial) are being unfairly supported with public funds. It could appear that direct financial rewards are being offered for commercial performance, thus supporting the day-to-day commercial operations of universities.

1.2.6 Informal arrangements and Third Stream activities

It is common for academic staff at universities to carry out extra-academic activities on an individual basis. The range of activities carried out in this way is very broad including contributions to non-academic publications, assistance and participation in media programmes, advisory roles to public and private organisations, consultancy assignments and even research projects. As they provide a channel for the dissemination and application of knowledge acquired during the development of academic activities, such "extra-curricular" work can arguably account for a substantial share of all "Third Stream" activities. Universities may allow their academic staff to use a limited number of days for such activities, over which staff may have to buy out their time. Yet there will be different processes to manage this type of work, and it is very likely that, even when reporting mechanisms exist, extra-curricular activities go unreported. It is safe to assume that some "Third Stream" activities are carried out outside the university system (Gray, 1999), as academics consider that the bureaucracy involved in reporting is unnecessary, or an encroachment into their "out-of-hours" activities (Tjeldvoll, 1999).

In other words, the economic return to the universities is not an indicator of the total economic return delivered by Third Stream activities to the academics that perform them or of the value they add to society. Universities, aware as they are of the low levels of pay in academia, do not carry out intrusive audits on the non-academic activities of their faculties; the practices in most universities are based on the "don't ask don't tell" principle.

If the objective of Third Stream policies is to encourage engagement outside academia, the type of activities that are carried out off the books by academics should not be discouraged insofar as they do not affect negatively the performance of core research and teaching activities. Yet an attempt at quantifying these activities may be translated into more intense efforts to monitor individual extra-curricular work. Academics may perceive this as increased pressure on their activities outside the university and respond by (1) abandoning them or (2) actively hiding them away from the university administration. It is important that any new data collection instruments are not perceived by the academic community as intrusive, and that the system for gathering such information is not unreasonably time-consuming and burdensome.

It is also important that any approach to the definition and collection of indicators is accompanied by a system of incentives encouraging academics to contribute to indicator collection tasks. In this respect, it would useful for the public sector to learn from private sector practices of performance measurement. Many studies of performance measurement in businesses have shown that successful systems are often linked to individual incentives (Neely et al. 1995). It is the link between what people do and what they are measured against that is essential to ensure acceptance and support for any performance system.

1.2.7 Centralisation of management

Whether conducted individually as discussed above, or at departmental level, many Third Stream activities take place in a decentralised manner. Small projects and consultancy assignments, contributions to the media, and advisory work will be conducted by at most, small teams and are seldom mediated by the university's

central services. Often academics are collecting "small rents" from their Third Stream activities, involving themselves in a wide number of modestly paid activities.

The development of new reporting requirements, linked to the elaboration of university-wide indicators and to the reception and management of core university funding may provide an incentive to centralise the management of Third Stream activities. Yet the imposition of a centralised management culture might lead to a "culture clash" with individualistic, entrepreneurial academics. This will depend on the types of managerial processes laid out at central level, and on the ways in which university services deal with individual entrepreneurial activities. A heavy bureaucratic approach to central management is likely to stifle the same Third Stream activities it was supposed to support and promote.

The "culture clash" between individual academics and central administration can be avoided by developing responsive and flexible systems of management. Many central university administrators are aware of these dangers and are attempting to develop new responsive systems of university management. These new management systems could in part, be funded by Third Stream programmes. Over time they might provide an opportunity to improve central administration and therefore help to alleviate these intra-university conflicts.

1.2.8   Unintended effects on the selection of Third Stream activities

When trying to measure specific activities and link financial rewards to the results of such measurements, it is to be expected that organisations and individuals may adjust their activities to the indicators being used, possibly generating unintended effects across the university system. Organisations are likely to respond by pursuing performance in the selected indicators rather than developing strategies to address the areas in need of improvement. The effects can be prejudicial as institutions substitute the pursuit of a narrow set of indicators for the development of in this case, Third Stream strategies.

This situation of unintended effects is common in many social systems. Tenner refers to these unintended consequences as *revenge effects* (Tenner, 1997). Coping with revenge effects requires that considerable attention be placed on understanding how different actors respond and adapt to new opportunities that are created by the new measurement system. One possible solution to this problem is to develop complex models that are difficult to "fix" by strategic behaviour. This strategy might be useful in particular circumstances, but it has been shown that the opportunities to engineer the responses to complex sets of indicators does not diminish with the complexity of the data sets and models used. In other words, complexity cannot remove the problem of strategic behaviour (Loch et al. 2001).

Moreover, there is evidence that performance measurement works best when people understand how they work and what indicators influence or shape results. For example, research has shown that the application of complex multi-criteria decision tools to the selection of research priorities in large corporations has failed to win the confidence of their users in the company. Company managers faced with the application of complex models to guide the allocation of research resources complained that the models were not transparent and were open to abuse by those that could figure out how to present their data so that the models yielded favourable

results.[6] As one manager stated in this context, "figures don't lie, but liars can figure" (Sharp and Keelin1988).

1.2.9   The problems with impact measurement

We can distinguish two main sets of indicators that can be used in the measurement of "Third Stream": *indicators of activity* and *indicators of impact*. It is possible to measure the effort that organisations invest in engaging with non-academic users, or the results of such efforts in terms of societal or economic impact. Yet attempting to measure the impact of Third Stream activities is very difficult for the reasons outlined below.

Identifying additionality

Identifying additionality is a problem that affects *any* attempt to measure the impact of any human activity: what would have happened in the absence of the activity, the impact of which we are trying to measure? It is possible that the "effects" we are trying to measure might have occurred *anyway*. This question is relevant when assessing the effects of advisory and consultancy activities. For instance, giving advice to a parliamentary committee is an activity that is easy to identify and measure. It is more difficult however, to assess its impact. In particular, would the committee have had reached the same conclusions in the absence of the academic advice?[7] Similarly, the net impact of the activities of technology transfer offices may also be difficult to assess.

Therefore, a rigorous impact assessment must attempt to evaluate the *additional* effect of the action under analysis; in our case the difference that the Third Stream activities have made. Additionality can only be identified if the research design includes ways of comparing the situation before and after the activity, and to trace the difference to the specific tasks that the activity has developed (attribution).

Impact assessment and timing

It has been widely argued that the impact of academic research is long-term and often indirect. This leads to a second problem when trying to assess the impact of research and the dissemination of research results: When is it a good time to measure impact? How long should we wait? For how long a period should we try to identify impacts? There is substantial evidence that the timing of the evaluation effort significantly affects the results. Even within the academic world itself the timing of impact is uncertain. Academic articles that have exerted considerable influence in the evolution of their disciplines have sometimes been ignored for a long period before being "re-discovered".[8] The impact of scientific research on the development of new products and applications is even longer term and more difficult to trace.[9]

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[6] For a specific example of these problems see Sharp and Keelin (1988)

[7] A summary of the problems that additionality presents for evaluation and of methods to address them can be found in Luukkonen (1998).

[8] Furthermore, in aggregate terms, research has shown that long and short-term citation patterns differ considerably across papers (Plomp, 1989).

[9] Early retrospective studies attempting to assess the dependence of innovations on scientific work by retrospectively tracing and measuring technological improvements that could be attributed to previous

Because impact often occurs through long-term processes, deferring impact assessment would conceivably help to capture more fully the effects of the projects. Although cost considerations make it usually impracticable to delay impact assessment studies too long, long-term impact monitoring arrangements could be included into permanent data gathering strategies on Third Stream activities. Besides, it is not always the case that impact takes a long time to materialise. Academic research closer to application, and consultancy activities may have immediate non-academic impacts. Sometimes, academic research addresses specific technical problems or highly topical issues. In these cases the impact may not only be short term, but may be difficult to detect later on when the problems that triggered the research have been solved, or are no longer perceived to be pressing.[10] Short-term impact does not necessarily translate into enduring effects.

Halo effect and skewed impact distributions

The use of impact measures as an indicator of performance may yield biased results because after a study has gained visibility it tends to receive additional attention just because of such visibility. This is usually known as the "halo effect" (see for instance Cole and Cole 1972). People may refer to and use a famous study or article, refer to the work of specific individuals and invite them to participate in committees or to appear in the media, just because they or their work are perceived as being important. In short, fame attracts fame. Therefore, if for instance, we measure non-academic impact[11] by the references that individuals or groups of individuals and their work receive in the media, we may overestimate the real effect that the work has had, and we may also underestimate other work on which the "visible" contribution may have rested.[12]

Serendipity

Some Third Stream activities involve setting up commercial R&D ventures with private sector partners. Yet the outcome, and therefore the impact, of research activities are by their very nature unpredictable, and serendipity is an important element when attempting to develop new products. For instance, the timing of an innovation reaching the market and the prevailing market conditions will have a very substantial effect on the revenue streams it will generate. Given the uncertainty that accompanies any research effort, and the variability of market conditions in the

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research programmes were carried out by the US Department of Defense (DoD) and the US National Science Foundation in the 1960s. The first large-scale retrospective study, "Project Hindsight", was carried out in the mid-1960s by the DoD and concluded that for most weapons systems analysed, between 30 and 100 improvements per system could be traced to *basic research* carried out between 10 and 20 years before the system entered development (Sherwin and Isenson, 1967; Kostoff 1997). In a related study, Mansfield found a 6-7 year lag in the uptake of academic research into industrial innovation across a number of science-based industries (Mansfield, 1991: 1998).

[10] For an example of such a case from the social sciences see the impact of the AIDS research programme in the UK (Molas-Gallart, Tang and Morrow 2000).

[11] We define non-academic impact as occurring whenever a research effort results in identifiable influences on current social, policy, and management practices.

[12] This is a variant of the difficulty of tracing and attributing, (particularly in the long term) societal impacts to specific research results.

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medium and long run, it is conceivable that high quality activity, however quality is measured, may not result in impact.

Serendipity is reflected in the fact that the returns to innovations are highly skewed. Using a variety of databases of inventions and innovations, Scherer and Harhoff demonstrate that "the top 10 % capture between 48 to 93 % of the total sample returns" (Scherer and Harhoff, 2000: 559). They argue that when dealing with technology policy, one should expect only 1 in 10 projects to be successful. They suggest that governments must learn to accept failure as part and parcel of supporting research. Linking funding to the impact of previous innovative ventures will concentrate resources on a very small number of actors and this approach is likely to reduce the chances of future success by reducing the spread of initiatives undertaken in the future (Scherer and Harhoff, 2000). A better approach is for policy-makers and managers to spread their bets across a wide number of different actors, thereby creating more opportunities for successful projects to emerge.

A measurement response: activity-based approach

To measure the impact of universities on society would require considerable effort and investment in order to trace the contribution of university activities across different parts of society and the economy. Universities do not have the resources to conduct such wide-ranging studies on a comprehensive and regular basis. Instead, our approach focuses on those fundamental elements of Third Stream that universities can see for themselves: their own Third Stream activities. Focusing on the performance of activities allows us to overcome the problems associated with impact assessment and to propose a feasible process of indicator development.

1.2.10 Measurement fatigue

Enthusiasm for measurement activities among the UK university sector is extremely low. Both of the current measurement systems, the RAE and the Teaching Quality Assessment (TQA), have recently come under heavy criticism for overburdening departments with bureaucratic and time-consuming measurement and assessment procedures. There is talk of dramatic changes to both the RAE and the TQA to lighten the burden on the time and resources of the university sector. Given this environment, interest in and support for the development of another range of performance indicators will be lukewarm at best. Indicators for Third Stream activities, given both the relatively limited level of funding for these activities in comparison to research and teaching, will need to embody a new approach to university indicator collection and management. New ways of developing indicators that are less labour intensive and yet provide meaningful assessments of activities are required.

1.2.11 Paperwork and the costs of data generation and management

When recommending the use of new indicators, it is important to assess the effort that will be necessary to collect, analyse, and update the data. It is common to underestimate the work that is needed to collect comprehensive data necessary to carry out proper evaluations and impact assessments. Often labour-intensive techniques can be applied in one-off studies but cannot be used as the basis of continued comprehensive studies over time. The use of indicators that are labour intensive to gather, generates not only a problem of costs, but increases the

administrative overhead on academic staff and can lead to increased centralisation of university research management. As discussed above, centralised oversight from university management may provide a disincentive for researchers to collaborate in the reporting of Third Stream activities.

1.3 Measuring Third Stream activities: previous studies

Although the measurement of Third Stream activities is fraught with difficulties, there have been several substantial attempts at measuring aspects of the interaction between university and society. The approach taken in most of these studies is much narrower then the one adopted in this report. Thus all the previous UK studies have focussed on the linkages of Universities with Industrial firms. More specifically they are modelled on the AUTM surveys of US universities (discussed below), where the main focus is on universities' entrepreneurial activities. Although they concentrate on a subset of Third Stream activities their methods and approaches to indicator selection provide a basis on which to develop our own approaches.

The UK is not alone in its interest in promoting Third Stream activities and there are a number of lessons that can be learnt from the experiences of other OECD countries in developing new indicators. Reviewing these experiences can also provide insights into the potential links between the UK's emerging strategies and those of other OECD countries and international organisations.

1.3.1 UK Studies

During the 1990s there have been several UK surveys of university/industry interactions sponsored by HEFCE (Higher Education Funding Councils of England).[13] They provided data on patterns of interaction, the motivation for such interaction, and on the overall scale of activity within the HE sector. The last of these surveys related to the academic year 1996/97. More recently, CURDS (Centre for Urban and Regional Development Studies) at the University of Newcastle-upon-Tyne, undertook a further survey updating the information to 1999/2000 (Charles and Conway 2001).

These surveys collected data under the following categories:

- institutional strategies;
- collaborative research;
- intellectual property;
- consulting activities;
- spin-off firms;
- training and personnel links;
- regeneration.

Further, UNICO, the University Companies Association and Nottingham University Business School (NUBS), supported by ESRC and others are currently undertaking

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[13] See for instance the study undertaken by Tartan Technology and PREST at the University of Manchester (Howells et al, 1998).

an exercise to gather data on the IP (Intellectual Property) commercialisation activities of UK Universities. In particular the study is designed to focus on analysing the:

- number of spin-offs created each year;

- barriers to spin-off formation;

- income generated from university commercialisation activities;

- staffing & resourcing of TTOs (Technology Transfer Offices).

1.3.2   US and Canada

Perhaps the best known survey of Third Stream activities is the annual evaluation undertaken by the Association of University Technology Managers (AUTM) in the US. The aim of the survey, which began publication in 1993, is to monitor the patenting and licensing activity of US and Canadian universities, research institutes and teaching hospitals in order to show how they are making federally funded inventions available to the public. Much of the evidence showing increasing levels of commercialisation of university research in the US is based on the results of this survey.[14] The AUTM approach represents good practice in the elaboration and implementation of surveys oriented to the assessment of universities' commercial activity. It provides a structured approach with firm definitions, which have been refined over time (see Table 4 in the Appendices for a summary view of the areas addressed). However, the AUTM survey instrument is tailored for the US context, and needs to be adapted when applied in other environments.

Additionally, some TTO/TLO (Technology Licensing Office) and academic studies have collected complementary information on patenting and licensing activities and entrepreneurship. This information has been used to develop more complex indicators and statistical inferences that help TTO/TLOs to manage their activities and prove their economic contribution to society. The data and estimates that have been generated and analysed include:

- the value of pre-production investment undertaken by firms involved in licensing university technology;

- estimates of the jobs generated by firms involved in licensing university technology and attributable to the new activities launched thanks to such licences;

- estimates of taxes generated by these activities.

In Canada, Statistics Canada has run a similar exercise: the *Survey of Intellectual Property Commercialization in the Higher Education Sector*. This is a voluntary survey issued to the members of the Association of Universities and Colleges of Canada (AUCC). The study focuses on IP management issues.

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[14] A detailed description of the indicators derived from the AUTM and complementary information sources can be found in the Appendices (Table 4).

1.3.3 OECD and EC

In the last 5 years both the OECD and the European Commission (EC) have been involved in studies aimed at benchmarking industry-science interactions. These initiatives aim to undertake international comparisons by using aggregate country level data on a limited number of indicators of industry-science interactions.

The OECD has recently published a report on spin-off formation and is engaged in an initiative aimed at collecting and analysing information on the role and significance of intellectual property rights emanating from public sector research organisations.

Further, the OECD (2001a and 2001b) has launched an initiative to examine how the strategic use of Intellectual Property Rights (IPR) is evolving in public research organisations. One of the aims of this project is to examine the extent to which various OECD countries are gathering data such as:

- number of Technology Transfer Offices (TTOs) and Technology Liaison Offices (TLOs) per research university;

- funds committed to Intellectual Property (IP) management – either by the Public Research Organisations (PROs) and universities, or through national programmes;

- number of patents (either patent applications or grants) by universities and PROs;

- licensing and royalty revenues;

- types of technologies that are patented and licensed;

- number and size of research contracts with the private sector;

- the cost and frequency of litigation over infringement of intellectual property rights.

The project aims to establish international comparability of such data by suggesting a standardised methodology and some core questions to be included in future questionnaires.

The European Commission has also launched recent research initiatives of relevance to this study. The main aim of a project commissioned by the EC (Polt et. al., 2001) is to identify the factors that affect the behaviour of actors and institutions involved in industry-science relations and compare EC country's performance in these areas. The areas analysed include:

- *R&D collaboration.* Joint R&D activities, contract research, R&D consulting, co-operation in innovation, informal and personal networks.

- *Personnel mobility.* Temporary or permanent movement of researchers from industry to science and vice versa.

- *Co-operation in training and education.* Further professional education, curricula planning, graduate education, PhD programmes.

- *Commercialisation of R&D results.* Disclosures of inventions, licensing patents, start-ups of new enterprises.

A detailed list of the specific measures used in the study and the sources of information can be found in Table 3 (Appendix 1).

The European Commission Proton project

The European Commission is intending to fund further research on Third Stream activities in the European Union. This work will be funded by the European Commission Fifth Framework Programme and carried out through an Europe-wide consortium largely made up of universities. The project, called Proton, has as its overriding objective to boost the commercial uptake of publicly funded R&D carried out at universities. Its objective is to develop the "professional skills" of researchers. The project defines professional skills largely in terms of the ability to commercialise the outputs of research. Among its activities Proton aims to develop benchmarks of technology commercialisation activities across Europe, and may therefore be developing indicators and data of interest to the development and management of Third Stream activities. In addition to other objectives Proton also aims to:

- identify good practice in this area;

- identify methodologies for enhancing co-operation with industry and for monitoring European trends and developments in the area;

- explore different routes to commercialise university-developed technology;

- promote the uptake of spin-off schemes;

- raise awareness among university and research centre R&D staff to the benefits of commercial exploitation.

- identify the skills and training needs for a more dynamic "Transfer Office" (TO) profession, and design and deliver training solutions;

The Proton project is still in the process of development and its results will take sometime to be forthcoming.

2   Section 2: Our approach

In the previous section we have reviewed the main issues that the development of a measurement system for Third Stream activities has to face and have presented a summary of some of the most relevant initiatives that have, to date, engaged in the development of relevant Third Stream measures. None of the approaches described however, deal with the full range of Third Stream activities. We believe that a wider and more holistic perspective is required to fully appreciate the mechanisms that shape the relationships between universities and the rest of society. In the next section, we offer a conceptual framework for developing a holistic approach to Third Stream activities.

2.1   Main objectives

The terms of reference for this study call for the development of a methodology that is feasible in terms of time and resources and is based on a set of metrics that are:

- **S**imple
- **M**easurable
- **A**ctionable
- **R**elevant, reliable and reproducible; and
- **T**imely

Such SMART metrics have to be underpinned by a relatively simple model representing the *main* ways through which universities can engage potential non-academic users and beneficiaries in their activities and have an impact on society. In this section, we outline such a model. Throughout the following pages we will use the term non-academic to refer to all organisations other than HEIs and not-for-profit research organisations focusing on curiosity-driven research to advance publicly available knowledge (academic research). This includes private sector firms, government departments and agencies (other than those whose main role is the funding of academic organisations like the Research Councils).

Previous analytical frameworks have tended towards complex theoretical systems that are difficult to operationalise through a set of testable hypotheses. Even when the theories can be related to sets of indicators, these are often difficult to collect and relate to variables that are not necessarily "actionable" as required by the SMART approach. Instead, our approach will be based on a simple conceptual framework emphasising the identification of the processes of diffusion, exploitation and use of research results and of the broader capabilities existing within universities.

2.2   Conceptual framework

The development of Third Stream indicators must relate to a structured and comprehensive record of the diverse ways in which universities may engage with their societal and economic environments. An analytical framework detailing the different mechanisms through which universities can engage in Third Stream activities can then be used to structure and analyse a broad set of indicators.

Our analytical framework starts with a basic distinction between what universities have (capabilities) and what they do (activities). Although the activities of universities and their capabilities are obviously interdependent, for the purpose of Third Stream analysis it is helpful, as a structuring tool, to distinguish those Third Stream activities oriented to the exploitation and use of *existing* capabilities, and those that are related to new or ongoing university work:

1. Research universities have ***capabilities*** in two main areas: (a) physical facilities and (b) knowledge capabilities. These capabilities are developed as the universities carry out their core functions of teaching and research. Facilities include research infrastructure like laboratories, libraries, test rigs and computer centres, and teaching facilities and buildings. Knowledge capabilities include different forms of "knowledge stock", from the tacit knowledge and skills embodied in the university researchers and lecturers, to codified knowledge as represented by reports and patents, software, processes, business methods, and research methods and techniques.[15] These two sets of capabilities can be used and exploited outside academia, constituting our first two groups of Third Stream activities; i.e. the exploitation and use of (1) university physical facilities, and (2) existing knowledge capabilities.

2. Using the means at their disposal, universities carry out three main sets of activities; they: (1) **teach**, (2) **research**, and (3) **communicate** the results of their work. All these activities can be considered Third Stream when they engage or target non-academic communities.

Figure 1 summarises the different Third Stream activities structured according to this framework. The top half of the figure represents the capabilities that universities have, while the lower part refers to what universities do. The figure depicts a broad definition of the range of activities that shape and influence the relationship between universities and rest of society. This section will discuss each of the activities listed here.

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[15] These forms of codified knowledge can emerge from research contracts with external users to develop solutions to specific social or economic problems. In these cases such "knowledge stock" will have been generated directly through Third Stream activities.

Figure 1 Conceptual framework for analysing Third Stream activities
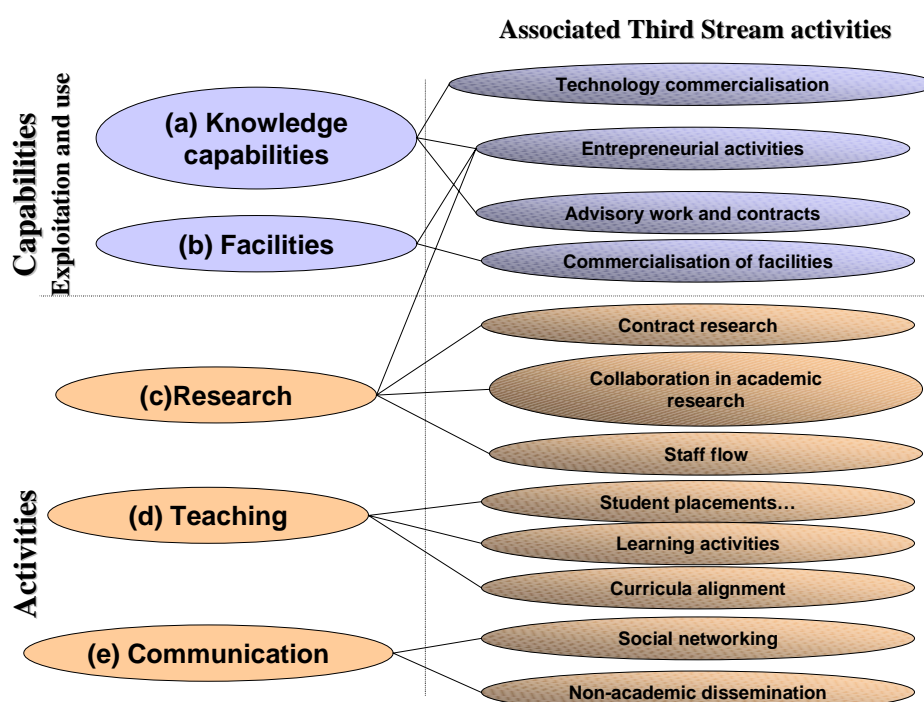
2.2.1 Capabilities – the exploitation and use of existing capabilities

Technology commercialisation

This set of activities relates to the exploitation of intellectual property, codified in clearly identifiable information packages that can be the object of commercial transactions. Best known and more widely used are the patenting activities of universities and the related licensing of these patents to commercial firms. Yet there are other forms of Intellectual Property (IP) that can also generate income streams for universities. Software packages and business methods can be licensed for use, and will be protected by copyright, trademarks and, in some cases, patents.

Many universities have focused on the generation of income through the commercialisation of intellectual property. To this end, they have often set up specialised offices and groups in charge of monitoring, promoting, organising and exploiting the economic value of the university's intellectual property. The activities undertaken by such offices include the supervision of contractual terms to ensure that the university receives favourable IPR(Intellectual Property Rights) terms, assessing the value of university patents and other IPR, seeking potential clients for IP exploitation, and negotiating and signing IP contracts with external users. All of these can be considered to be Third Stream activities.

Much of the literature and associated research methodologies on Third Stream activities focus on these types of activities. As these are aimed at achieving commercial goals and require specific and substantial investments, they can be easily quantified through input measurements (the expenditure in commercialisation activities) and output indicators (mainly the financial flows accruing to the university because of technology commercialisation).

Entrepreneurial activities

In the context of this study, we understand entrepreneurial activities to mean all the actions carried out by universities or their departments to set up new firms to exploit existing university capabilities (either knowledge "stock" or existing infrastructure), or carry out new research. Therefore, this set of activities is unique in that they apply to a range of Third Stream activities covering many of the categories in our conceptual framework (from the exploitation of existing capabilities to the generation of new knowledge through research). Yet they will often be linked to the use of existing knowledge resources and their further adaptation to make them usable in commercial environments. Unlike technology commercialisation, which follows an "over-the-wall" approach to technology transfer, entrepreneurial activities often engage academics and non-academics in further co-development and adaptation of the existing knowledge base, to develop practical innovations for specific applications.

Entrepreneurial activities can take a variety of forms. Joint ventures, spin-offs, start-ups and incubators, and science parks are some of the tools used by universities to promote the development of new businesses. Universities also set up business ideas competitions, and establish "pre-seed" funding and loan facilities to support entrepreneurial activities. Also, these activities are easily quantifiable as they involve specific financial flows, and have therefore been the object of considerable research attention.

Advisory work and contracts

Academic staff can use their existing knowledge to provide advice outside academia. Such advice can be based on their factual knowledge, familiarity with research tools, or theoretical understanding of practical problems, and can be given free of charge (as would be the case when academics give evidence to Parliamentary committees) or as paid advice. It can be given in person, or be conveyed through short reports or other written formats, like written evidence. This set of activities would also include invited speeches and lectures given to non-academic audiences.

In all these cases however, advisory work as defined here does not require additional research by the academics involved. This type of work provides a channel for the capabilities and skills of academics to reach potential non-academic users and beneficiaries. These activities are therefore diffusion channels and in themselves, do not provide a guarantee of impact.

Commercialisation of facilities

Universities own a broad set of facilities that can be of interest to non-academic users. Laboratories, test rigs, conference and teaching facilities, libraries, as well as buildings and land inside or close to the university grounds can be made available to non-academics. The commercialisation of these facilities can be associated with other Third Stream activities. For instance, renting laboratories and testing facilities to industrial users may be accompanied by collaborative research agreements bringing together private sector scientists, technicians and academics. Studies of the economic benefits of research have shown that industry often relies on local

university facilities to test new ideas and products.[16] Yet there are other cases where the commercialisation of facilities may not be linked to the other streams of university of activity; for instance, when the university acts purely as a landowner without consideration of the activities carried out in its premises.

2.2.2   Activities – the core university activities and the Third Stream

We consider teaching, research and the communication of research results to be core university activities. When these are developed with the participation of non-academic actors and/or pursuing mainly non-academic goals, the performance of such activities constitutes in itself an instance of Third Stream activity.

Research

Contract research

Academic institutions carry out research under contract from non-academic organisations. Often, such research will be oriented to the solution of specific problems, or the provision of data and information of interest to the client.[17] In the context of this study, we consider "contract research" (a Third Stream activity) to occur when its objective is not the pursuit of knowledge for its own sake but the solution of specific problems, the contractual arrangement is not that of a research grant, and the client covers the costs of the study.[18] It is therefore likely, that this form of research will be accompanied by some restrictions on the dissemination of the research results, often in the form of privileged access to results and of moratoria between the delivery of results to the sponsor and their publication in academic journals or other forms of dissemination.[19]

The distinction between contract and grant-funded academic research does not imply that academics performing contract research are less motivated by the pursuit of knowledge than others.[20] It is often the case that researchers work simultaneously on both forms of research, the distinction between the two resting only on the objectives of the project and the mechanism of funding.

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[16] For example, Arnold and Thuriaux (2001) found that in Ireland there were a number of strong reciprocal arrangements between university departments and local firms for accessing laboratory equipment.

[17] In some instances however, non-academic clients may fund basic research that they may consider important to the further development of their businesses or organisations.

[18] In some cases, contract research may be partially funded by public organisations through their research support programmes. When publicly-funded research projects involve firms as their main performers, and aim to develop exploitable technologies, the participation of universities in such projects can be considered a further case of "contracted research". Such would be the case with the involvement in some, although not all, EU "Framework Programme" research projects.

[19] It should be noted that most contract research does eventually get published in academic journals. Past bibliometric studies have shown that over 80% of all contract research projects end up in academic publications (Rosenbloom and Wolek, 1970).

[20] For example, basic research can constitute a Third Stream activity when it is conducted for a non-academic customer covering all the costs of the activity, and in response to specific needs identified by the customer as of interest to its own organisation.

Non-academic collaboration in academic research

In this context, we understand academic research as "curiosity-driven" research carried out primarily to foster knowledge and addressing issues and problems of a theoretical nature.[21] Academic research may be funded by public resources, foundations, or even private companies, but it will pursue the publication of results as a main objective and will be considered by the funding organisation as a grant, rather than a contract which is expected to deliver a specific set of results.

When funded by private firms and organisations this type of work is often referred to as "collaborative research". When entering into collaborative research, universities will pursue academic goals, and the contracting firm or organisation may have its own longer-term objectives. Although these deals involve contracts, usually handled through the university's research contracts division, they cannot be confused with the "contract research" described above.

When individuals and organisations outside academia participate in academic research, they may be interested in the future application of the results and skills generated through academic research, or they may use their access to academic work as a way of identifying emerging research talent with a view to further collaboration or the hiring of young promising researchers. To gain immediate access to academic research, they may participate by providing research facilities or funds, offering their organisations for case studies and pilots, or by directly participating as members of the research team. In some cases, the firms themselves may be leading academic research efforts as a way of developing and supporting their skills and knowledge base.

Flow of academic staff and scientists and technicians

One of the ways in which the knowledge and expertise generated by university research can be further developed in a context of application to societal or economic problems, is through the movement of qualified personnel. University staff can for instance, take temporary positions in industry and government and through this channel, develop their knowledge and skills for application to non-academic environments. Conversely, scientists and technicians from industry can be seconded for a period to academic departments in order to conduct research. These transfers will usually be associated with collaborative research and provide a key diffusion channel for the transfer to non-academic applications of tacit knowledge and skills embodied in academic personnel.

Teaching

A primary role of universities is the teaching of courses leading to the award of a recognised academic degree. Yet teaching-related activities may be considered as being Third Stream when:

- they bring students in contact with non-academic users and beneficiaries;
- develop courses that are targeted to professional students and are not necessarily oriented to the award of an academic degree;

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[21] This does not mean that the issues addressed may have no relevance (immediate or otherwise) to the solution of non-academic problems. Academic research can include "problem-oriented" research, in which the selection of theoretical topics is guided by present or future societal needs.

- include stakeholders from outside academia in the definition of academic curricula.

Student placements and other employee links

"Student placements" can take two directions: the university may take a range of initiatives to ensure that students can gain access to work experience with future potential employees, or it can open academic courses to industry and government professionals. Universities are being increasingly sophisticated in their promotion and management of internships and placements. Whereas these activities had previously been seen as training, they now fit within a broader pedagogical frame including business and entrepreneurial awareness and the development of business-support services.

The placement of students in industry and government can be organised through internships, or be directly connected to course assignments. For instance, students may conduct research in collaboration with external interested parties responding to specific problems put forward by such "customers". The negotiation and management of such arrangements with external "customers" is usually difficult and time consuming, and is not equally suited to all types of courses. Yet, when implemented, they provide the students with valuable work experience and may lead to future employment opportunities with the initial "customer".

Learning activities

In the context of this report learning activities refer to courses and other activities offered by universities and specifically tailored to the needs of industry, government and professional groups, and the community. These activities will usually be short term, highly targeted to deal with a limited range of issues, and will not lead to the award of a degree. They include professional development courses and other training activities, separated from traditional courses and addressing in detail the specific needs of the participants. Therefore these activities are normally custom-made, and offered on a one-off, part-time basis to industry or public sector groups. Usually, they do not lead to a degree (they are not "credit-bearing"). Beyond traditional courses, universities also offer managers and executives customised fora for the discussion of strategic issues with academics.

Vocational and continuing education courses are other mechanisms that universities use to reach out to the community, offering teaching services that may not necessarily be linked to the pursuit of an academic qualification. In many cases however, the courses are credit-bearing and are organised so as to lead to formal degrees, and can therefore be considered part of the core teaching duties usually associated with Second Stream activities.

Alignment of curricula to societal needs

When preparing their curricula, university departments may consult with external non-academic parties and adapt their programme of studies to existing needs. The extent and relevance of such extra-academic contacts, and the way in which they may be related to the profile of teaching activities, are difficult to evaluate independently and cannot be based on any single indicator activity (see below). Yet the engagement of non-academic interests in the definition of the teaching activities and the corresponding alignment of academic curricula, represents an important

Third Stream activity as it fundamentally affects the most important of university activities.

Communication

It is the objective of academic researchers to give wide publicity to the results of their studies. Yet their main target is academic publications, subjected to peer review and addressing mainly theoretical development. With some exceptions as in the medical and public health sciences, academic publications are seldom read outside academic communities and therefore, provide a poor channel for the dissemination of results outside academia. Yet such dissemination constitutes an important Third Stream activity. This is specially the case when universities generate capabilities through academic research for which no *immediate* application context exists. For these capabilities to be beneficial to society they have to be channelled outside academia. Communication activities constitute the main processes through which knowledge and research results are conveyed outside academia, and can then be further developed and ultimately applied in non-academic contexts. Further, in a rapidly changing society characterised by inadequate understanding of technological and societal changes, universities can play an important role in promoting a public understanding of science through their extra-academic communication efforts.

In our framework, we distinguish two main types of non-academic communication: that conducted through social networks and involving personal exchanges, and communication at arms length through publications and media appearances (general broadcast).

Social networking

Social networks bringing together academic researchers and non-academic users can provide a *means* to the diffusion of the *knowledge and skills stock* existing in universities, but they are difficult to measure in a holistic manner. The importance of networks as a conduit for the application of research results outside academia has been highlighted by many studies. Case studies have shown how research results are readily disseminated when social networks based on personal acquaintances exist, but that it is hard for knowledge to be transmitted in the absence of such networks (Platt, 1987). The importance of building on existing user contacts to generate effective exploitation is also underlined by Scott and Skea (1996). Even the whole process of knowledge utilisation can be viewed as a networking process revolving around interpersonal communications (Yin and Gwaltney, 1981).

Academic researchers and user communities are brought together by social networks that are generally loose associations, often informal and implicit, easy to rearrange and recombine (DeBresson and Amesse, 1991. p. 364). Yet the loose, informal and shifting character of such networks makes them very difficult to capture and measure through indicators.

Non-academic publication and media appearances

The "broadcast" of research results through non-academic publications, references in the press and the audio-visual media, and appearances in such media are avenues of dissemination to broad non-academic audiences of the results of research conducted by academics (be they factual, instrumental, or of a conceptual or theoretical nature). These diffusion channels do not rely on strong networks of the kind reviewed above.

Successful diffusion does not necessarily depend on the strength of the links between researchers and potential users.[22]

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[22] Popular publications in the management literature can for instance, have an effect on the ways that management objectives are defined in a large number of firms without the authors and the managers belonging to the same social networks.

3   Section 3: Towards a measuring model

This section develops, step-by-step the basics of a measuring model for Third Stream activities. We first present a general discussion of the different types of indicators that could be used to address each of the categories of Third Stream activity identified by our conceptual framework. Then, from a broad range of indicators, we suggest a subset that could be used to set the foundations of a measurement system and provide arguments for such selection. At the present stage, these suggestions can only be considered as preliminary; for instance many of the indicators proposed are new and will need to be precisely defined in an operational manner. This work needs to be done when designing the data collection instruments and falls beyond the scope of this study. A complete structured list of the indicators we have considered is presented in the Appendices (Table 2). We conclude with a discussion of the different ways in which measuring tools could be constructed and associated to ranking and funding models.

3.1   An analysis of potential indicators

We first discuss the different groups of potential indicators that could be used to measure and map Third Stream activities. Under each heading we will analyse the most relevant sets of indicators that could conceivably be used and analyse their strengths and weaknesses following the requirements of "SMART metrics" (see page 19).

As laid out above, our main focus is on activity measures. A flaw in many activity measures is that they are devoid of a quality weighting: there is no way of discriminating across activities that may be counted in the same way but require different degrees of effort and may a have widely different scope for potential impact. However, we have already discussed the difficulties in pursuing impact indicators. Some sort of "quality weighting" is only feasible through measures that try to capture outcomes of university actions. For instance, the number of non-credit bearing courses organised for industry and government can be considered a measure of effort invested in a Third Stream activity, while the number of students attending these courses can be considered an indicator of the outcome of this effort and over time, this could provide an indirect measure of quality.

The eventual balance of indicators to be used is contingent on the policy concerns of the government departments and organisations using the final data. So far, the Department of Trade and Industry appears to be particularly interested in the economic impact of policy measures, while the Higher Education Funding Councils are interested in the full spectrum of activities and impacts, including measurable social impacts. Further, when combining a selection of indicators into a generic model for the assessment of such activities, a problem that we are likely to face is that, as Third Stream activities are frequently interdependent,[23] their indicators may

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[23] For instance, contacts established through networks may lead to consultancy assignments, as can an influential publication or an appearance in the media. Conversely, a consultancy assignment may reinforce networks between academics and users, or can result in further publications (Molas-Gallart

not be mutually independent. We will then have to be particularly careful when developing scoring and ranking mechanisms, as the interdependence amongst different indicators can lead to instances of double counting.

3.1.1 Exploitation and use of knowledge capabilities

Technology commercialisation: patents, licensing and other forms of IP protection

Description

As discussed above, universities can commercialise technology by seeking patent protection and then licensing the use of the technology to commercial firms. Other forms of intellectual property rights that can also generate income streams for universities include licensing of software packages and of business methods. Some potential indicators under this category include:

- number of patents applied for (at any of the major patent offices in the world);

- number of patents granted;

- number of patents that are licensed;

- number of licensees;

- amount of royalty income;

- types of technology that are patented and licensed;

- cost and frequency of litigation over infringement of intellectual property rights;

- funds committed to IP management.

Main strengths and weaknesses

The main strength of these indicators is that they are readily quantifiable, and often readily available. Because they have extensively been used in surveys, they have already been defined in detail and could be easy to operationalise.[24]

Because of such relative ease of use, they have in the past been used as a proxy for *all* types of Third-Stream activities, and thereby lies their main danger: that Third Stream measurement may unduly rely on what is a limited set of indicators. There are a number of factors that need to be taken into account when interpreting technology commercialisation indicators:

- *Concentration in a few areas*. Most university patenting is heavily concentrated in chemicals, pharmaceuticals and medical technologies. This does not mean that these are the fields where university research has its greatest utility. It simply means that these are the fields where:

  (a) the potential direct contributions of university research to practical application are relatively high, and

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et al. 1999). Third Stream activities can interact with each other, highlighting the non-linear character of research impact.

[24] The AUTM survey for instance, provides a detailed definition of patent applications filed, patents issued, available licensed technology and licence income received.

(b) patenting affords a relatively strong protection against imitation and therefore enables universities to capture at least some of the income if the invention is successfully commercialised (Pavitt 1997).

- *Simple patent counts are not enough.* US studies tracing the effect of the Bayh-Dole Act on the evolution of patenting by US universities (Mowery et. al. 2001) have shown that although there was a large increase in the volume of patenting, the 'quality' of the patents (as measured by the rate of citations in other patents) declined. Moreover very few patents were licensed and even fewer earned the universities holding them substantial sums of money. Thus it would be essential to collect some outcome data among the indicators suggested above, as for instance, revenue streams, number of licensees, etc.

Feasibility of data collection

The ways in which the patenting and licensing processes are organised vary greatly across universities. Central university offices may be responsible for the whole process, although sometimes the same functions may also be developed at the departmental, or even the individual level. In some cases, commercialisation and licensing functions may be contracted out to specialist firms, or carried by companies set up by the university for this purpose. This variety will have to be taken into account when devising data collection strategies and may increase the administrative burden and cost of collecting comparable data.

Potential impact on organisational behaviour and missions

One of the main objectives of universities is the generation and wide diffusion of knowledge. Applying for a patent may mean delays or limitations in the publication and diffusion of research results, and in some cases, suppression altogether. Moreover there is an obvious conflict between granting exclusive licensing rights to a single firm and the rapid development of technology that can be achieved by competition amongst a number of firms.

Entrepreneurial activities (spin-off companies, commercial arms, and others)

Description

This category comprises of a range of activities undertaken by universities, their departments, staff members and students to set up and manage new firms to either exploit existing university capabilities or to carry out new research. They include the financing of new firms from university resources (spin-offs and commercial arms), making academics more aware of entrepreneurial opportunities and offering them support when starting their own companies (start-ups), and the provision of physical space and expert financial, legal and marketing support (incubators and science parks). Potential indicators for measuring such activities include:

- *number of spin-offs*, defined as new firms set up on the basis of licensing technologies developed in a university or those in which a university directly establishes or makes an equity investment;

- *number of commercial arms,* defined as firms set up by universities or their units and departments to carry out contract research;

- the *amount of income* the university receives from these firms;

- the *number of their employees*, and *sales*;

- their survival rates;

- *number of start-ups* set up by academic staff or students with the support of university services, and their *sales, number of employees, and survival rates;*

- university support to such start-ups in the form for instance, of *business ideas competitions,* university *development funds* and *loan facilities*.

More speculative indicators of entrepreneurial activities could include the number of academics involved in preparing business plans or seeking advice from specialist advisory facilities located on science parks.

Main strengths and weaknesses

The main strength of indicators under this category is that they are, at least in principle, easy to identify as they refer to activities that are large scale ("the setting up of a new firm") and involve financial flows. They suffer however, from several weaknesses:

- In general, the number of spin-offs and start-ups created is very small, 'lumpy', and tends to be concentrated in a narrow set of areas, mainly those related to IT and biotechnology. Thus, despite the policy attention given to such firms, their significance is likely to be small compared to the total set of activities that comprise the Third Stream (Salter and Martin, 2001).

- Survival rates, and more importantly, the level of sales and income derived from these activities, depend on the market situation. In particularly emerging sectors like biotechnology and advanced information technologies markets have been highly volatile, and such volatility is bound to affect all indicators based on the performance of start-up and spin-off companies operating in these sectors.

- The variety of entrepreneurial instruments may pose a problem when trying to aggregate and compare data involving different instruments. Specifically, although the role of commercial arms of universities is very different from that of spin-offs, in practice it may be difficult to differentiate among them for data collection purposes.

- Academics carry out entrepreneurial activities working outside the university.[25] Yet it is not always possible (and arguably not desirable) for administrators to track the activities of staff outside normal working hours, and therefore not all entrepreneurial activities by academic staff can be identified and gathered through quantitative indicators.

- There are also difficulties concerning the definition of terms like spin-off and start-up. There is no broad consensus as to the precise meaning of these concepts, and they are often used in different ways. Our definition of spin-off requires the existence of a strong linkage between the university and the firm; either in terms

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[25] Such "moonlighting academics" are often amongst the tenants in the science parks and innovation centres set up by their own universities.

of licensing of university technology or in terms of an equity investment.[26] However, "spin-off" is also used in other contexts to refer to firms founded by entrepreneurs linked to the university (for instance as ex-employees or past students). In our text we refer to these companies as "start-ups".

Feasibility of data collection

When the scale of activity is substantial, it would be reasonable to assume that spin-offs would be well documented in university records. Yet some data like the equity value of the spin-offs may not be readily available as it can be considered commercially sensitive information. Also, information on start-ups and their impact is bound to be difficult to track and collect. Further the extent to which such individual entrepreneurship can be attributed to the activities carried out from within the university or encouraged by the university, will often be disputable. Yet data will exist on those entrepreneurial activities directly supported by the university through specific measures like development funds and loan facilities. Among others, these are metrics under development in all the institutes funded by Science Enterprise Challenge.

Potential impact on organisational behaviour and missions

As Stephan (2001) highlights, there is a need to take into account the possible negative effects that incentives to engage in entrepreneurial activities might have on other university activities. First, by providing financial incentives, such activities may pull faculty away from teaching and curricula development activities. Second, the migration of top scientists working in new and highly complex research areas from teaching to creating and running new enterprises may mean that future training of graduates in important new fields may be compromised.[27]

Advisory work and contracts

Description

Indicators in this group refer to situations in which academics provide advice and other support services to contribute to the solution of non-academic problems, without any need for additional research. Because many of these activities are carried out at an individual level and are not always remunerated, traditionally data has not been collected and new comprehensive information can only be gathered through individual surveys. When it exists, centralised data on this type of activity will be incomplete, and its accuracy will depend on evolving institutional arrangements. For instance, if a university company is set up to provide consultancy services, centralised data is likely to become more accurate but only to the extent that staff uses the company.

The two main types of indicators of activity in this area would relate to:

- the number of consultancy/advisory contracts;

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[26] Note that the definitions used in the AUTM survey appear as more restrictive. The AUTM survey defines start-ups (our equivalent term is spin-offs) as companies that, when founded, were dependent on technology licensed by universities.

[27] An example is bioinformatics where there is a scarce pool of highly trained scientists, but a number of new start-ups are being created pulling scientists away from university tasks.

- the number of engagements (meetings attended, conferences given, etc...) in which the academic has been providing advice to non-academic audiences.

The financial revenues generated by these engagements could also be considered as an indicator providing a "quality control" element providing an indication of the scale of advisory contracts.

Main strengths and weaknesses

It is important to note that in the context of this report advisory work includes only a subset of what is traditionally understood as consultancy: only those projects where no additional research is involved would be considered here. Yet sometimes it may be difficult to make this distinction; for instance, a small element of research may eventually be necessary even when it had initially been thought that would not be necessary. Besides, there is a grey area as to whether a limited, complementary amount of information gathering can be considered research and different survey respondents may implicitly use different criteria. However, from the point of view of developing indicators for organising, monitoring and managing Third Stream activities, the engagement of non-academic users in the definition and conduct of research through contractual arrangements is substantially different from exploiting existing capabilities through the provision of professional services. The strategies for developing these two sets of activities would be different and their implications for university research strategy are widely divergent.

To monitor this set of activities we focus on indicators based on rudimentary activity counts, reflecting the number of interactions and meetings without accounting for their importance.[28] Using financial revenue indicators to assess the volume or importance of the assignments is fraught with difficulties. It would imply assuming that tasks that are not generating income are not worthy of note.[29] If we try to assess importance by other means, we are immediately faced with explicit value judgements: is the provision of advice to a national government office more important than the supply of consultancy services to a local authority? Should we consider that an activity that has had an identifiable policy impact is more successful? If so, would it then follow that it is preferable to provide advice to those in government than to those in opposition? Eventually any indicator assigning "importance" to advisory and consultancy activities will be value laden.

Other indicators like the existence and size of a central dedicated unit dealing with consultancy assignments imply assumptions as to the best ways of organising this type of activity. Yet as discussed above, it is not always the case that management centralisation of consultancy activities is the best management solution to support this function. In practice, consultancy management models vary from university to university, and indicators based on organisational data cannot account for these differences in organisational practice.

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[28] The definition of what constitutes a "meeting" should be made clear in the data collection instruments.

[29] For instance, to provide evidence to a parliamentary committee would not be considered a relevant task.

Feasibility of data collection

Data collection in this area is likely to require individual surveys. As far as this set of activities is concerned, the survey does not need to be complex, but should be prepared in such a way as to avoid double counting of activities (as many consultancy assignments may be undertaken by groups rather than individuals). To avoid complexity and confusion it is of paramount importance that the data collection targets be clearly identified before the universities set up their data collection systems.

The survey instrument could be linked to the formats used by the university and its departments to gather supporting information for tasks like personnel reviews. For instance, a direct link to the personnel review processes would do away with the need to devise yet another form and more paperwork. Yet if such a linkage with the personnel review process is enacted, for the answers received to provide a comprehensive representation of this type of activities, engagement in this work must be considered as a positive activity by the assessment committees. In some academic environments this may require some substantial cultural change; this change can be stimulated if the Third Stream funds are allocated at the same organisational level at which academic personnel reviews are conducted and recommendations for promotion made (usually at departmental or faculty level).

Ultimately it may not be feasible to distinguish between contracted research and consultancy assignments where further research is not needed. An assessment has to be made as to whether this differentiation is of sufficient importance to research managers as to justify the increase in the complexity of the survey (need for explanatory notes, etc.) that is needed to gather differentiated data.

Potential impact on organisational behaviour and missions

Including this type of activities within performance measurement indicators linked to funding streams is likely to increase the interest amongst academic organisations to establish formal advisory links (unpaid or paid) outside universities. Focus on the number of such activities rather than their impact may result in universities seeking many instances of interaction, rather than focusing on larger, potentially high impact, activities.

3.1.2   Exploitation and use of university facilities

Commercialisation of facilities

Description

Many universities support a wide range of facilities that can be of use to the private sector. These facilities include office space, libraries, conference centres, and most importantly, laboratory equipment and testing facilities.

It would be possible to collect information from each UK university about the income it receives from letting its research-related facilities. This would provide a relatively simple economic indicator. Arnold and Thuriaux (2001) suggest however, that a considerable portion of the interactions between industry and universities concerning facilities are unpaid. University research and industrial firms often agree

to share resources. It is necessary for the indicator system to attempt to capture these unpaid exchanges. Information about the extent of use of equipment by industry, i.e. number of visits, may provide a measure of the interaction between the university and industry via the use of facilities.

Alongside laboratories and testing equipment, universities can also offer other facilities such as conference rooms and office space to industry and social groups. Data on this type of activities (for instance, the number of local events held on university facilities) can provide an indicator of social and economic impact on the community.

Main strengths and weaknesses

The use of university facilities is an important aspect of the interaction between universities and the community and therefore, measures of the extent of such use should in principle be included within our battery of Third Stream indicators.

Emphasis could be placed on the amount of income universities receive from non-academics for the use of laboratory and testing facilities maintained by the university. The main weakness of using revenue streams as an indicator of the use of scientific and technical facilities, is that it ignores the informal and unpaid exchanges that often take place between university staff and local firms. Supplementary indicators on number of visits and usage patterns on facilities may provide a complement to the financial income figures.

Concerning other facilities (office space, conference rooms, accommodation. . .), the extent of their non-academic use provides an indicator of the degree to which the local community benefits from university infrastructure and of the openness of the university to public access and its integration with the surrounding community. Yet indicators of the use of such "non-research" facilities at universities suffer from several major problems. First, universities differ greatly in the diversity and quality of their facilities. For example, a university with a major conference facility is likely to score highly for the non-academic usage of university space, even though there might be little interaction between the use of this space and the university itself. Second, it could be argued that much of the use of non-research facilities at universities is driven by the lack of comparable facilities in the local area. Lastly, it can be reasonably argued that the impact of the non-academic use of such facilities is fairly limited; the university may actively act as a landlord but such activity does not draw on the unique knowledge and knowledge generation capabilities that universities hold.

Feasibility of data collection

The collection of comprehensive data on the use of research-related facilities at universities would require individual departments to specify which contracts and which parts of research contracts are for use of facilities. It might be very difficult to disentangle the use of university facilities from normal research contracts. However, it should be possible for central administrators and major departments to indicate the income they derive from simple, straightforward letting of their research-related facilities. It might also be possible to collect indicators of unpaid usage by counting the number of visits received and the types of activities visitors engaged in.

The collection of data on the use of non-research facilities is more difficult to describe in detail. Private sector companies run many of the ancillary facilities on

campus and therefore it would be difficult to collect detailed data on the use of these facilities by clients external to the university. Yet such indicators can provide a sense of the throughput of non-academic members of society through the university.

Potential impact on organisational behaviour and missions

The collection of financial income data on the use of the universities' research-related facilities is unlikely to have a major impact on behaviour. Many of these services are already financially costed and new indicators would draw from these existing financial figures. It would however, be important to ensure that unpaid interactions between university staff and industrial firms through reciprocal arrangements are not driven underground. It is essential to develop indicators that reflect the extent of interaction associated to the use of facilities as well as the financial income derived from this use. It would be unfortunate if the exclusive use of financial income indicators drives out informal interactions.

Indicators about the use of university non-research facilities by non-academics need to be handled with caution. They may provide an incentive for universities to develop "landowner functions" and be rewarded for building up activities that are not directly linked to their core function of generating and disseminating knowledge. Further, the use of facilities by external, paying, commercial organisations may push out internal, non-paying, academic users. However, the use of the university facilities for cultural events addressed to the public provides a service to the community and plays a role in making the university more accessible to society.

3.1.3   Research activities

Contract research with non-academic clients

Description

As an indicator, the revenues received from contract research could be complemented with the average size and length of the contracts to provide a sense of the depth of the research assignments. Further, the distribution of funding across types of clients and research areas can indicate the number and extent of interactions with non-academic organisations, the diversity of funding sources, and the number of different organisations funding research in particular departments and the university as a whole.

Main strengths and weaknesses

The strength of revenue indicators is that they refer to financial figures that are mostly available. Universities already collect much of this information and its use as a comparable indicator could be achieved with relative ease. Yet there are many different ways in which these activities can be carried out and it may not always be possible to identify and assess the different mechanisms so as to establish a robust basis for comparison across universities.

Although many universities will carry out this type of contract research directly, other universities will tend to route it through specialised commercial arms. For measurement purposes however, the activity of such commercial arms may be difficult to distinguish from that of university spin-offs. Further, contract research can also take place "off the books" and through informal channels, and it would not be feasible to collect data on these activities. Given these practical difficulties, the

indicators we have included under this section, will refer only to contract research carried out through the university.

Because revenue figures are relatively easy to collect, there may be a tendency to rely heavily on them to assess Third Stream activities. A wider perspective is required to ensure that unpaid and informal interactions are assessed alongside financial revenue figures.

Feasibility of data collection

Data can feasibly be collected; in fact, much of the information needed is already available. At present, universities collect some information about the share of funding received from different sources. This information is collected annually and published by HEFCE. It is also used in the assessment process for university departments for the RAE. Extra effort will be required to explore the distribution of funding across different sources, highlighting the number of actors involved in funding research contracts. Also the data currently available at present does not make the distinction between research contracts and advisory work that we have made here. It may not be feasible to operationalise this distinction into a straightforward data gathering strategy.

Potential impact on organisational behaviour and missions

On the one hand, the reliance on indicators of income from contract research could lead universities away from focusing on developing long-term sources of funding. Traditionally, industrial funding has been seen to be more short-term and focused, and it has been argued that an over-reliance on industrial funding can lead to universities becoming short-term oriented in their research activities. On the other hand however, the inclusion of contract research indicators would act as an incentive for universities to seek new sources of commercial work and can contribute to increase the diversification of funding sources.

Non-academic collaboration in academic research

Description

Academic research is curiosity-driven and primarily carried out to foster knowledge and to address issues and problems of a theoretical nature. It is commonly funded by grants and it aims to publish its results in academic publications. Collaboration with non-academic organisations when conducting academic research can be monitored and measured. The number of research projects that involve contributions from non-academics and the value of such contributions can be used as indicators for this type of collaboration.

Main strengths and weaknesses

Non-academic collaboration in research projects will often be formalised through agreements and contracts and can therefore be the object of centralised monitoring. However, there are different types of contribution, underpinned by different contractual terms. The economic value of in-kind contributions in which the collaborators offer access to facilities or the time of scientists and technicians can be difficult to estimate. Such valuation is however important because the significance of contributions varies widely across projects.

Feasibility of data collection

Data on these arrangements is normally kept in central or departmental filing systems as part of normal management procedures. Yet the data presented in the formal documentation is unlikely to follow the format required for the evaluation of Third Stream activities. Bringing together dispersed sources of data and structuring them according to a common format can be time consuming and will require adequate resources.

Potential impact on organisational behaviour and missions

Including external collaboration in academic research as an activity to be rewarded through the distribution of Third Stream funds, adds to the already existing incentives to develop university-enterprise collaboration in research. It could be argued that non-academic participants may influence research agendas, and confer a more short-term, problem-oriented approach to academic research. Yet collaboration between academics and future potential beneficiaries of academic research can provide the type of social linkages that facilitate further collaboration and build avenues to develop and adapt academic outputs with potential applications.

Flow of academic staff and scientists and technicians

Description

The mobility of research personnel from academic posts to temporary employment elsewhere and vice versa, from firms to academia can be monitored and measured. Potential indicators relevant to these activities include:

- number of university research staff taking up a temporary position in industry;

- number of industrial scientists taking up a temporary position in academia;

- permanent moves (in both directions) as a result of previous collaboration between academia and industry.

Main strengths and weaknesses

These types of indicators can help to assess an aspect of the academic-industry interaction that is much emphasised in the literature: the flow of 'tacit' (i.e. person-embodied) knowledge. Further, personnel movements are easy to identify and are likely to be registered. However, different universities manage personal records of this kind in different ways. Data may not always be recorded centrally and therefore may not be readily available.

Feasibility of data collection

It will often be necessary for existing centrally held personnel records to be supplemented by data collected from departmental administrators. Such data collection can be organised by the university central services.

Potential impact on organisational behaviour and missions

Increasing movement of key research staff may potentially have a negative impact on other university related activities along the lines discussed above under entrepreneurial activities. Temporal appointments may pull faculty away from teaching and curriculum development, and the future training of graduates in important new fields may be compromised.

3.1.4   Teaching activities

Student placements and other links with potential employees

Description

The number of student placements, and similar arrangements like attendees on sandwich courses, can provide an indicator of engagement between teaching activities and the non-academic world.

Main strengths and weaknesses

Data on student placements and similar arrangements is uneven. As there is a wide variety of arrangements, and placements are undertaken for a variety of time periods, there is a lack of comparability across different types of placement. Also, at present it is impossible to know whether these placements eventually lead to full time employment.[30]

Feasibility of data collection

Gathering data on student placements is intricate but feasible. Few central university administrators have this type of information, but it could be gathered on a systematic basis once appropriate systems are put in place. Most of the information required is already contained in departmental teaching offices, although in a variety of formats. Systematic data collection would require extra departmental and central resources.

Potential impact on organisational behaviour and missions

The inclusion of student placements among Third Stream indicators would provide an incentive to increase the engagement of teaching activities and students, with potential non-academic users. It would also contribute to increasing the emphasis on the employment prospects of students.

Learning activities

Description

Indicators in this area would assess the amount of training, teaching and associated services offered by university to industry, government and professionals, and the community. Information on the amount of income generated by university from this broad range of learning activities and associated services would provide an indicator of their scale and provide a measure of whether a university is using its teaching and research capabilities to offer teaching and workshop programmes for non-academics.

Main strengths and weaknesses

The income from these services would provide a direct and relatively objective indicator of contribution to non-academic learning. Yet the weaknesses of this approach are considerable.

First, it may prove difficult to disentangle learning activities from traditional academic teaching programmes, and ensure that this distinction is meaningful for collecting information about financial income. Take for instance, the case of continuing education courses oriented to part-time adult students who may not necessarily have an academic background and may not necessarily be interested in

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[30] The current first destination survey carried out by the Higher Education Statistical Agency (HESA) is incomplete in this respect.

the pursuit of a qualification. However, these courses are often credit bearing and can be organised in such a way as to lead to the award of an academic degree.

Second, instruments like collaborative workshops for industrial managers may straddle research and teaching activities and may be difficult to classify as either one or the other.

Feasibility of data collection

Individual departments would need to estimate the amount of funding they receive from learning services and these figures would then be aggregated for the entire university. Teaching funding is complicated by the dual funding structure and it is often difficult for individual departments to attribute income to particular activities. The job of data collection would fall largely on individual departments, further raising the administrative burdens already faced by front-line administrators.

Potential impact on organisational behaviour and missions

The potential impact of collecting information on this type of services would be to create an incentive for departments to become more active in the development of teaching and coaching products that do not lead to an academic degree. However, the extra administrative burden of collecting the indicators could lead to many of these activities being driven underground and taken off the university books. For instance, it is relatively easy for individuals to conduct training services outside the university's normal accountancy rules. A simple way to make these activities transparent to central university administrators is to make them credit bearing. Yet this will place them in a situation similar to that of the continuing education courses discussed above. Their primary function is not to lead to the award of a degree, but they offer the option to students to use them toward the requirements of a degree. By so doing, the difference between tailor-made courses and normal academic teaching activities will become blurred.

Alignment of curricula with demand

Description

It might be possible to have each university assess the degree to which courses are aligned to societal demands and requirements. To develop indicators in this area it would be necessary to map the mechanisms used by university departments to align course material, such as whether or not course curricula are commented upon by industry. Indicators of course alignment would need to be collected at the departmental level and then aggregated up to the entire university. Although it would be valuable to have information about these linkages, the process of course development is a complicated one and involves many different factors.[31]

Many of the courses offered in engineering and medical schools are developed in consultation with the different professional institutes governing the professions. In this case, the opportunities for individual departments to innovate in course curricula are limited by requirements to teach certain classes and skills. There is some margin in the process of course certification that allows individual departments to develop

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[31] Individual departments usually do their own course development. Each department submits its plans for new courses to the university committees for approval, who act as a "quality control" mechanism.

specific course programmes, but overall rules regarding professional training bound these course revisions.

An indirect approximation to the extent to which university courses are aligned with societal needs could be obtained from the first destination of recently graduated students.[32] One of indicators used in the UK to understand the movement of students into practice, has been the HESA survey of the first destinations of students. This data is a valuable source of information about the contribution of universities to social and economic development, but in its present structure is incomplete for our purposes.

HESA is not the only organisation to engage in studies of the flow of students into the economy. The National Science Foundation in the US conducts a yearly survey of science and engineering graduates, exploring whether they are employed and in what sectors. This provides an indicator of the contribution of different universities to different industrial sectors. Recently, the Ontario Government in Canada has implemented a more advanced survey of student employment. Ontario has adopted a dual approach for understanding student placement after education, focusing on both the skills developed by students during the course and skills required for their subsequent employment. Both former students and their employers are asked to assess the link between the courses the student completed and the current work in which they are involved.

Main strengths and weaknesses

Direct and indirect indicators of course alignment can provide a measurement of the responsiveness of the academic curricula taught at universities with industrial and social demand for skills and knowledge. An obvious weakness lies in the difficulty of defining with precision what the "alignment" of curricula entails. It is hard to imagine how an operational definition of this concept could be developed. Rough and ready assessments by individual departments about their processes of course development could be collected, but these assessments are unlikely to be measurable and therefore would be of limited use in assessing the overall state of "alignment" in the university as a whole.

Indirect indicators can be obtained by assessing the employment obtained by recent graduates ("first destination surveys"). The strength of student destination data is that they can help track the movement of graduates into the economy. Therefore, they are an important indicator of economic contribution, but "first destination" may not be directly associated to any Third Stream activity. For instance the prestige of the university may be an important factor in explaining "successful" first destination data, although the approach taken by the Ontario Government goes some way towards solving this problem.

The main weakness of student placement indicators is that they require considerable resources to develop, collect and maintain. The current HESA first destination survey would need to be significantly altered along the lines of the Ontario survey and expanded to ensure a wide number of respondents and more consistent information across universities and departments. Further, the timing and definition of

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[32] A key indicator of social and economic contribution of universities is the movement of trained problem-solvers from academic institutions into private and government practice.

"first destination" is also difficult to operationalise. For instance, recent graduates may take low pay temporary jobs in the services sector while seeking a job that is suited to their training. Which one of these jobs should be considered the "first one"? Also first destination job data could be qualified with retention indicators.

Feasibility of data collection

It is difficult to imagine how direct data on course alignment could be collected. Individual departments would need to indicate something about the processes they use to develop course material and what role non-academic actors have had in shaping the course curricula. The procedural requirements for course approval could be adapted so as to provide indicators of the extent to which each department has attempted to align its course materials to industrial demands.

The development of indirect indicators through "first destination" data provides a different set of problems. The feasibility of collecting data is relatively high given adequate resources. HESA has already developed a useful data set on first destinations. Further surveys could be developed, incorporating the approaches of the NSF and the Ontario Government.

To be useful, the data would need to fairly comprehensive and collected relatively frequently (at least every two years). It would be difficult for individual or groups of universities to collect this data themselves. The key actor in attempts at further data collection would be HESA.

Potential impact on organisational behaviour and missions

The potential impact of examining the degree of alignment of course curricula could help to entice individual departments to make a greater effort to align their material to current societal needs. Currently, there is no requirement to do so and therefore indicators that provide a measure and incentive for course alignment might have a positive impact. This needs to be balanced by a concern about the costs and value of the measurement itself. Direct indicators would be extremely subjective and difficult to implement effectively. Moreover, there would be considerable extra administrative burdens placed on individual departments to respond to central university demands to demonstrate alignment. This could have a pernicious effect on intra-university relations.

The use of indirect indicators like improved and expanded first destination data can have substantial effects in the promotion of 'Third Stream' activities. It would promote the alignment of courses with societal needs, and focus attention on the employment prospects of students when developing and supporting teaching programmes. However, it could also lead to an over-emphasis on short-term skills in course development. There is a careful balance between the need to educate students with the skills required to find work and the need to ensure that education provides portable knowledge and skills. Building too tight a link between current work patterns and course development might create rigidity in the education system, limiting opportunities for new courses and ideas to develop.

3.1.5 Communication activities

Social networking

Description

As discussed above, the importance of social networks in the communication and application of research ideas and results, and of knowledge in general, has been emphasised by many studies. Yet, despite such broad agreement as to their importance, there is no common understanding of what constitutes a "network". For the purpose of this study we are going to confine our understanding of networks to the types and patterns of relationships established among individuals or groups of individuals.[33]

We will focus on activities involving the establishment of communication links with groups or individuals outside academia with the purpose of communicating research strategies, activities and outcomes in all areas of academic activity, including the humanities. The indicators should not attempt to assess the strength and stability of the relationships established, as it can be argued that the potential scope for impact does not depend on the strength of linkages with networks of users. On the contrary, innovative social thought and economic theories that may result from academic research, are more likely to emerge in an environment of independent and "detached" research, with the main impact occurring through weak links with non-academic audiences (Molas-Gallart et al. 1999, p.10-12).

As described above, the loose, informal and shifting character of networks bringing together academics and non-academic users and beneficiaries, makes it very difficult to capture and measure these activities through indicators. Yet indicators of social network activity oriented to the *communication* of research interests and results can include the participation in business and trade conferences and meetings. This can be as a paying participant, invited participant or invited speaker. Obviously, from the point of view of dissemination there is more value in participating as a speaker, and this should be accordingly reflected if these indicators are included in a final assessment model. Data can be gathered through a direct survey to individual academics.

Main strengths and weaknesses

A clear definition of what constitutes a conference and a meeting will need to be presented in the data collection instrument. It may be difficult to define clear boundaries between non-academic and academic meetings, although broad rules of thumb can be used to clarify distinctions and make the data consistent and comparable. For instance a business conference could be defined as one in which at least three quarters of attendants *and* speakers are not academics. A minimum number of attendees could also be established for meetings to "qualify", and the number of attendants in the meeting or conference could also be used as an indicator of relative importance as a communication channel. Yet there is no feasible way to

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[33] The field of "Social Network Analysis" has developed highly formalised techniques to study such networks but its focus is on the analysis of relational data referring to the evolution and patterns of the relations which link complex groups of individuals (Scott, 1991). However, our main interest is not on modelling network structures and these techniques are too complex for the comparison and evaluation of this set of Third Stream activities.

account for the "quality" of participants. Furthermore, this is a very partial indicator of social network activities as it only relates to a very specific and highly formalised kind of social exchange.

Feasibility of data collection

At present, most universities and departments do not keep centralised records on this type of activities. Data can only be collected through individual surveys.

Potential impact on organisational behaviour and missions

As with many kinds of social network indicators, the ones we propose here refer to very specific kinds of formalised activities. As these indicators would be used as performance measures, they may steer academic organisations towards the pursuit of formal relationships to the detriment of other more informal activities, which could be, at least as important. Yet it must be noted that it is common for academics who are active "informal networkers" to also participate in formal business gatherings and conferences.

Non-academic publications and media appearances

Description

As non-academic users seldom have the time to read or monitor academic publications (Tang et al. 1998) and academic quality may not be related to societal impact, the access to the media and the production of publications targeted to non-academic audiences are key tools in the dissemination of academic research activities and results to non-academic audiences. Indicators of activity in this field include the number of non-academic publications (articles in popular and trade magazines and other non-peer-reviewed articles, press articles, reports, web sites), their impact (citations in non-academic publications, references given by the media, web site hits), and the direct participation in radio and TV programmes.

Main strengths and weaknesses

As with other sets of indicators analysed here, a distinction has to be made between indicators of activity, and those referring to the impacts of such activity. At an individual level, academics will be aware of the interviews they have given to the media, their participation in TV and radio programmes, and their non-academic publication activities. They can easily keep track of their activities in these areas. Indicators can then be gathered through a survey instrument distributed to individual academics. Some Council-funded Research Centres already monitor and measure these activities. At central university or departmental levels the presence and activity of press officers can also be monitored and measured.

To measure impact is much more difficult. In principle, citations and references in the press and media can provide an approximate impact indicator. Yet academics may not be aware that such citations have been made and interviews will yield incomplete results, particularly in cases when there is substantial press interest. Collecting citation data from non-academic publications would be a large an expensive endeavour.

Web site hits are also an indicator of interest and consequently can provide an indirect impact indicator. Yet such hits can originate from both academic and non-academic individuals, and it is therefore impossible to isolate web hits as an

indicator of Third Stream impact. Further, hits to a web site may be triggered by content other than that related to the academic work of the host.

Additionally, impact indicators suffer from similar problems to those that are well known in academic impact assessment. In particular, they may be critical or refer to perceived negative effects of the academic work being cited ("negative citations"). Further, media citations as well as media appearances may not refer to research results or academic activities. They could for instance, relate extra-academic activities: famous academics may receive press coverage because of their personal status, or may have a high profile because of other activities (for instance as literary writers). In these cases press citations cannot be construed as an indicator of Third Stream impact. In practice, to differentiate between references that emerge from academic activities and others that do not is impossible.

Feasibility of data collection

Activity data can feasibly be collected through individual surveys. Individuals can easily keep track of these activities and the *additional* paperwork necessary is unlikely to be substantial. The development of impact indicators would be much more problematic requiring substantial research and analytical efforts.

Potential impact on organisational behaviour and missions

It is unlikely that the systematic monitoring of this type of Third Stream activities will affect the structure of academic organisations and the definition of their main missions. However, it is to be expected that academics will be encouraged to publicise the result of their work outside academia and this will in turn translate into increased attention being paid to press relations, communication affairs and public relation activities.

3.2 Selection of indicators and model definition

3.2.1 Criteria and approach

As explained above, the call for tenders asked for the development of indicators that are simple, measurable, actionable, relevant, reliable, reproducible and timely. Although the issues we are analysing are complex, it is important that the set of indicators to be ultimately used in a measurement system, can be defined simply, and structured within a transparent model. Complexity in the definition of the indicators is likely to generate problems in the collection and administration of data. Complex indicators may create confusion amongst those in charge of generating the primary data and may require substantial effort to collect. The balance between precision in the definition of the concepts used and simplicity in the presentation of an indicator for data collection purposes will need to be addressed when designing survey instruments and data gathering mechanisms.

Preference for simple indicators does not necessarily mean a focus on data that is already being collected; some of our suggested indicators are new and would require new approaches to data collection. These approaches and data management practices may be initially complex to set up, even if the indicators gathered and the questions asked are simple. If adopted, university administrative processes will have to adapt to the new requirements, and it is therefore important that such adaptation yields positive results regarding the central tasks of supporting and managing Third Stream

activities. In other words, the establishment of new indicators cannot only be proposed on account of their value as performance measurements, but must take into consideration the way in which the indicators can help university administrators in the support and management of these activities. The indicators have to be useful to the university managers who will be responsible for their collection, and cannot be seen as an external imposition for the sole purpose of measuring and rewarding past performance.

In the selection of indicators, we have followed a set of simple guidelines, as follows:

- *Use existing data where possible* – We have attempted to integrate our indicators with existing data sources, such as data collected by HEFCE and HESA. For many indicators however, it will be necessary to improve or refine the existing sources of data collection or create new collection mechanisms. Table 1 provides a very approximate estimate of the additional effort that will be necessary to implement each of the suggested indicators.

- *Use existing university procedures to generate data* – A number of university procedures, such as those related to financial management, may provide opportunities to collect information for the purposes of Third Stream measurement. Minor modifications to these procedures would allow for considerable information to be gathered.

- *Limit the cost of data collection* – Given the high levels of measurement fatigue across the UK university sector, it is necessary to ensure that the new indicators do not impose a high cost on departments to collect and manage. There will obviously be new costs for central departments in the development of new indicators, but we have attempted to select indicators that do not require expensive collection and management efforts.

- *Limit intrusion on individuals* – Most university employees would be seriously concerned with the imposition of a new set of performance metrics. Our approach attempts to limit the requirements on individuals and to focus on indicators that can be collected centrally. Conceivably some of the new indicators could be collected using university procedures like personnel reviews and staff employment records. This would still be costly to do, it is likely to generate some opposition among academics, and has important implications for the organisation and management of the review processes. However, if this option could be implemented, it would provide a streamlined system of collecting data through existing tools and from the point of view of the individual, it would be perceived as less burdensome than having to respond to an additional set of surveys.

- *No "distributional" indicators* –We have not included indicators to compare how different societal or industrial groups are affected by the same variable; for example, SMEs versus large firms, or "local" firms versus "national" and "international" firms. In many cases, the collection of distributional data would add a substantial degree of complexity to the already fairly complex set of activities that will be needed to collect data across the different areas of Third Stream activity. This may not always be the case; some universities are building client databases to support the marketing of their research and professional

teaching services. These are important management tools that may help universities analyse the evolution of their commercial client base. Yet using these data for comparison purposes is not straightforward. First, it would require the establishment of an homogeneous client data management system across the country, even when universities may have different management needs. Second, to make sound comparisons across universities, the system would have to be based on a set of category definitions that needs to be clear and detailed, and therefore cumbersome. Finally linking distributional data sets to funding decisions is likely to be difficult and controversial, as it would mean favouring specific groups of potential beneficiaries vis-à-vis others. Therefore, our goal is to develop a measurement system for aggregate Third Stream activities and not to focus on indicators of the distribution of these activities across particular sub-classes of actors.

- *Not too many indicators per section* – Given that we want the indicator system to be SMART, we suggest a strategy of limiting the number of indicators for each particular area of Third Stream activity. For example, instead of adopting 30 or so of the possible indicators of entrepreneurial activity, our preliminary list of proposed indicators for this area of activity is limited to only five. Our goal is to limit the amount of information that will need to be collected and ensure that areas that are easy to measure, such as commercialisation, are not given special attention over other areas less susceptible to measurement.

- *Indicators across all areas* – In order to ensure that the measurement system is representative of all types of Third Stream activities, we have attempted to develop indicators for all the Third Stream areas identified in our conceptual framework. In some cases, the indicators are themselves proxies of the behaviour directly concerned; in others, they could be considered relatively "soft and loose". We felt that for those areas that were difficult to measure it was preferable to have simple, soft indicators than no indicators at all.

3.2.2   Process of Indicator Development

The process of indicator development is *iterative*, involving many stages of indicator definition, testing, piloting, validation, collection and analysis. This report is only one of the initial steps in a longer process of indicator development that is likely to take considerable time. It is unlikely that a robust and standardised system of measurement to collect data could be developed immediately. Measurement requires time, investment and commitment: the development of a holistic Third Stream measurement system will require a commitment from all the interested parties in the UK higher education sector.

There are number of issues to be resolved before a fully-fledged measurement system can be implemented. A key issue is the cost of data collection and management. Such costs are often significantly underestimated as they are primarily sustained by those who are being measured. A second issue to be faced before implementation is who will be responsible for indicator analysis. Analysis of indicators often requires a different set of skills to those involved in indicator collection; typically, agencies collecting indicators will commission outside experts to conduct data analysis for decision-making purposes. Third, the development of indicators depends on consistent and robust methodologies that are codified into

manuals and other compendia of rules, including definition of terminology used, survey instruments, etc. The process of developing a manual for data collection and analysis is often controversial and involves inputs from many different organisations and actors.

Finally, many of the new indicators that are introduced in measurement systems are initially extremely controversial and it takes considerable time for these indicators to become part of normal practice and understanding. For example, the development of the Frascati manual for collecting information on Research and Development (R&D) was a source of considerable debate in the 1960s (OECD, 1992). Many questioned whether R&D could ever be effectively measured. Today, there are ongoing debates over the Oslo Manual for collecting information on technological innovation (OECD, 1997). The Oslo Manual acknowledges that many of the terms used in its system are ambiguous and mean different things to different people; in other words, many of the areas of science and technology that are measured rely on subjective judgements about behaviour.

Given the complexities of developing a new measurement system, we anticipate that a several-stage implementation process will be required to develop a Third Stream funding system based on measurable evidence. The core objective of the system is to link the decision-making procedures to the progressive development of information resources to guide the allocation of Third Stream funding. We anticipate that, over time, the system of measurement will be become increasingly consistent, robust and useful for guiding funding allocation decisions. In the first few years of data collection, much of the data will be uneven and inconsistent, indicator definitions will be unclear, contested and evolving, and much of the data still incomplete. However, as the data collection system is further refined, the data will become more complete and accurate, and therefore, useful as an instrument for allocating funding.

3.2.3   Selection of indicators

As is the case with most measurement systems, "the devil is in the detail". The definition of a measurement model for Third Stream activities needs a detailed and clear approach to indicator definition, selection and collection. Based on the above discussion of strengths and weaknesses of different sets of indicators, we propose a set of indicators that could be used to monitor across the whole range of Third Stream activities.

Table 1 lists the proposed set of indicators to be included, together with a summary indication of how the data is to be collected and our judgement on the approximate likely cost. We have selected the indicators in Table 1 from a comprehensive list of over 60 different indicators distributed over the 12 categories of our conceptual framework. This represents a first attempt at developing a methodology for the measurement of Third Stream activities. Some of the indicators listed will need to be further refined, and when new data collection instruments are required clear definitions and conceptual boundaries will have to be developed. The complete list of all indicators we have considered can be found in Table 2 (Appendices). Table 1 needs to be read in conjunction with this longer list, which presents a synopsis of the strengths and weaknesses of each of the more than 60 indicators listed. A more detailed discussion of each category of indicators can be found in the chapter *An analysis of potential indicators* above.

Some of the indicators selected are new, whereas others are already collected and published. The indicators in Table 1 are shaded in different tones to indicate the level of additional work that needs to be done to collect them. Light grey shading refers to indicators that are already collected somewhere in one way or another and would therefore require less effort to define, gather, organise and manage for the purposes of Third Stream measurement. In darker grey shading we have marked the indicators that will need more effort to collect, but we still consider that their inclusion in a measurement model is feasible. In many cases these are new indicators that will need to be further defined and for which new data collection instruments will be required.

The second column in Table 1 describes the instrument that could be used to collect the data, and whether these data will be available centrally or at the departmental level. Finally, the third column estimates the likely cost of collecting the data according to the level of additional work required.

Table 1 Possible indicators to be included in a Third Stream measurement model

Indicator	Data collection instrument	Collection costs
Technology commercialisation		
No. of patent applications.	Technology Commercialisation Offices may gather data at some universities. At other universities such information may be held by central administration or at the departmental level.	Moderate
No. of patents awarded.		
No. of licences granted (including option agreements).		
Royalty income (including option fees).		
Median value of royalties (including option fees).		
Entrepreneurial activities		
No. of spin-offs created in the last 5 years.	Technology Commercialisation Offices may gather data at some universities. Elsewhere information may be held by central administration or by departments.	Moderate
No. of current employees in spin-offs created in the last 5 years.		
Turnover/profits from spin-offs and commercial arms.		
Development funds and loan facilities provided by universities to support start-ups	Technology Commercialisation Offices may gather data at some universities. These are metrics under development in institutes receiving funds from the Science Enterprise Challenge	Moderate
Advisory work		
No. of invitations to speak at non-academic conferences (excluding project presentations to funders).	Information could be collected as a part of the annual appraisal process or through a survey.	Medium
No. of invitations to attend meetings of advisory committee of non academic organisations.		
Commercialisation and use of university facilities		

Indicator	Data collection instrument	Collection costs
Income derived from leasing/letting/hiring of S&T university facilities (laboratories and testing facilities).	Data to be gathered from contracts, authorisation forms, or booking procedures. Some of the information will be available centrally and some at departmental level. Data collection process may be labour intensive.	Medium
Total no. of days spent by external (non-academic) visitors using laboratories and testing facilities without payment.		
Income derived from leasing/letting/hiring of cultural and university leisure facilities (e.g. theatres, conference rooms, sport centres, ...).		
Total no. of events run and organised by the university for public benefit.		
Income derived from leasing/letting/hiring of office and library space to industry and social groups.		
Total no. of days spent by external (non-academic) visitors using university office and library facilities without payment.		

Contract research with non-academic clients

Indicator	Data collection instrument	Collection costs
Value of contract research carried out by the university.	Data to be gathered from information available in contracts and held centrally. Collection may be labour intensive.	Medium
No. of contract research deals (excluding follow-on deals) signed by universities with non-academic organisations.		

Non-academic collaboration in academic research

Indicator	Data collection instrument	Collection costs
No. of refereed publications authored with non-academics.	Information could be collected as a part of the annual appraisal process or through a survey.	Moderate
No. of non-academic organisations collaborating in research projects funded through Research Councils, charities and foundations, European Commission Framework Programme, and other grants.	Data to be gathered from information available in contracts and held centrally. The collection process may be labour intensive.	Moderate
Value of contributions (both in cash and in-kind) provided by non-academic collaborators to above projects.		

Flow of academic staff, scientists and technicians

Indicator	Data collection instrument	Collection costs
No. of faculty members taking a temporary position in non-academic organisations.	Data to be gathered from personnel records and CVs held centrally at university level. The collection process may be labour intensive.	Medium
No. of employees from non-academic organisations taking temporary teaching and/or research positions in universities.		

Student placements

Indicator	Data collection instrument	Collection costs
No. of students in sandwich courses and attending internships organised by the university.	Data may be collected from central student records.	Medium

Active alignment of teaching to economic and societal needs

Indicator	Data collection instrument	Collection costs
No. of credit bearing courses established through a direct request from non-academic organisations.	Established formal procedures to approve university courses may be used to collect this information. Organising it will be labourious. Data collected at central university level.	Medium
Percentage of total recent graduates not looking for work 18 months after graduation.	HESA First Destination Survey collects and publishes this type of information. However, the quality and reliability of the data needs to be improved and timely availability achieved.	High
Percentage of total recent graduates and employees highly satisfied with the knowledge and sets of skills acquired through the course.	This information is not collected in the UK. A special survey along the lines of the Ontario survey would have to be conducted.	High
No. of postgraduate students directly sponsored by industry.	This information may be collected at departmental level.	Medium

Learning activities

Income received from non-credit bearing teaching and associated activities (courses, collaborative learning…) undertaken.	Data may only be available at the departmental level, and could be gathered by setting up suitable mechanisms.	Medium
No. of different institutions that have attended or have taught in non-credit bearing teaching and associated activities.		

Social networking

No. of times that academics have participated in professional, non-academic conferences (in which the majority of participants were not academics).	Information could be collected as a part of the annual appraisal process or through a survey.	High

Non-academic dissemination

No. of appearances by university academics in regional, national or international TV or radio.	Information available from university press offices.	Moderate
No. of times university or members of its faculty are mentioned in national broadsheets because of its research and teaching activities.		Moderate

3.2.4 Integrating additional data sources into a Third Stream measurement system

Our approach focuses on activities and other variables that universities can measure themselves. This perspective is limited by the fact that universities can only see part of the layers of interaction that bind them to the rest of society. Other sources of information can complement the set of metrics that we have proposed, although it would be difficult, if not impossible, to use these alternative data sources in scoring and funding formulas. Mainly, they provide figures at such a high degree of aggregation that the information is of limited value to UK university managers.

One such data source could be the UK Community Innovation Survey (CIS). The UK CIS provides the largest and most comprehensive database on innovation in UK

industrial firms and is conducted at five-year intervals. Although it focuses on the process of innovation within the firm, the survey includes several questions about university-industry interactions; mainly on instances of formal collaboration between industrial firms and universities and about whether universities are considered to be a source of information for innovation. However, the data provided does not specify which universities the interviewees cite as a source of information for innovation or with whom they have formal collaborative linkages.[34] Therefore, the information provided is not detailed enough to help guide funding allocations or to score individual universities on their impact on innovation in UK industry.[35]

In the future, more detailed questions about university-industry interactions could be introduced in the UK CIS. It is also possible to imagine a specific survey being addressed to those firms that indicate that they collaborate with universities, exploring the universities they collaborate with and the types of interactions that take place between themselves and the university sector. The benefits of a new survey would be considerable, but it would require extra resources, and in any case, we would have to wait until 2006 (the date of the next survey) for any further results..

Another possible source of useful data on Third Stream contributions could be a "bibliometric" analysis of academic publications to assess the number of joint publications between university and industrial firms in the UK. Such indicators of university-industry interaction could be collected at the level of the individual department or university. However, the costs of data analysis would be considerable.

3.3   Data analysis and scoring mechanisms

As described on page 2 (Introduction), once a system of Third Stream indicators has been identified the second step in the process of linking metrics to funding decisions is data analysis, and in particular the establishment of a scoring mechanism which could provide support for decisions about funding allocations. One key element of such a scoring system is that it needs to be unrelated to the size of a particular University. The alternative of using 'raw' numbers would result in larger universities having much higher scores for most measures compared to smaller ones. Thus for comparability across universities of different sizes the data need to be scaled. However, after applying the scoring mechanism, the resulting funding formula would have to take into account the size of the University. Thus two universities with identical ('normalised') scores but different sizes would receive different levels of funding.

Further, to generate scores reflecting performance in Third Stream activity it is necessary to combine the indicators collected in a formula to compute the score of each university. Such a formula needs to be simple and transparent as past research (discussed above on page 14) has shown that performance measurement works best

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[34] The preliminary results of the third UK CIS indicate that only a small proportion of firms cite universities as a source of information and even fewer firms have formal collaborative links.

[35] Yet the survey confirms general patterns of university-industry relations that must be taken into account when developing metrics to support funding decisions. The UK CIS shows large differences across sectors in the extent to which universities are identified as sources of information and engaged in collaborative ventures. For instance, science-based sectors such as pharmaceuticals, are clearly much more engaged with universities than traditional industrial sectors.

when people understand how the underlying models work and what indicators influence or shape results (Loch et al. 2001).

A scoring system could be organised in many different ways. In particular it is necessary to address two issues that can affect the final scoring results: the techniques to scale and normalise each indicator and the process to compute scores for each category level when several indicators are used within a category.

3.3.1 Normalisation

A number of different variables can be used to normalise for university size. For example, some of the indicators could be divided by the total number (full-time equivalent) of faculty employed by the university. This figure may be collected from university staff records and it would not be based on the distinctions within faculty that are for instance, contained in the current RAE. Normalising by staff numbers provides a uniform procedure for indicators and therefore reduces the complexity of the scoring system.

Other candidates to be used in a normalisation procedure could be total staff, total university income or the numbers of students. It might also be possible to normalise certain research related indicators by the number of research staff to remove a possible bias against universities with a higher focus on teaching when compared to research. A potential problem with using research staff as a normalising variable lies in the definition of research staff. Within the context of the RAE, different universities have adopted divergent strategies for the definition of who is "research active" among their members of staff, in order to improve their performance. A simple alternative would be to define "research staff" as those members of faculty formally included in the research (rather than teaching) scales, but this would leave out the mass of lecturers and professors on teaching scales who are also research active.

In any case, the final definition of the normalising variable for each indicator should be determined during the process of indicator development. Once an indicator system is in place, a variety of normalising variables can be specified and the implications of using each normalising variable can be assessed and compared in greater detail.

Furthermore, after controlling for size, each indicator will have a different scale. For instance, the number of patents awarded to a university is likely to be much lower than the number of academic papers written in collaboration with non-academic organisations. The scale of co-authored papers is higher than the scale of patent awards. There are different procedures to normalise the indicators so that they are all expressed in similar scales.

A simple approach involves ranking all universities from first to last in any given indicator and then assigning a value to each rank. For example, first place will be 1 while the middle rank will equal 0.5. In the case of highly skewed distributions, this procedure eliminates some of the skew of the original indicator. A normalisation procedure that allows us to preserve any skew in the original distribution is to divide the indicator for a specific university by the maximum value of the indicator across all universities. Thus, the university showing the best performance will have a score of 1, while other universities will have scores between 1 and 0 depending on the value of their indicator.

3.3.2 Computing scores for indicator categories

Each category of our framework will contain a different number of indicators. Thus, if total scores were assigned by simply aggregating the value of all indicators, then the danger is that those categories with more indicators receive a higher weight in the calculation of a final score. To control for this, one could first determine a score for each category by averaging the scores for all normalised indicators within that category.

3.3.3 Aggregate scoring mechanisms: alternative models

The final aggregate score should be reached by combining the category scores for all 12 categories in our framework. We differentiate between three main options for the organisation of such a mechanism. Each of these models is designed to create some flexibility so as to take account of the 'variety of excellence' among the university sector.

Model A – The Set Menu option - Model A treats all indicator groups and universities equally. In this model, each university will be assessed against all the categories of indicators used, with each category being granted the same weight. The strength of this approach is that it is simple and provides a clear mechanism for inter-university comparison. The scoring system is transparent and the opportunities for strategic behaviour are limited, given the large number of indicators being used. If all categories are treated equally, it is difficult to inflate scores by focusing only on a few indicators. The model also has the advantage of ensuring that all types of Third Stream activity are considered in the scoring system. However, the approach does not account for differences in goals and strategies among universities and it does not allow for the weighting of different indicators according to their perceived relative importance. It is a "one-size fits all" approach to measurement.

Model B – Balancing Weighting option – Model B allows individual universities to weight, within certain limits, the importance of each category for their university. One option could be to allow universities to arrange their weights across the 12 categories in our framework using a simple 100 points scoring system: universities would distribute their 100 points across all the categories. For instance, to ensure that all indicators are included in the final score, a "5-point rule" stating that no category could be weighted below 5 of the 100 points could be adopted. This approach would ensure a degree of comparability across universities and that all indicators were taken into account to reach the scores. The advantage of this system is that it allows universities to have some opportunity to set their own Third Stream priorities and then to be measured against them. There is some potential for universities to engage in strategic behaviour by weighting their scores according to their strengths. One option to limit the scope of such behaviour would be to get the universities to set the weights before the collection and analysis of the data. The weights could then be adjusted after a number of years to ensure that the changing priorities of the university are taken into account.

Model C – Type of university option- Model C involves creating three or four different archetypes of universities and then allowing each university to select its archetypal form by which to be measured. A simple archetypal system for universities could be research-intensive, teaching-intensive and community-focused. A university would select one of these types and then be compared to other

universities in this category. Each archetypal category would use a different, predetermined, set of weights, which could be determined among the universities that assign themselves to the group. Another option would be to have external bodies, such as HEFCE or the funding councils, assign the weights across categories for each archetypal form of university. This system would allow for different universities to specialise in different tasks and be measured against these tasks. Its main weaknesses are that the archetypal categories will be arbitrary and that the weighting system for each archetypal form will be difficult to define and agree. The mechanism would also contribute to the reinforcement of divisions within the university sector between different "types" of university and may therefore, be politically impracticable.

Of the three options described above, our preferred option is Model B. This approach would allow for a degree of flexibility in the measurement system, but still ensure some degree of direct comparison between universities. However, all systems described above would need to ensure that all the universities collect the same data for each indicator. This data collection would also need to be based on a common methodology that will have been developed before the scoring mechanisms are implemented.

The results of all the indicator scores could be made publicly available thus allowing for the analysis of the relationship between various university features and performance in Third Stream activities.

In the following section we describe a staged process of how a Third Stream measurement system can be turned into a scoring and ranking mechanism that could shape funding. The scoring mechanisms will be fully developed towards the second half of this process (stages 3 and 4 as described below), and will therefore only be put in place once a set of robust indicators has been tested. This will allow for an accurate analysis of how different systems affect the final scores and rankings (sensitivity testing). Therefore, it would not be appropriate at present to decide on the details of a potential scoring mechanism. Our goal has been to provide some suggestions about alternative models and the implications of adopting them.

3.4 Developing an evidence-based Third Stream funding allocation process: the Next Steps

3.4.1 A four-stage approach to the development of funding formulas

One of the key requirements of the establishment of a funding allocation system is that it takes into consideration the evidence presented by the metrics collected. Such a system should be established over several stages concurrently with the development of metrics and scoring mechanisms described above.

The current system for allocating funds to support Third Stream activities is based on project-based competitions and judgmental decision-making. Although the removal of judgement is not a requirement of evidence-based policy, there could be considerable benefits from ensuring that these judgements are made on the basis of significant evidence. Our aim is to move towards an evidence-based allocation of Third Stream funding. As some evidence is better than no evidence at all, the development of a measurement system for Third Stream activities provides an opportunity to create better informed policy choices.

The development of the measurement system will need to be supported by an explicit government requirement for universities to collect Third Stream activity information. At present, government expects universities to bid for Third Stream funding and in the process, provide information about its activities in different relevant areas. The government is considering taking this process a step further and instigating a process of systematic Third Stream measurement to inform funding decisions. Universities will then have to collect indicators if they want access to these resources: initially, funding will drive data collection. However, as data collection systems become established, the process is likely to reverse: measurements may eventually drive the funding allocations. We suggest that such a move towards an evidence-based allocation system take place over a four-stage implementation process.

Stage 1. Development of a measurement system - In Stage 1, the indicator system will be developed and improved while funding allocations remain largely determined by the independent judgement of a panel. The information inputs to this panel will remain university plans, local and regional development reports and other assessments. In particular, universities will be required to submit a 4-year Third Stream Plan detailing their Third Stream strategy is such a way as to allow the panel to assess its quality. Further, the panel may decide to retain the Third Stream Plan as an input to the decision making process throughout the following stages. The first move towards a more evidential system, requires that the sector stakeholders agree to a common set of indicators of Third Stream activities that would be collected by all UK universities. This system could be based on our conceptual model, and take as a departure point our group of selected indicators, which would need to be further clarified, defined and organised into different sets of data collection instruments. Once agreement is reached on the set of indicators and collection methods, universities would commit themselves to collecting this information over a reasonable time period. The government would also have to provide some incentives for universities to collect such indicators, such as ensuring that future Third Stream funding rounds would be dependent on completion of the indicators. The government would also have to ensure that funding was made available to the universities to support the costs of indicator collection. It is anticipated that this stage would take place over a two to three year time period, during which most of the data collected will not be used for informing funding allocation decisions.

Stage 2 – Mixing evidence with judgement – In Stage 2, the results of the data collection effort will be available to the funding panel. Since some of the indicators are easier to collect than others, it is anticipated that at this stage only some of the indicators will be available to the panel. Yet this information would still provide a critical information input to guide the panel's decision-making. Given the unevenness of the data, it would not be possible to use the numbers to drive the funding allocation process in a deterministic manner; rather they would be used to shape and inform decision-making that will remain largely judgmental. Further refinement of the data collection and analysis instruments may be required as it is common for the first generation of indicator collection to engender unexpected difficulties.

Stage 3 – Evidence-driven judgements – In Stage 3, considerable information should be available on the performance of Third Stream activities across universities. It should be possible to have comparable data from all universities, making it possible

to develop an evidence-driven approach to the funding allocation processes. The Panel could use the data to generate different scenarios for the distribution of funds, using different formulas based on different indicator weights. Each scenario could then be discussed among panel members. The funding allocation would then be based on the panel's judgement of the appropriate set of rankings and funding formulas. At this stage, it will be possible to develop a funding formula that could be carried forward into future rounds of funding.

Stage 4 – Formula-based funding – By Stage 4, it would be possible to use a specific formula to guide funding allocations. Its algorithm would have been developed in Stage 3 and then further refined in Stage 4. In this stage the scoring system could drive funding decisions. One way of doing this would be to establish a scale to group universities according to their scores, and distribute different amounts of funding to each group following formulas similar to those used in the present RAE. However, even under such a mechanistic approach, judgment would not be completely removed from the allocation process: the formula itself would be based on judgements about what was important and what was not. Further, the Third Stream panel would not, in any case, be disbanded. It would, at least, be responsible for overseeing the development of the formula and ensuring that allocations respond sensibly to emerging challenges in the university system. Further, there will always be scope for improving the indicators system. The inclusion of some additional direct impact and quality assessment indicators can, for instance, follow on the construction of a robust system of activity measurement. The Panel will also retain final approval over the allocation of funding across universities and could provide support to universities by suggesting potential avenues to improve their Third Stream performance, advise government on policy, and publish 'good practice' guides for universities to follow.

In our opinion, the movement toward a formula driven system is not a necessary precondition of the development of an effective Third Stream allocation mechanism. Universities and the government may find that the approach used in Stage 3 is sufficiently robust for the allocation of funding. Funding decisions will remain a social process, drawing upon informed judgements. The option of developing a formulaic approach to funding is however, available and could provide a further opportunity to refine the deliberations of a Third Stream panel.

Timing

The development of the Third Stream measurement system would require substantial commitment of time and resources over the medium-term. The amount of time needed for the four stages described above is difficult to estimate, but our judgement is that each stage would take approximately two years to develop. Although this represents, a somewhat long-term vision for Third Stream measurement, we believe that it is necessary to *begin* the process as soon as possible while at the same time avoiding the temptation of rushing into a fully-fledged scoring and funding system without having previously developed a robust measurement system. As in the case of other indicator development projects, the initial steps are the most difficult, and they need to be launched by a determined strategy and considerable up-front investment.

Another timing issue is the frequency of the scoring of Third Stream activities at UK universities. The current RAE is based on five-year intervals, while the teaching

quality assessments and future quality audits take place over a three-year cycle. We would argue that the data collection for Third Stream should be carried out on an annual basis, but the allocation of funding could be based on a longer-term time horizon. Both three or five-year scoring appraisal would be acceptable. The choice between these two timing options could be left to the Third Stream panel to decide. A three-year appraisal cycle would be more flexible than the current RAE, leaving room for entrepreneurial universities to be rewarded for moving quickly in this area and ensuring that funding allocations were sensitive to changes in performance.

3.4.2   The Next Steps

To launch the four-stage process described above a series of initial steps will be necessary. We identify here seven steps that we suggest be taken to start the implementation of Stage 1:

1. Organise a structured debate within the UK higher education community about the next generation of Third Stream funding.

2. Create an inter-university working group with government representatives to agree and develop an initial list of common indicators, an associated data collection manual, and establish the format of the Third Stream Plans that universities will be required to submit (UUK could play a leading role here).

3. Develop and publish a data collection manual, including list of indicators, definitions and guidelines for collection.

4. Convene a Third Stream assessment panel (with representatives from a variety of different UK communities) and use them to guide the development of the initial set of indicators and associated manual.

5. Enlist government financial support for the costs of indicator collection.

6. Prepare and organise internal university systems for new data collection.

7. Establish a time frame for the first round of data collection.

3.4.3   Consequences of developing a Third Stream measurement system and funding formula

The introduction of measurement systems generally helps to encourage behaviour by defining activities that previously went unnoticed or were unusual. Often actors will use the measurement system to guide their behaviour. For example, it is fairly common for firms in an industrial sector to use national levels of R&D spending by sales in their sector, as a guide for their own levels of R&D spending. In the long term, the development of Third Stream indicators could play a similar role in shaping behaviour.

Yet in the long term, the linkage of the measurement systems to funding allocations is likely to generate some new challenges. As we have seen, in the first stages of indicator development funding allocations will remain largely judgmental. But over time and as the data improves, it is possible to move partly towards a funding formula. The experience of the RAE is instructive regarding the implications of such an approach to funding. Over the three generations of the RAE, there has been a tendency for overall improvement in the assessment results. This is a common outcome of the adoption of an assessment system: once something is measured, the

measurements tend to improve.[36] Further, if we were to adopt a scoring model that allowed universities some degree of flexibility in defining the weights attributed to different categories of indicators (like our Models B and C above), universities would be able to focus on their targeted areas and improve their performance relatively quickly. The consequence would be a tendency for scores to converge at the higher levels of the scale.

We expect these patterns of improvement to be exhibited once a Third Stream measurement and scoring system is introduced. Over time, increasing numbers of universities are likely to exhibit better performances. If the overall level of funding for Third Stream activities remains constant (or increases slower than the rate of growth of performance), it is possible that universities will receive lower levels of funding, even if their performance has improved.

As universities improve their performance, it will also become more difficult to rank them. This is happening now in the implementation of the RAE. Recent RAE results confirm that many of the UK science departments are operating at world-leading levels (5* or 5 levels), indicating that there is very little separating these different organisations in their research performance. The RAE experience also teaches us that a 5-point scale is insufficient for performance measure, and its present 7-point scale with five main ranking levels remains largely impenetrable to people outside the UK. This suggests that a scale with several ranking levels is likely to be needed to allow for a finer stratification of different levels of Third Stream performance.

Another important problem facing the adoption of a Third Stream measurement and scoring system is that, by itself, it will not resolve the tension between the desire to reward excellence and the need to build new capabilities. The measurement system will be largely backward looking because only activities carried out in the past can be measured. Yet, if one seeks to build capacity in universities where the amount of Third Stream activities is limited, the metrics and funding systems need to be organised in such a way as to promote performance improvements. It could be possible to use the first year of a fully-fledged measurement system as a baseline and then measure the subsequent performance of each university against this baseline. A funding element could then be linked to performance improvement, thus providing a direct capacity building incentive. In practice, a balance will have to be found between a system that measures and funds performance improvements and one that rewards absolute levels of excellence.

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[36] There are several possible explanations for this pattern. The "Hawthorne effect" states that once something is measured it gains extra attention and therefore increases in size and activity. Other explanations are that incentives do create behaviour and the performance of the system improves in response to these incentives, and that there is a normal process of inflation in assessment systems.

4 Conclusions: Guidelines for the development of a measurement system for Third Stream activities

This section reviews some of the main points and findings of the study. These conclusions can be read as guidelines for the development of a measurement system for Third Stream activities and its use to support funding allocations.

- *The contribution of universities to society is complex, non-linear and self-reinforcing*

The relationships between universities and the rest of society are not easily traceable and involve many small-scale interactions.

- *Universities differ*

There are considerable differences between universities in the UK with regard to Third Stream activities. A measurement system should support a 'variety of excellence' in the UK university system.

- *Disciplines differ*

The type of discipline heavily influences the interaction between academia and the rest of society. In some areas, the link between the university and non-academic activities is very tight. However, in other areas, the link is indirect and channelled through a variety of intermediaries. Indicators need to be sensitive to these disciplinary effects and avoid biases that may reward those disciplines that exhibit the most visible direct link.

- *Adopt a holistic approach*

Third Stream activities involve a wide range of social interactions that cut across many different fields of social and economic activity. A measurement system needs to adopt a holistic approach, taking into account the variety of these interactions.

- *Use a variety of indicators*

There are no magic bullets in indicators of Third Stream activities. A variety of indicators need to be collected. Each of them will, by itself, be incomplete and its interpretation will be open to questioning. Yet when taken together, the result can be a powerful measurement system.

- *Existing indicators are not sufficient*

The current set of measures used to assess the activities in the university system cannot deal with the full extent of Third Stream interactions. A new conceptual framework is necessary that focuses on the wide range of different interactions that bind universities to the rest of society.

- *Commercialisation indicators are not enough*

Indicators of university commercialisation are not a sufficient guide for Third Stream policy. Commercial activities are heavily concentrated in particular disciplines and the returns to commercial activities are highly skewed. On their own, commercialisation indicators are a poor reflection of the overall economic and social benefits of the university sector.

- *Some data is better than no data at all*

We would strongly argue that there is a need for a new system of measurement for Third Stream activities. The current system of allocation is largely judgmental and project-based. The information collected and used in the process of allocation is insufficient and greater attention needs to be placed on developing evidence to drive the process of allocating funding.

- *Start sooner rather than later*

As indicator development is an expensive, time-consuming and difficult process, it is important to begin this process sooner rather than later. Indicators do not collect themselves and a pro-active strategy is required to create the information needed for evidence-driven Third Stream funding allocations.

- *Use existing indicators and practices where possible*

Any new system of Third Stream measurement should build on existing data and practices where possible. Indicator collection can run alongside existing practices and minor adaptations in practices can sometimes generate robust indicators.

- *Indicators must be consistent, comparable and clear*

The development of a measurement system relies on firm definitions of different activities. Indicator development is a process of codification that translates a complex range of activities into clearly defined types that are open to measurement.

- *The devil is in the detail*

Third Stream indicators are difficult to define and develop, and many of the new indicators will need to be further refined before full implementation.

- *Collecting indicators is difficult*

Many Third Stream activities are based on personal connections between individuals, and few universities have detailed knowledge of the type of connections involved. These are therefore hard to measure and indicators in relation to them difficult to collect.

- *Link performance to incentive systems*

Experience from the private sector indicates that performance systems work best when they are linked to incentives. There needs to be a direct link between indicator collection at the level of the department or individual and financial incentives. There is little incentive for individuals and departments to provide information for the university if the funds received as a consequence of the information provided do not appear to benefit them directly.

- *Simple questions, complex implementation*

Even simple indicators can be extremely difficult to operationalise. It is important when developing instruments for data collection to adopt easily understood language and to simplify questions.

- *Soft indicators become harder over time*

In the first instance, many new indicators seem to be extremely soft –judgmental or ill-defined– but over time they can improve and become more accepted. The 'hardness' of an indicator is related to its degree of acceptability rather than simply what it measures. For example, many indicators of science and technology are relatively 'soft', yet are widely accepted (take for instance the innovation indicators in the Community Innovation Survey).

- *Focus on activities*

The approach outlined in this report is activity-based. We have chosen an activity approach because we feel that it is important to focus on positive activities. It would be useful to have impact data, but this is usually too expensive to collect and analyse. Furthermore, impacts are extremely skewed, uncertain and often attributable to serendipity.

- *Action is needed*

Failure to collect a comprehensive, structured and comparable set of Third Stream indicators could have a pernicious effect on the UK university system. The UK government has indicated its intention to build up Third Stream funding as a new source of continuous funding for UK universities (Department of Trade and Industry, 2000). The current approach of the UK government has been to focus only on indicators of the commercialisation of university research. It has also demanded that universities make considerable efforts to bid for this funding, developing strategies and projects. The present approach still overlooks the wide range of different ways in which universities interact with society. The government has also indicated that it wants to shift away from project-based Third Stream funding. In the absence of further indicator development, it is likely that narrow commercial indicators will be used to drive all Third Stream funding allocations. By overemphasising this aspect to the detriment of others, this approach would have grave consequences for the UK university sector and the society they serve.

- *Universities should take the lead*

There will be considerable advantages for the university sector to take a leading role in developing indicators of Third Stream activities. It is necessary for the university sector to help shape the way the government assesses it for the purposes of Third Stream funding. If it fails to take this leadership, it will forego the opportunity of shaping its own future.

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Appendices

Appendix 1 Comprehensive list of potential indicators

Table 2 presents all the indicators we have considered for inclusion in a model to measure Third Stream activities. The table discusses in summary form the strengths and weaknesses of every indicator. A more complete analysis of the issues faced when developing indicators in each of the categories in our framework, can be found in the *An analysis of potential indicators* section of the main text. Indicators marked in light and and dark grey can also be found in our list of suggested indicators (Table 1 in the main text). The shading of the cells has also the same meaning as in Table 1. Light grey shading refers to indicators that are already collected somewhere in one way or another and would require relatively less effort to gather, organise and manage for the purposes of Third Stream measurement. In the darker grey shading we have marked the indicators that will need more effort to collect, but we still consider that their inclusion in a measurement model is feasible. In many cases these are new indicators that will need to be further defined and for which new data collection instruments will be required. Indicators in cells with a white background are those that, at this stage, would either be too difficult to collect or could easily be misinterpreted and therefore, have not been included in Table 1.

Table 2 Potential Indicators

Indicator	Strengths	Weaknesses
Technology commercialisation		
No. of patent applications.	It reflects innovations that are perceived to have a potential commercial value and provides a measure of the rate at which ideas with commercial potential are brought forward. It includes applications in any (national or foreign) patent office. Most of the indicators in this category can be based on the definitions used by the AUTM Survey.	No indication of the social and economic value of the innovations being commercialised, or of the market size and opportunities in the country where the patent is filed. They may provide incentives for universities to file more widely than it would seem appropriate from a commercial point of view.

Indicator	Strengths	Weaknesses
No. of patents awarded.	As above. It provides a measure of the number of patent applications that are granted and therefore can be used as a "quality indicator."	No indication of the social and economic value of the innovations being commercialised, or of the market size and opportunities in the country where the patent is filed.
No. of licences granted (including option agreements).	Reflects demand for innovations generated at universities.	Does not discriminate among licences; despite the knowledge that some licences generate more income than others.
Royalty income (including value of option fees).	Reflects the demand for university innovations. An indicator of commercial success, can therefore be used as an indirect quality measure. Over the medium term the indicator is likely to rather stable.	Distribution of income is very skewed, often with a single licence generating most of the income for a university. Revenue from royalties is also dependent on market conditions beyond the control of university staff.
Median value of royalties (including option fees).	Reflects the demand for university innovations. It controls against the possible bias that can be introduced into income indicators by the possible extreme high value of very few inventions.	
No. of inventions disclosed and/or no. of researchers disclosing inventions.	Direct measure of the number of inventions generated.	The disclosure process is part of the mandated US system. It is not used by British universities.
Indicators on other forms of IPR (copyright, trademarks…).	Important in a number of areas such as software.	Lack of established data, collection methodologies and techniques.
No. of confidentiality/non-disclosure/material transfer agreements.	An indicator of one of the important ways in which US universities commercialise their technology.	The disclosure process is part of the mandated US system. It is not used by British universities.

Indicator	Strengths	Weaknesses
No. of technology licenses and/or option agreements having generated a high, pre-determined level of income.	A more refined measure of economic value of licences and option agreements.	Levels of income from licences are contingent on shifting market conditions, beyond the control of universities.
Patent applications as a % of inventions disclosed. Patents awarded as a % of patent applications.	These ratios can be used to inform the management of Third Stream activities. They can be considered as proxy indicators for the efficiency of specific technology commercialisation activities.	They are not adequate for comparing performance across organisations with very diverging levels of activity.
Technology licenses & option agreements as a % of patents awarded.	These ratios can be used to inform the management of Third Stream activities. They can be considered as proxy indicators for the efficiency of specific technology commercialisation activities.	They are not adequate for comparing performance across organisations with very diverging levels of activity.
No. & value of products brought to market and based on technology licensed from the university. Value of exports of products based on technology licensed from the university.	Direct measure of the economic value of university commercialisation activities.	There is no established methodology to attribute a portion of the market value of a product to specific innovations that have contributed to their development.
No. of licensing, admin professionals and risk managers involved in commercialisation activities. Expenditure on the above. Cost of litigation over infringement of university IPR.	Input indicators focusing on the amount of effort expended to commercialise university intentions.	Their use could generate perverse effects encouraging higher expenditure without concern for results.

Indicator	Strengths	Weaknesses
Entrepreneurial activities		
No. of spin-offs created in the last 5 years.	Spin-offs are defined here as new firms that have financed (partially or fully) from university resources. They are an indicator of university efforts to exploit commercially a broad set of university capabilities and a mechanism for universities to conduct further customer-oriented research.	Does not measure either their size or their economic and social relevance.
No. of current employees in spin-offs created in the last 5 years.	As above. In addition, it provides an indicator for the magnitude of this set of activities.	Growth of spin-offs may be attributable to market conditions or other factors unrelated to university activities.
Turnover/profits from spin-offs and commercial arms.	Measures the direct economic impact of spin-offs and commercial arms. Provides an indicator of the level of contract research that universities channel through commercial arms.	Many new science-based spin-offs can take a long time to generate income. Turnover-based indicators are not, in isolation, adequate to measure spin-off activity. Turnover and profit accruing from commercial arms is difficult to separate from that raised by spin-offs
Development funds and loan facilities provided by universities to support start-ups	Focuses on an important aspect of university entrepreneurial activity. Data of this kind may already be available in some universities. These are metrics under development in institutes funded by the Science Enterprise Challenge	Input indicator. Its use could encourage higher expenditure without concern for outputs.
Equity realisation ("cash-in for equity")	A measure of success in university entrepreneurial activities	Depends on the perceived value of a company and on market conditions. Equity sales are a discrete event: the indicator is likely to be "lumpy". It is likely to

Indicator	Strengths	Weaknesses
		take a long time between a venture is launched and when equity in the venture is realised. It can disadvantage newer technology transfer offices
No. of academic staff holding equity in start-up and/or spin-off companies.	Input indicator that refers to a specific type involvement of academics in entrepreneurial activities, and the extent to which such involvement is widespread.	Direct indicators of spin-off and start-up activity are more adequate as a measurement of entrepreneurial activity.
No. of business plans funded by university financial sources. No. of start-up projects funded by university financial sources.	Input indicators focusing on an important aspect of university entrepreneurial activity. Data of this kind may already be available in some universities.	Input indicators, do not focus on results. Value of the funding is a better indicator of the entrepreneurial effort made by the university.
No. of start-ups founded in the last X years, their employees and turnover.	Start-ups are defined as companies founded by university academics or their students. They are often supported by the university.	The criteria to determine the extent to which a firm established by staff or students can be attributed to Third Stream activities are complex and cannot be operationalised through simple data gathering procedures.
Value of university equity holdings in spin-off companies and commercial arms	Indicator of the economic value (and therefore magnitude) of entrepreneurial activities. Depending on the valuation system used, it could be easier to collect.	Valuation systems differ. Most meaningful valuations will depend on market conditions.

Indicator	Strengths	Weaknesses
Spin-offs survival rates.	Survival rates reflect spin-off success and will be less skewed than turnover or profit measures.	Difficult to develop an operational definition of survival. Firms in trouble may be taken over by other companies or their own management. Requires detailed information on ownership structure over time.

Advisory work

Indicator	Strengths	Weaknesses
No. of invitations to speak at non-academic conferences (conferences in which the majority of participants were not academics). No. of invitations to attend meetings of advisory committee of non academic organisations.	Identifies positive demand and social value of university knowledge capabilities.	Indicator does not reflect the magnitude and importance of the events.
Income from advisory work.	An indicator of the value of this activity.	Biased against unpaid advice (for instance to Parliamentary committees). Some of this income will be personal and the data will be impossible to collect.

Commercialisation and use of university facilities

Indicator	Strengths	Weaknesses
Income derived from leasing/letting/hiring S&T university facilities (laboratories and testing facilities).	Reflects demand for and social value of university facilities.	Biased towards paid use of facilities while there is evidence that external use is not always charged. Too strong an incentive to let research facilities may result in academics and students being driven out of laboratories.

Indicator	Strengths	Weaknesses
Total no. of days spent by external (non-academic) visitors using laboratories and testing facilities without payment.	Identifies demand and social value of university facilities and addresses the bias against unpaid use of facilities that would occur if only income indicators were used.	Data collection can be problematic.
Income derived from leasing/letting/hiring cultural and leisure facilities (e.g. theatres, conference rooms, sport centres).	Reflects demand and social value of university facilities, and provides an incentive for them to be made available to the community.	Biased toward paid use of facilities while there is evidence suggesting that use is not always charged.
Total no. of events run and organised by the university for public benefit.	Reflects activities carried out by the university to contribute to local community welfare.	The success and magnitude of each of these activities are not being considered
Income derived from leasing/letting/hiring of office and library space to industry and social groups.	Reflects demands and social value of university facilities.	Biased toward paid use of facilities and there is evidence that suggests use is not always charged.
Total no. of days spent by external (non-academic) visitors using university office and library facilities without payment.	Identifies demand and social value of university facilities and addresses the bias against unpaid use of income-based indicators.	
Income derived from leasing/letting/hiring accommodation and other residential services.	Measures economic value.	The exploitation of residential real estate is not linked to the research and cultural activities that we consider part of Third Stream activity. Use of indicators of this type could provide incentives for universities to focus on "residential landlord" roles unrelated to their core functions.

Indicator	Strengths	Weaknesses
Total no. of days spent by external (non-academic) visitor using university residential services free of charge.	Identifies social demand for residential property.	Indicator would reflect charitable roles that are unrelated to the Third Stream activities we are trying to measure.

Contract research with non-academic clients

Indicator	Strengths	Weaknesses
Value of contract research carried out by the university.	Identifies the level of non-academic demand for research services from the university. These types of deals would be different from advisory contracts, in that they involve a research element.	The value of this activity is affected by complex market conditions and its distribution is likely to be very skewed with a few deals being of very high value. There may be difficulties in differentiating between contract research and advisory contracts.
No. of contract research deals (excluding follow-on contracts) signed by universities with non-academic organisations.	It compensates for the possibility that a very limited set of activities may account for most of their total value. Considering the number of research deals provides an incentive to improve the diffusion and diversity of research services offered by universities.	Does not indicate the social value of the activities measured. There may be difficulties in differentiating between contract research and advisory contracts. It may lead universities to split large deals into several smaller ones to beef up the indicator.
Number and value of contract research deals carried out through commercial arms.	Contract research carried out through commercial arms can be a very important Third Stream activity.	In practice it can be difficult to distinguish between commercial arms and spin-offs and their activities. The turnover and profits of both types of activities are included as an indicator of entrepreneurial activity (above).
No. and value of contract research deals carried out by academic individuals without using university-related administrative channels.	Such "off-the-books" activities can be substantial in some departments.	Trying to gather this data could be seen as an intrusion in the private affairs of academics. Very difficult to collect. Its inclusion could appear to reward behaviours that are unrelated to university

Indicator	Strengths	Weaknesses
		Third Stream activities.
No. of different non-academic organisations who have signed contract research deals with the university.	It compensates for the possibility that a very limited set of activities may account for most of their total value. By including the number of organisations we introduce an incentive to improve the diffusion and diversity of research services offered by universities.	This indicator would be difficult to operationalise as it is very hard in practice to define what constitutes a different organisation.
Distribution of research contract deals among firms, industrial associations, NGOs, government agencies and other organisations.	These indicators can be useful for management purposes.	They are distributional measures and do not provide aggregate measuremrnt of Third Stream activity.
Average or median length and/or size of research contract deals.	These indicators can be useful for management purposes.	They are distributional measures and do not provide aggregate measurement of Third Stream activity.

Non-academic collaboration in academic research

Indicator	Strengths	Weaknesses
No. of refereed publications authored with non-academics.	Identifies substantial collaboration with non-academics in the production of academic work.	Indicator says little about the quality, magnitude, and social value of the activity.
No. of non-academic organisations collaborating in research projects funded through Research Councils, charities, and the EC Framework Programme	Reflects the degree to which non-academics are involved in academic research projects.	The number of partners alone does not control for the size and magnitude of their collaboration. Also the terms of what constitutes "collaboration" need to be defined.
Value of contributions (both in cash and in-kind) provided by non-academic collaborators in above projects.	Provides an indicator of the volume of the non-academic contribution.	Different techniques can be used to assess the value of in-kind contributions.

Indicator	Strengths	Weaknesses
Flow of academic staff and scientists and technicians		
No. of faculty members taking a temporary position in non-academic organisations.	Reflects a high degree of engagement and collaboration between universities and outside organisations and provide therefore an indicator of Third Stream activity.	
No. of employees from non-academic organisations taking temporary teaching and/or research positions in universities.		
No. of employees from non-academic organisations who have moved to academic jobs in university as a result of collaborations with the university.	Potential impact indicator.	It is very difficult to determine the extent to which the move has been a consequence of previous collaboration, and therefore attributable to Third Stream activities.
No. of faculty who have moved to permanent employment in non-academic organisations as a result of previous collaboration between both organisations.	Potential impact indicator.	It is very difficult to determine the extent to which the move has been a consequence of previous collaboration, and therefore attributable to Third Stream activities.
Student placements and other links with potential employees		
No. of students in sandwich courses and attending internships organised by the university.	Measures a direct way of aligning teaching activities with societal needs.	

Indicator	Strengths	Weaknesses
Active alignment of teaching to economic and societal needs		
No. of credit earning courses established after a direct request from non-academic organisations.	Identifies actions to align teaching capabilities to new social needs.	Requests for the establishment of new courses must be traced and logged. The indicator may be laborious to collect.
No. and % of recent graduates not looking for work 18 months after graduation.	An indirect indicator of the alignment of their training with societal needs and demands.	Too close an alignment with industrial needs may lead to short-termism in the definition of teaching curricula.
Rates of satisfaction among recent graduates and potential employees with the knowledge and sets of skills acquired through the course.	Direct indicators of the extent to which course curricula respond to the needs and expectations of students and future employees.	Data collection will require substantial resources.
No. of postgraduate students directly sponsored by industry.	Provides an indicator of the degree to which specialised postgraduate courses address the needs of industry.	Bias in favour of applied disciplines addressing industrial-related issues (management, engineering).
No. and % of recent graduates working in fields closely related to their university degrees.		Difficulties in arriving at a precise definition of "closely related". Requires tracking of alumni and extensive surveys. Difficult and expensive to collect.
Learning activities		
Income received from non-credit bearing teaching and associated activities (courses, collaborative learning…).	Services to enhance learning in the community outside traditional credit-bearing courses are a key Third Stream activity. The income received from these activities provides an indicator of their size.	There may be a bias in favour of courses targeted to private sector organisations with ample economic resources, and against those aimed at the local community and generating lower levels of income.

Indicator	Strengths	Weaknesses
No. of different institutions that have attended or have taught in non-credit bearing teaching and associated activities.	An indicator of the extent of these activities which focuses on activities targeted to professional audiences. It is not biased against communities with limited economic resources.	May be difficult to collect. Is difficult to define with clarity what constitutes a different institution

Social networking

Indicator	Strengths	Weaknesses
No. of times that academics have attended professional, non-academic conferences (conferences in which the majority of participants were not academics).	This is a proxy indicator of the extent to which academics are involved in professional activities targeted at non-academics and where networking with non-academic communities can take place.	No indication of the relevance of the conference or the type of participation of the academic.
No. of non-academic clubs promoted by the university.	An indicator of formal attempts to establish networks outside academia.	Difficult to arrive at a precise definition of what is meant by a "club".

Non-academic dissemination

Indicator	Strengths	Weaknesses
No. appearances by university academics in regional, national or international TV or radio.	Can be used as a proxy indicator of dissemination outside academia. Audiovisual media reaches audiences far in excess of those reached through publications and therefore provides a key avenue for non-academic dissemination.	There may difficulties in collecting data.
No. of times university or its faculty members are mentioned in broadsheets because of their research and teaching activities.	Can be used as a proxy indicator for the non-academic impact of university teaching and research activities.	The indicator does not discriminate between "positive" and "negative" mentions.

Indicator	Strengths	Weaknesses
No. of non peer-reviewed publications (excluding books and book chapters).	This is a proxy indicator for activities related to the dissemination of university work to non-academic constituencies. Books are excluded because they may be oriented to academic audiences even if they are not peer-reviewed.	There is no weight for the quality or importance of the publication, and its use could provide an incentive to indiscriminately pursue large numbers of small publications in all types of printed media.

Appendix 2: Indicators used in previous studies

Table 3 Indicators in Polt et al. (2001)

Variable	Indicator	Year	Source
Contract and Collaborative research	% of Higher Education R&D financed by industry	1998	OECD
	Significance of R&D consulting with firms by HEI researchers	Mrya	nat. rep.
Co-operation in Innovation Projects	% Innovative enterprises co-operating with HEIs/Public Sector Research Establishments (PSREs)	1994-96	CIS2
Science as Information Source for Industrial Innovation	% Innovative enterprises using HEIs/PSREs as information source	1994-96	CIS2
Mobility of Researchers	% of researchers in HEIs/PSREs moving to industry	Mrya	nat. rep.
	% of HE graduates in industry moving to HEIs/PSREs	Mrya	nat. rep.
Training and Education	Income from vocational training in HEIs as % of R&D expenditures	Mrya	nat. rep.
	Number of students in vocational training in HEIs per R&D employees in HEIs	Mrya	nat. rep.
	Share of students carrying out practices at enterprises during their study (placements, master thesis, PhD programmes etc.)	Mrya	nat. rep.
Patent Applications by Public Science	Patent Applications by HEIs/PSREs (and individual HEI researchers) per 1,000 employees in HEIs	Mrya	nat. rep.
Royalty Incomes	Royalties as a % of total HEI R&D expenditures	Mrya	nat. rep.
Start-ups	Number of technology-based start-ups in HEIs per 1,000 R&D personnel	Mrya	nat. rep.
Informal contacts personal networks	Significance of networks between industry and HEIs (exp. assessment)	Mrya	nat. rep.

Mrya: most recent year available
OECD: Main Science and Technology Indicators, Basic Science and Technology Statistics
CIS2: Community Innovation Surveys II (1997-1998, reference period 1994 to 1996), Eurostat
nat. rep.: national statistics or assessments provided by national experts

Table 4 Indicators used by AUTM survey and US universities' TLOs

l.l.l		*Indicator (by field/department, type of IP ...)*
Inputs		No. of researchers whose work has resulted in a patent application
		No. of researchers whose work has resulted in licences
		No. of researchers that hold equity of firms in which they are directly involved
		No. of licensing professionals (by field of specialisation)
		No. of TLO administrative professionals
		No. of TLO risk manager professionals
		No. of TLO employees
		TLO budget for legal costs
		TLO budget for employees' salaries
		Total TLO budget
		TLO legal costs
		TLO legal costs reimbursed
		Total TLO costs
Outputs	Disclosure	No. of inventions disclosed
	Patenting	No. of patent applications
		No. of patent grants
	Licensing	No. of confidentiality/non-disclosure/material transfer agreements
		No. of technology licenses (by start-up/SME/LE, exclusive/non-exclusive)
		No. of option agreements (by start-up/SME/LE, exclusive/non-exclusive)
	Income	Value of royalties
		No. of licenses whose royalty reached $100.000/1 million
		Value of cash-in for equity
		No. of cash-in for equity reached $100.000/1 million
		Sales of products using licenses
		No. of products using licenses that have become available to market
		No. of products using licenses achieved Federal Agencies approvals
		No. of products using licenses whose sales reached $100.00/1 million sales
		Exports of products using licenses

Sources: Massing (2001), Carlsson et al. (2000), Mowery et al. (2001), Tornatzky (2001), Gray, et al. (2001), AUTM website (http://www.autm.net/indexie.html), and US universities websites (http://www.duke.edu/web/ost/about/aoverview.htm, http://web.mit.edu/tlo/, http://otl.stanford.edu/flash.html, http://www.otm.uiuc.edu/) .

Table 5 Questions used in the Ontario survey on recent graduate placement

Variable	Questions related to[37]
Course characteristics	Course content
	Course was up-to-date
	Overall quality of instruction
	Equipment was up-to-date
	Preparation for job market
	Skills developed in course
Skills developed	Specific job-related knowledge
	Specific job-related skill
	Oral communication
	Written communication
	Comprehension
	Math skills
	Computer skills
	Critical thinking
	Problem solving
	Research and analysis
	Teamwork
	Organisation and planning
	Time management
	Quality of work
	Productivity
	Creative and innovative
	Adaptable
	Responsible

Source: Ministry of Training, Colleges and Universities (2001)

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[37] Respondents are asked to assess each issue using *"satisfied/dissatisfied" and "important /not important" scales.*

Table 6 Indicators used in other studies

Variable	Indicator	Source
Company contacts with university (technique: company survey)	No. interactions (by MIT/other university	Bank of Boston, 1997
	Importance of faculty consulting	Bank of Boston, 1997
	Importance of joint R&D	Bank of Boston, 1997
	Importance of licensing from university	Bank of Boston, 1997
	Importance of continuing professional education	Bank of Boston, 1997
	Importance of recruiting	Bank of Boston, 1997
Determinant of location (technique: firm survey)	Importance of access to labour	Bank of Boston, 1997
	Importance of access to professional	Bank of Boston, 1997
	Importance of access to universities	Bank of Boston, 1997
Technology transfer (technique: 16 case studies)	No. of projects including licensing	Rood, 2000
	No. of projects including cooperative research	Rood, 2000
	No. of projects including personnel exchanges	Rood, 2000
	No. of projects including reimbursable work	Rood, 2000
	No. of projects including use of laboratories	Rood, 2000
	No. of projects including procurement contracts	Rood, 2000
	No. of projects including international tests	Rood, 2000
Movement of people between university and firms (technique: firm survey)	No of student interns hired by firm in the context of formal agreements (by Science & Engineering and non-S&E)	Santoro, et al. 2001
	No. of recent university graduates hired by firm as a direct consequence of university-industry collaboration project or activity (by S&E/non-S&E)	Santoro, et al. 2001
	No. of faculty moved to firm (by S&E/non-S&E)	Santoro, et al. 2001
	No. of firm employees moved to university (by S&E/non-S&E)	Santoro, et al. 2001
	No. of firm employees moved to university as a direct consequence of university-industry collaboration project or activity (by S&E/non-S&E)	Santoro, et al. 2001
Other relations	No. university research centres where firm is member (industry survey)	Adams, et al. 2001
	No. of joint publications	Zucker & Darby, 2001

Appendix 3 Notes of the Steering Committee meeting, London, 26th February 2002

The meeting opened with a frank assessment by the project team of the field of monitoring 'Third Stream' activities in universities: whilst university *commercialisation* activities have been studied and are monitored to a certain extent, many other university contributions to decision-making are poorly understood and, even less, monitored or measured. It is within this context that the first draft of the project report was put together. This meeting was intended to provide an opportunity for the project steering committee and others to give their reactions to the draft.

Reflecting breadth

There was broad agreement that measures of university Third Stream activities needed to reflect the full breadth of such activities, and not simply focus on commercialisation. In addition, the report focused largely on universities' science and technology activities, but indicated that measures should not overlook the contributions made by the social sciences and humanities, for example to the creative industries. Some activities are simply easier to measure, but this does not mean that the other activities are not significant. Therefore the measures being developed needed to reflect the full range of contributions made by universities, including those to the social economy.

Variability across universities

Universities vary considerably, so it would seem difficult or inappropriate to measure performance of Third Stream activities across these institutions on the same basis. Some universities are good at generating new knowledge, while others are effective at communicating knowledge. To capture this variety, one option would be to allow universities to report on their Third Stream activities against their own circumstances and goals. However, on the government side there might be a nervousness about allowing universities to assess themselves on their own goals and to provide funding on that basis. There seemed to be agreement on the need to define a framework within which all universities would report.

Measuring and rewarding impact or effort?

Part of the challenge of reporting Third Stream activities is that measuring the *impact* of university activities is difficult, especially since impact depends heavily on factors beyond their control. Recognition of this might lead to suggestions that universities should be rewarded for their efforts rather than the impacts, but this might lead to 'activity for the sake of it'. Measures will need to capture both aspects.

Measures and rewards

There was some discussion of the use to which information on Third Stream activities would be put. Many at the meeting hoped that within universities the collection and use of information could be aligned with existing management arrangements, partly to minimise the costs of reporting if government does decide to request information from universities on such activities. For government, the question is whether to use the information to reward existing Third Stream activity,

or to set a baseline to promote new activities. There is likely to be a reluctance to 'pay twice', so that anything that generates a return to universities might not be rewarded. Similarly, government is unlikely to wish to pay for activities that academics carry out already for personal benefit, such as advisory work with public profile. These points generated some discussion as to the feasibility of separating the various factors.

Change over time

There was acknowledgement that for some of the indicators that were already, or might be, put forward in the report, universities may not be collecting the necessary information at present. This meant that while the report may suggest some indicators may be difficult to report on in the short term, possibly leading to inaccurate measures, errors can be reduced over time and difficulties ironed out as experience in the definition and collection of these indicators accumulates. Similarly, some of the indicators might be qualitative in the short term, but it might be possible with experience to make these more rigorous and therefore more amenable to benchmarking.

Third Stream and teaching

The report needed to avoid depicting the role of teaching as being an exclusively 'parent-child' kind of relationship. Some of the most significant Third Stream activity in universities is where academics work at a strategic level with their peers in other sectors to learn and collaborate around common puzzles and opportunities, such as in executive education. The measures needed to reflect collaborative arrangements, as such partnerships can be very productive for both sides. Similarly, indicators on mobility of staff need to reflect mobility in both directions and over various lengths of time, to show the full range of relationships.

Quality in Third Stream

There was some discussion about the issue of measuring quality in Third Stream activities. Some were of the opinion that, for example, articles in trade magazines by academics should not be counted since there is no quality control. Others felt that such activities were all a significant part of the picture, and formed important channels through which universities came to make their contributions to decision-making more widely, as well as being indicators of effort in their own right.