Research Partnership

N8 Research Partnership
Sharing for Excellence and Growth

Synthesis Report

Professor Luke Georghiou on behalf of the N8 Research Partnership

The N8 is a partnership of the eight research intensive universities in the North of England: Durham, Lancaster, Leeds, Liverpool, Manchester, Newcastle, Sheffield and York.

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**This synthesis report summarises the main findings from 4 workstrand reports.
All the reports can be found on www.n8research.org.uk**

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Background to the N8 Research Partnership and this project

The N8 Research Partnership is a partnership of the eight research intensive universities in the North of England – Durham, Lancaster, Leeds, Liverpool, Manchester, Newcastle, Sheffield and York. The N8 Research Partnership aims to maximise the impact of this research base by identifying and co-coordinating powerful research teams across the eight universities to work with business and other research users. Our previous work has concentrated on multi partner research in Regenerative Medicine, Molecular Engineering and social sciences. In addition, we have recently launched the N8 Industry Innovation Forum (N8IIF), funded by HEFCE and the Technology Strategy Board, to provide businesses with access to multi-disciplinary research teams and new knowledge and ideas from the N8 research intensive universities.

Following the publication of the Wakeham Review of efficiencies in research funding[1] we established a project, funded by the Engineering and Physical Sciences Research Council, to examine the opportunities, barriers and current best practice in relation to sharing the use of equipment between research groups.

Workstrand 1: Benefits, barriers and cultural factors Leads: Dr Thordis Sveinsdottir, Ms Deborah Cox and Professor Luke Georghiou – University of Manchester
Workstrand 2: Identification of equipment sharing opportunities Leads: Professor Edmund H Linfield, Dr Gavin Burnell, Dr Catherine L Wearing, Mrs Kathy Brownridge, Professor David Hogg – University of Leeds
Workstrand 3: Business models for access and costings
Lead: Professor Mark Rainforth – University of Sheffield
Workstrand 4: Opportunities for optimising use of medium scale facilities
Lead: Professor Tom McLeish – Durham University

This synthesis report summarises the main findings from 4 workstrand reports. All the reports can be found on www.n8research.org.uk

1 RCUK / UUK Task Force (2010) Financial Sustainability and Efficiency in Full Economic Costing of Research in UK Higher Education Institutions – Chair Sir William Wakeham

Executive summary and conclusions

Access to well-maintained and state-of-the-art equipment and infrastructure is crucial to the UK science base and therefore to underpinning national economic competitiveness. In an era of financial constraint it is imperative that public resources are invested wisely and effective use is made of such facilities by the research community and by other end users. This may imply targeted and preferential investment where there is a proven willingness and capacity to work in partnership across institutions. Ensuring optimum usage across collaborating institutions is, therefore, attractive to both the funders and the users of such facilities as a means of ensuring that the nation retains leading-edge capacity.

Sharing of research equipment can offer positive benefits of three main types:
- Creating concentrations of research activity where collaboration between and within universities and with industry can drive excellence and impact in research,
- Increased efficiency by reducing the number of items that need to be purchased and obtaining higher load factors on existing items; and
- Allowing capital items too large for a single institution to be acquired and hence solving the problem of indivisibility of assets.

These benefits can only be obtained if certain pre-conditions are satisfied:
- Trust is built between the holders and users of equipment through common objectives and assurances about treatment of samples and equipment;
- Potential users need to be able to locate the equipment they need and that equipment must have available capacity in the desired period; and
- A governance and management framework needs to be in place to ensure that the additional costs associated with sharing are adequately covered and allocated, service levels clarified, and that intellectual property, health and safety, liability and training issues are organised; and
- Proximity and travel time are factored into the calculation, depending upon the likely frequency, intensity and duration of use.

The work undertaken by the N8 universities, funded by the EPSRC, has made substantial progress in finding ways to lower the barriers to sharing. Key achievements of this project include:
- A substantial upgrade of the quality of databases of equipment and far more efficient searching facilities through the taxonomy;
- Consideration of the requirements for standard cost models that are compatible with current practice;
- Identification of strategic opportunities for high quality science and engineering that would be realisable through investment in shared facilities.
- The project has also shown that an organised approach to research equipment planning can yield substantial additional benefits including creation of foci for working with business, catalysing wider rationalisation of approaches to equipment intensive science and opening of opportunities for collective (and cheaper) procurement, training and service contracts.

However, it is important to recognise that, even with highly efficient arrangements in place, sharing can only succeed if the circumstances are right:
- Sharing inevitably involves substantial transaction costs which are only in part sensitive to the scale of equipment investment under consideration – for example, access arrangements and the provision of technicians for longer hours to create availability are both largely fixed costs irrespective of the size of equipment under consideration;
- Hence, sharing is far more likely to be an economic proposition when larger items are under consideration. There is no fixed cut-off as maintenance and other requirements vary but it is unlikely that equipment below a threshold of between £200-500k will be viable for anything beyond casual opportunities.

Incentives need to be balanced across all parties to sharing:

- For funders it is clear that the prime incentive is to reduce duplication nationally and hence the level of demand for support, freeing up scarce resources for other investments. It is also likely that funders will welcome synergies arising from interdisciplinary combinations or increased critical mass coalescing around shared facilities. It is critical however that in pursuing this agenda the funders avoid the pitfalls of reducing capital costs by transferring them to the institutions they support in the form of high operating costs. A second pitfall to avoid is the creation of 'forced marriages' where those involved have neither the desire nor the capability to work effectively in a common facility.
- The complexity involved in achieving efficient and effective sharing arrangements suggests that it is likely that it will take some time to develop a sharing culture and to optimise practical arrangements. An analogous experience was the introduction of collaborative research in the 1980s. At that time it was accepted by government that a level of subsidy was needed to cover the additional costs involved while researchers moved up the learning curve. In the current situation two incentives are very important to ensuring that a sharing culture takes root:
  - Funders meeting the full capital costs of shared facilities rather than expecting institutional contributions (this removes for the time being a complex issue of how such contributions would be allocated in the light of potential benefits (or costs) of hosting the facility, and of different levels of usage between the participants); and
  - Funders ensuring that access and coordination costs are an allowable expense both for hosts and visitors to a facility.

Institutions and researchers are also beneficiaries through an increased access to facilities compared with what would otherwise have been possible at the given resource level. However, here too actions are necessary to ensure that the benefits are realised:

- Institutions need to have proactive policies for research equipment which ensure that registers are kept up to date and that acquisitions are aligned with the strategies of the relevant research areas.
- They should provide support for those who seek to build the kind of collaborative approaches that create the levels of social capital needed for sharing to thrive. Systems to facilitate sharing should be non-bureaucratic and non-discriminatory in terms of treatment of researchers from outside the holders' group; and
- Expectations need to be managed. Sharing is not a panacea and the approaches we have developed and advocate are complex to implement. Cultural change will take time to implement and in many cases models improve but do not fully resolve the financial challenges.

This report has been based on the experience of N8 universities in the past year. From the perspective of those involved it has been a valuable experience that is already yielding clear benefits. Key factors in realising these include:

- A standing collaboration with high levels of trust, good communication and a management resource that has allowed rapid decision-making when opportunities have emerged;
- Senior management commitment to the project combined with buy-in from those at the operational level;
- Practical encouragement and support from the funding bodies;
- Discovery as the project has proceeded that this approach also facilitates working with industry;
- A focus on key areas where there are clearly realisable benefits and the engagement of leading researchers in those areas.

The first of these factors represents a substantial past investment of time and commitment by N8 institutions. The others are more rapidly available to all who choose to go down this path. We would hope that other institutions and groupings of institutions can benefit from our experience in the broader national interest. We are working actively with groups in other regions to explore the possibilities for establishing compatibility in databases and the associated taxonomy. There is no enthusiasm for any kind of national database or a view of any equipment below the level of large facilities to be seen as a resource to be deployed centrally. Discussions with other leading research universities have indicated a strong consensus that this bottom-up approach is the way forward. It is core to the progress of science that equipment in the end should be under the control of those closest to the research that makes use of it.

The N8 project, funded by the EPSRC, has delivered a number of tangible benefits. It has also created the first step towards a new way of working, from looking at asset sharing, to exploring new research strategies and the overall ecology of opportunities to develop new science. We will be taking this work forward in a number of ways including creating academic teams to develop the research, human capital and infrastructure opportunities in a small number of strategically important areas of common interest.

Our work on the sharing of equipment has generated enthusiasm and a strong belief that it will be beneficial to N8 universities. However, moving forward is a step by step process which would be damaged by forcing the pace. Benefits will take time to realise and should be seen not as a rationale for capital cuts but as a means to combine mitigation with performance of better top-class research.

1. Introduction – the role of research equipment and the challenge of sharing

1.1 The core role of equipment and the current policy context

The advance of science has been closely bound with the development and availability of instruments and facilities. The competitive position of the national science base in turn requires that researchers are equipped with up-to-date instruments of high quality. Such capability enables the science base to support the national goals of competitiveness, economic growth, well-being and sustainability both through its own work and in collaboration with industry. During the current period of severe financial constraint it is essential that the best use is made of research capital assets. This report describes work done by members of the N8 research partnership to develop a strategic approach to regional assets and to identify the circumstances under which sharing of equipment can provide efficiencies and catalyse opportunities for development.

The context of research equipment is highly dynamic. The long term trend of sophistication has led to rising costs of remaining at the front in science even though innovation in instrumentation has led to dramatic falls in the cost of achieving a given effect (for example the degree of resolution). These innovations have led to spectacular gains in productivity driven by automation – for example in areas such as DNA sequencing. Over a long period there has been an extension of the range of capital intensive approaches to research from traditionally intensive areas of Physics and Chemistry to areas such as biological and medical sciences, environmental sciences and engineering.

More recently equipment has provided a focus for interdisciplinary collaborations as there has been a convergence in requirements around areas such as imaging. A further trend has been the emergence of highly networked equipment systems (including but not confined to computing facilities) not tied to a single location.

Over the years, especially in times of economic constraint, capital funding has tended to be subject to additional restrictions, for example funding bodies imposing requirements for matched funding from industry or from institution's own resources. The current severe restrictions on capital funding (for RCUK an initial 53% reduction in capital allocation in the first year) have resulted in an impetus towards greater efficiency in the use and deployment of equipment. The RCUK/UUK Task Group on financial sustainability and efficiency recommended:

"...greater intensity of utilisation of assets by HEIs should be encouraged, particularly the sharing of research equipment and facilities." [1]

The implementation of this recommendation was set out in March 2011 in the RCUK document *Ensuring Excellence with Impact* [2] which introduced a requirement for all applications for equipment below the Official Journal of the European Union threshold (€125,000 net of VAT) to be subject to both an evaluation of the use of existing relevant capital assets and to a contribution of a percentage of the cost from non-Research Council funding. For items above that threshold a business case is required including consideration of how the investment fits with departmental, regional and national strategy, with an indication that investments will be made strategically across the research base. RCUK stated that it would work with the research community to develop methods of pooling resources in the best location.

1 Report of RCUK/UUK Task Group on Financial Sustainability and Efficiency in Full Economic Costing of Research in UK Higher Education Institutions, June 2010, Para 81.

2 RCUK, Efficiency 2011-2015: Ensuring Excellence with Impact, March 2011

Since that time there have been occasional amounts of additional capital made available, often at short notice. This has emphasised the need for a strategy to be in place to guide such allocations, both among institutions and nationally. RCUK has consulted on the production of a Capital Investment Roadmap to inform the "identification, prioritisation and timely realisation of key capital investments".

1.2 The N8 Project

In the context of the policy developments described above and following on from its existing programme of collaborative research activities, the N8 group decided to explore the possibilities for inter-institutional equipment sharing strategies that would support its research strategy and ensure compliance with the funders' requirements. The project has been supported by a substantial contribution from EPSRC institutional funding, awarded to those universities with which it has framework agreements. This support is gratefully acknowledged.

Figure 1 N8: Sharing for Excellence and Growth

Figure 1 summarises the elements and objectives of this work. At the base of the triangle are activities to develop the capability to overcome barriers to sharing, and to facilitate the practice through shared access to asset registers and effective business models. In the middle are activities to develop strategic approaches to selected areas and types of facility while the top indicates the objectives being pursued through this approach. A full description of the project, its workstrands and investigators is given in Annex 1.

1.3 Sharing Equipment

Sharing of equipment is a normal part of the practice of science (for example in the context of collaborative research projects) but in order to treat the subject systematically it is necessary to separate the main types of circumstance in which this takes place. Broadly speaking sharing can be understood as taking place at three levels:

- Casual access – where researchers are allowed occasional use of spare capacity on assets principally used by other researchers;

- Shared ownership – whereby assets are acquired jointly by or on behalf of more than one research team, possibly across institutions, with an explicit intention for joint use; and
- Central national or regional facilities which provide controlled access or research services.

It is also the case that sharing of equipment takes place in industrial R&D as companies seek to maximise the use of their assets, and in public laboratories.

A number of previous studies have addressed the issue of sharing of equipment including the PREST/CASR national equipment surveys of 1989 and 1996. [3,4] A specific follow up to the first of these national assessments on the sharing issue had found that there was limited scope for unlocking underutilised capacity without significant organisational change. [5] A structural barrier was that equipment with spare capacity tended to be older and with poorer technical capabilities. The study had also indicated that costs and barriers, principally those associated with managing access, meant that the benefits of sharing could normally only be realised for higher value items where the effective capital cost reduction offset the operating costs.

Given the age of these studies it was decided to revisit the issue of barriers and benefits from sharing and at the same time to commence work on solutions to some key logistical issues, notably the identification of equipment with capacity for sharing and the preparation of a workable business model to govern the arrangements. These issues are pursued in the following three chapters.

2. Benefits, barriers and cultural factors

Issues connected to the sharing of research equipment were explored through interviews with 24 staff in N8 universities including academics in the fields of Chemistry, Biology and Marine Science, experimental officers and finance staff. Two interviews were also conducted with representatives of multinational companies engaged in equipment sharing relationships with universities. The interviews offered the opportunity not only to explore the direct experiences of researchers but also the perceptions and cultural factors surrounding sharing. Some points are illustrated by quotations which, unless otherwise indicated, are from researchers in N8 Universities.

2.1 Current sharing arrangements

The interviewees confirmed that most sharing arrangements fall within one of three types corresponding broadly to those identified in the previous section:

2.1.1 Ad hoc sharing

'Within our research group we hold research equipment in common and we share that equipment quite freely, we have no barriers. If one of my colleagues' PhD students wants to use my cryostat that is fine. Then there are pieces of equipment that are the groups' equipment and we have all contributed work towards a grant to get it.'

Researchers that work in research groups within universities tend to share equipment with colleagues who work within the same group, department or faculty and sometimes across department and faculties. In some instances there was evidence of sharing across universities,

3 Georghiou, L., Halfpenny, P. and Hinder, S. Survey of Academic Research Equipment in the United Kingdom, Report to the Advisory Board for Research Councils, University of Manchester November 1989.
4 Georghiou, L., Halfpenny, P., Nedeva, M., Evans, J. and Hinder, S, Survey of Research Equipment in United Kingdom Universities, Report to Committee of Vice-Chancellors and Principals, HEFCE, HEFCW and SHEFC, June 1986
5 Halfpenny, P., Georghiou, L. and Yates, J., The Scope for Increased Sharing of Academic Research Equipment, in Irvine, J et al (ed) Equipping Science for the 21st Century, Edward Elgar: Cheltenham (1997)

although these tended to take place within longstanding collaboration networks or relationships. These sharing arrangements have developed over time and scientists are generally extremely positive about sharing their equipment with people they know and trust. Most of the sharing within smaller research groups tended to take place ad hoc and be only minimally managed. More often than not some correspondence, a telephone call or an email was enough to request time on a piece of equipment. Bookings were mostly made by pen and paper, as online booking systems are costly and time consuming to set up. The smaller the research unit the greater the sense of ownership tended to be and the issue of trust become more important. The piece of equipment was thus attributed to a scientist, usually the Principal Investigator on the grant proposal for that specific equipment and he or she oversaw management and time sharing.

2.1.2 Shared ownership

'The time when you have most problems is when you have communal equipment, which are things like spectrometers. We have a bigger lab upstairs where we prepare our samples; we actually share that lab with three other academic colleagues. However, the problem with any shared communal area is that you will have one messy person who does not clear up after themselves so you end up with a messy lab very quickly.'

The sharing model where two or more departments or faculties owned equipment together was also evident. A sense of ownership became less strong in these cases and a scientist commented that this was in some instances not entirely positive as this led the equipment to go largely neglected and common spaces around this equipment became run down and if things were damaged they were not quickly replaced or fixed. This indicates that feelings of personal ownership are not always a negative factor and can be helpful in managing and maintaining scientific equipment to a good standard.

2.1.3 Central facilities

The third model of sharing identified was that of shared research facilities. In these instances equipment was grouped together within a shared central facility. All bookings were managed centrally and dedicated support staff were on hand to assist with use and provide training for users. Scientists who worked at these facilities reported high satisfaction rates amongst users and the scientists we interviewed, that had used such facilities, were generally happy with their experiences. Both staff and users attributed the high satisfaction rate to the neutrality (absence of feelings of ownership) of the site, high end equipment on offer and dedicated and knowledgeable support staff on hand to run experiments, assist scientists or provide training. The issue of support staff arose in all the interviews we conducted with researchers, experimental officers and facilities managers who all claimed that having support staff to run, maintain and offer services to users was key to successfully sharing equipment across universities.

A flat hourly rate is most often charged to university researchers and commercial rates are applied to private and industry users. A facilities manager at one central facility described to us how this can potentially cause tensions if researchers perceive that commercial users are being given priority of access due to generating more income for the facility. The running of a high end equipment facility is expensive and income generation is important for continuing to offer good quality service and access to well-maintained equipment. Consequently there can be a tension between doing good science and generating income.

2.1.4 Equipment pools

This model of sharing was used by scientists within the marine science field. This field of research has a longstanding history of equipment sharing where large items such as large marine research vessels and remote controlled research data gathering submarines are available for loan for extended periods of time to scientists who are funded to undertake marine research in the UK. Some of the equipment is also available to international researchers who are involved in research collaboration networks. This ease of sharing is due to the fact that in some cases the equipment is not tied to a specific location. The international nature of marine research, international collaboration and visiting scholars means that shared equipment and data are high on the agenda and are seen as crucial for successful research within the field. A significant point emerging from the conversations with the marine scientists is that their fields of study are essentially national and international and so much of their equipment sharing transcends regional boundaries and cannot be restricted to a geographical limitation.

2.2 Possible Benefits of and Barriers to equipment sharing

2.2.1 Cost Barriers

One of the key concerns that academics expressed over increased sharing of equipment was that higher costs would be incurred. These were associated with increased maintenance, increasing use of consumables, and the hiring of extra staff for services and support. Academics were also concerned with increasing workload for their existing staff, that would be spent on assisting other, and sometimes, competing academics within their dedicated field. All academics we spoke to agreed that the key to successful sharing was having available dedicated support staff to train users, oversee that health and safety requirements were adhered to and assist with experiments. Academics agreed that it was not only the equipment itself that was needed for sharing purposes. Visiting academics would need additional space, such as laboratory space to prepare samples and office space where they could work whilst waiting for measurements and experiments to run their course. Academics also inquired as to how overnight stays and travel would be funded.

2.2.2 The culture of science and psychology of ownership

Science as a practice and the culture of science was frequently mentioned throughout the academic interviews. These mainly fall within two discursive strands:

The pursuit of science
'One thing I have always believed is that if you have good equipment to do science and someone wants to use it you should let them use it. I am here to do science, not to make profits.'

Equipment sharing was frequently mentioned as an important component of the work of doing good science. Academics speculated that an increase in sharing would mean that state-of-the-art equipment would now be available to a larger group of scientists than before and that sharing could increase collaboration within and also between disciplines. The academics who were positive about sharing (mostly those who worked at large scale facilities) spoke frequently of their vision of doing good science, and how sharing would further this agenda.

Science as a competition
'Am I going to have an academic benefit, am I going to have a paper out of it? If so, what is the value of that paper to me? Is it just me getting an acknowledgement in the paper somewhere, which is valueless or is it going to be a co-authored paper? If so, what kind of an impact type journal? Is it going to endanger my own PhD students' progress because now they don´t have enough time on the equipment?'

The recognition of science as a competitive field was mentioned by some academics. These admissions mostly came about when discussing the perceived burden that would inevitably follow increased sharing. This was seen as possibly impeding and slowing down the scientists' work and on the whole their research groups' work overall. They foresee a large part of their work, when sharing has been implemented, as being taken up by managerial and administrative tasks, and assisting visiting academics. They do not immediately recognise any benefits for themselves arising from this endeavour. Some mentioned that REF credits would not be awarded, co-publishing would not arise from most of this work so the measurable outcome for them was unclear. They made their wish clear and that was to work uninterrupted on their science.

2.2.3 Trust

'I suppose it is about, do you trust them enough so you can send your PhD students there and say 'go run this experiment' and you would be confident that they would come back and everything had happened. Also, if I ring up Manchester and say 'can we come and do an experiment' I would hope that they could actually fix up a time when I can do it, within the next three weeks rather than six months' time.'

Trust appeared as very important potential barrier to implementing greater sharing of scientific equipment successfully. Visiting academics spoke of trust in that they would worry that their PhD students and post-doctoral researchers would not be well assisted in their experiments, and whether the equipment would be up-to-date, well maintained and fully working once they arrived. The academics, who foresee welcoming other academics into their lab spaces spoke of trust in that they would wish for visitors to treat their laboratory space with respect, use the equipment as instructed and not damage anything. The academics who were most concerned with the thought of others visiting their lab and using their equipment were those who currently work in smaller research groups and are used to sharing only with people they have collaborated with previously. They also mentioned concerns over whether they would now have to be more careful in their own lab due to issues of confidentiality of data and IP theft.

2.2.4 Ownership and personalisation

'But basically this is my cryostat because I put in the work into getting it.'

There were very few mentions that could be interpreted as strong feelings of equipment ownership in the interviews throughout. There were however brief mentions of ownership in the sense that scientists may see equipment they have bought on a grant as theirs and therefore they see themselves as responsible for that piece of kit. Few academics we spoke to actually admitted to strong feelings of ownership in the sense that they would in any way hinder or deny other scientists access to their equipment outright. However, a few academics referred to an act that one of them called a 'soft denial', whereby a request from an outsider for use or measurement would be put to the back of the job queue and potentially then forgotten. It is difficult to ascertain how strong feelings of ownership are in interviews, due to scientists presenting socially acceptable answers regarding being good practitioners of science, rather than what they actually think and do. Interestingly, when issues of ownership arose in interviews some of the researchers discussed in a third person manner and described a stereotype of a old fussy academic who worked largely alone and would not allow others to use his equipment. Most academics attributed this attitude to be a child of its time and said that most of the younger generation of researchers are accustomed to sharing and collaborations in the name of science. Leaving aside ageist implications, the impression is of a spectrum of attitudes and behaviours. It is therefore difficult to provide a definitive answer on the issue of ownership and personalisation, without further research, but we would recommend that researchers' views and feelings toward their workplace and the equipment they use be kept in mind when implementing sharing instructions.

2.3 Logistical Barriers

Concern over sharing was expressed about equipment where there was a need to use it frequently. It was clear that one size will not fit all when it comes to implementing increased sharing demands. Some equipment is needed locally as the researchers will use that equipment on a daily basis. Furthermore, academics stressed that the fact that universities have a teaching obligation and to meet this, equipment for teaching students would be necessary at each department or faculty for the purposes of training undergraduate and postgraduate students.

In some instances equipment may be highly unsuitable for sharing, although it is not being used to its full capacity. Lasers for example take a long time to set up and fine tune for specific experiments. Experiments requiring lasers can last for months and although the laser is not being used every day during these months, sharing would require their re-calibration, which can take weeks or even months.

Interviewees stated that they would be willing to undertake more travel to do their work but only if certain criteria are met. Scientists are willing to travel for using high end and state-of-the-art equipment. They also want to see fully functional equipment that is well maintained. They want to be sure that there will be dedicated staff on hand to help them or train them in the use of equipment. They want to visit and send students to places where all health and safety checks have been made. They also want to know whether this increased travel and in some cases accommodation for overnight experiments is fully funded.

2.4 Equipment Sharing with the Private Sector

Industry representatives within multinational companies whose work is reliant on state-of-the-art research equipment, expressed general enthusiasm for greater equipment sharing with Universities. This was driven by the desire for enhancing collaboration and a drive to keep costs of equipment purchasing and maintenance down. The fast pace of technological developments is making equipment obsolescent faster (for example in biology and gene sequencing) and hence more expensive to continue to acquire. While depreciation within the specific companies is over seven years, obsolescence of high end equipment was typically within 2-3 years. In consequence the companies are now looking to increase the amount of sharing with universities. In one case a company collaborated in a joint bid to regional funding and the equipment was bought through a shared investment model. One of the corporations currently also shares equipment within its own sites in Europe and occasionally sends samples further afield to their sites in China, US or India. Lower level generic equipment would typically be duplicated on each site for easy access while larger and high end equipment is shared.

A further strong driver is the wish to share the maintenance, infrastructure and staff including support to maintain and operate the equipment, and also computational and IT support, data protection processing and storage. Industry representatives also pointed towards increasing costs arising from risk assessments and health and safety, and training costs arising from each piece of equipment purchased.

2.5 Benefits of sharing

In summary the benefits of sharing equipment fall into three categories:

- Creating concentrations of research activity where collaboration between and within universities and with industry can drive excellence and impact in research. Sharing can itself stimulate synergetic gains through bringing different teams, possibly from different disciplines together;

- Increased efficiency by reducing the number of items that need to be purchased and obtaining higher load factors on existing items, in effect sweating the assets to maximum effect; and
- Allowing capital items too large for a single institution to be acquired and hence solving the problem of indivisibility of assets.

All of these benefits are available in principle for inter-institutional sharing but additional work needs to be done to match, or in many cases exceed, the standardisation of practice that would exist within a single organisation. Past studies and our own work indicate that the circumstances in which sharing is most likely to occur involve 'neutral assets', that is equipment acquired for the purpose of collective use: large items, so that capital savings can offset additional operating costs, and sharing that takes place in the context of cooperation so that those involved feel and obligation to each other and to the successful operation of the sharing arrangements. Ideally such cooperation should be anchored in a high-level framework agreement and be mirrored by co-working at the operational level. The N8 approach has sought to engage at both of these levels and in addition to ensure complementary cooperation among the relevant administrative levels.

3. Identification of equipment sharing opportunities

Any system to share equipment within or across institutions requires knowledge of what is available. While research groups or departments could be assumed to know what was in their possession, many institutions have kept records only at the point of purchase or in some cases for insurance purposes. These could mix research equipment with other capital assets and were prone to inconsistent labelling of the entries, for example varying between functional, type, model and manufacturer based descriptors. Against this background it was essential for the N8 project to regularise databases of equipment.

Workstrand 2 led by the University of Leeds was aimed at constructing a taxonomy that could classify equipment items by primary function. It was envisaged that asset register schema would be refined and augmented to facilitate use of asset registers as tools for researchers to identify existing capabilities and capacities. Asset register schema would also allow identification of strengths and weaknesses in the functional spectrum of the regional equipment base, together with possibilities for shared support and maintenance. Furthermore, the development of web based tools would allow distributed maintenance of technical descriptions of capabilities and specifications of equipment, and to present views of the asset register (appropriately filtered) to external bodies such as partner Universities, funding bodies and the private sector.

The approach consisted of three key activities:

1. Classification of existing equipment into the taxonomy, adjusting and augmenting the taxonomy as necessary through negotiation with key equipment stakeholders to ensure relevance for all academic disciplines.
2. Implementation and refinement of the data schema required to support better use of the asset register by the researcher community and as a Management Information Systems (MIS) tool.
3. Implementation of web based front ends that would: (a) support update of technical information about equipment items by research staff responsible for this equipment, and (b) provide user-friendly searches on the asset register customised for appropriate target audiences, including both internal and external academic users, and the private sector.

These in turn led to three principal outcomes:

- An agreed taxonomy for the N8 to classify research equipment by primary function;
- A standard data schema to represent equipment in a common format across the N8;
- A web based front end to present equipment assets both to the N8 and the private sector.

3.1 Development of the three-level taxonomy

A three-level taxonomy was developed at the University of Leeds, and verified by implementation to all research equipment (>1100 items in total) of >£25k value within the Institution. Details were then supplied to N8 partners. The top level ('class') in the taxonomy describes the general stage of experimental process e.g. sample production, materials characterisation, specific sample analysis. The second level 'order' classifies by a broad approach or group of techniques e.g. spectroscopy, surface probe microscopy, cryogenic measurement. The final level 'genus' identifies a specific technique or instrument type e.g. uv-spectroscopy, atomic force microscopy. An iterative optimisation of the taxonomy was then undertaken, with feedback from partners requested, received, and implemented. The current version of the N8 taxonomy is now completed and in use by N8 partners. However, as new equipment becomes available, there will always be an on-going need for any taxonomy to be refined and updated.

3.2 Development of common data schema

Table 1. Common Data Schema

Data Field	Description
Manufacturer	
Model Number	
Technical Identifier	A free text field that is used for a local name that distinguishes between similar equipment items.
Is a sub-part of a larger instrument/facility	Identifies whether this equipment item is part of another (larger) equipment item or facility and which facility.
Description	Free text
Classification	One or more genera from the taxonomy
Images	
Other Documents	User manuals, sample results, extended descriptions.
Host Organisation	Academic school or research unit in which instrument is housed.
Academic Manager and contact details	Academic with overall management responsibility for the equipment item, including access e.g. PI on purchasing grant and their email and telephone contact details.
Technical Contact and contact details	Experimental officer, technician or PDRA who can answer specific technical questions about the equipment item and their email and telephone contact details.
Campus	

For future sharing of equipment assets, it was considered essential that all institutions utilise a common data schema for information that they are prepared to make externally visible. An agreed common N8 data schema is shown in Table 1. It was recognized that each individual institution would also hold its own specific information about their equipment assets (e.g. cost, location, etc), which would not be made externally available, and would vary from institution to institution.

3.3 Web-based searching

3.3.1 University of Leeds implementation

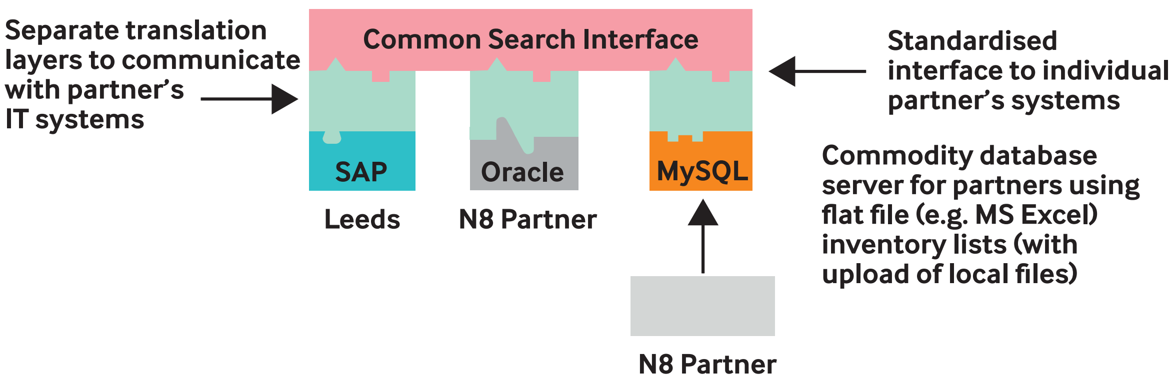
Exploitation of the taxonomy and database to search for equipment items is greatly facilitated by a web-based interface. An initial implementation at Leeds used proprietary software (Qlickview) that was not available to all partners. A web-based front end was thus developed https://esms.leeds.ac.uk/, and made available externally on 24th April 2012. Any organisation can now search for high-value (>£25k) items of research equipment at the University of Leeds. The site gives the ability to search for equipment either through the three-level taxonomy, or through the common N8 data schema. In addition, it provides researchers the opportunity to upload inter alia photographs, videos, key publications/notes, and a description of the equipment. This provides an additional resource for identifying pieces of equipment suitable for sharing across the N8, and beyond. It should also allow the SAP-based inventory to act as the data source for School/Faculty marketing, and avoid promoting equipment in isolation.

3.3.2 N8 Common Searchable Research Equipment System

In order to capitalise on a common taxonomy and common data schema, methods need to be developed for searching the complete N8 assets register with a single, searchable system. This would, inter alia, allow the advantages of equipment clustering identified within the University of Leeds to be replicated on a far wider scale. In developing a solution, it is felt important that each partner institution retains control over their own inventory data and has some flexibility in local policies as to when and how research inventory data is made available. It is also important that the proposed route is based on existing corporate information systems where in use or alternatively using commodity database systems.

The core of the proposed solution is a shared web-based front end that could be hosted on a dedicated, non-institution specific domain. This will communicate using a well defined and published software interface to each participating partner's research equipment inventory system. Results of the search will conform to the published data schema (essentially the agreed N8 Core Inventory Schema) allowing results from all partners to be collated and displayed in a single search interface. The overall scheme is illustrated schematically in Figure 2.

Figure 2. Schematic overview of system with searchable front end, common software interface to partners, individual translation layers to corporate MIS and provision of a simple commodity database for partners using flat file inventory lists.

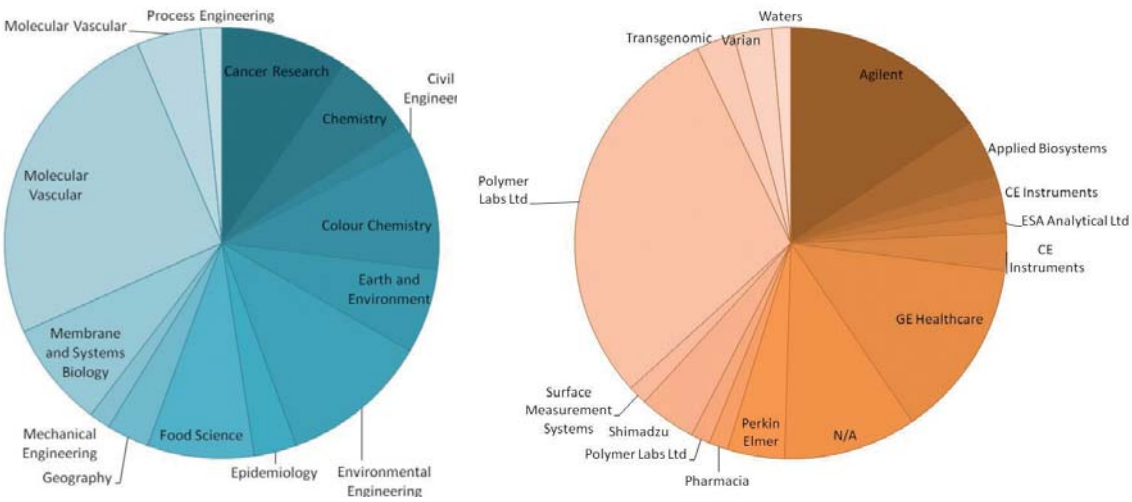


To take this forward, in the first instance, the Universities of Leeds, Manchester and Sheffield have agreed to work together to produce a common searchable research equipment system. Recognising that the benefits of this approach extend beyond the N8 partnership, a follow-on project supported by RCUK with participation from members of other regional groupings of universities will seek to demonstrate an inter-regional inventory system and explore related issues and opportunities on a national scale.

3.4 Additional applications of the taxonomy in asset management

The implementation of the taxonomy and searchable inventory at Leeds has enabled strategies to be developed for more efficient use of assets. For example estimates can be made of lifetimes of equipment. Snapshots can be taken of the distribution of equipment with similar functionality ('clusters' –groups of similar equipment at the 'genus' level of the taxonomy). As an initial step, clusters of equipment users were identified in: chromatography, scanning probe microscopy; x-ray diffraction; scanning electron microscopy; Raman and mass spectrometry. In each there are multiple systems (with different functionalities) across the Institution, and there are users from multiple Schools/Institutes/Faculties. For example, Figure 3 shows graphs indicating the distribution of instruments across the organization, and by manufacturer. These were used to stimulate cluster meetings between users from a range of fields to explore the possibilities of a more effective use of equipment across the campus. Scope was identified for joint bids, shared technical support and service contracts with follow up cross-cluster equipment workshops and training courses.

Figure 3. Pie Charts showing the distribution of Chromatography equipment (n=63) at the University of Leeds by a) School and b) Manufacturer



a) **b)**

4. Business models and costing

An effective sharing system requires that costs should be clearly identified and allocated in a way that all parties regard as equitable. Experience already existed across institutions of charging research project costs to Small Research Facilities and Major Research Facilities as defined by the TRAC (Transparent Approach to Costing) methodology. The task for Workstrand 3 led by the University of Sheffield was to explore the characteristics of a viable cost model based on case studies of existing practice. These both indicate good solutions and highlight problems – very much the reality of managing facilities. This chapter first discusses the requirements. It then presents the basis of a single cost model that has been designed to allow sufficient flexibility to accommodate differences across types of facility. Two case studies from Sheffield are used to illustrate the model and also to highlight the difficulties in achieving a fully sustainable operation based on charging. A further case study of the Bioscience Technology Facility at the University of York adds a user perspective.

4.1 Requirements for business models

A framework for characterising business models is presented here with five key elements:

- Charging models;
- Access;
- Legal arrangements;
- Technical arrangements; and
- Administrative arrangements.

These are reviewed in turn. The framework also includes the culture surrounding the use of the facility, an issue already covered in Chapter 2.

4.1.1 Charging models

The first set of issues to examine concerns the methods for calculating clear, sustainable, and fair access charges (including the VAT implications). As already noted the Facilities model has been audited through TRAC and is therefore robust. The advantages of using this cost model are clear- it provides a robust indication of what is required to make the facility sustainable. As noted above, there cannot be one rule fitting all for the costing. Research activities vary considerably (e.g. animal facility vs electron microscopy lab); for example, while it is desirable to work towards standardisation, there are differences in how depreciation is treated. Equally, there are differences between institutions in how space charges are included. One additional important distinction (which is not immediately obvious) is that there are differences in how much time a piece of equipment is available for, i.e. how is routine and unplanned equipment down time treated and how can the loss of income through equipment down time be accounted for?

It is clear that there are differences in the manner in which host departments ensure the financially sustainable running of facilities. One important difference is how the facility owner addresses access from non-FEC costed research, for example, access by PhD and MSc students. The most appropriate method is that the access charge for these students is paid directly from the Faculty/School/Institute, so that the Facility can then run independently and sustainably. This therefore has no impact on the cost model.

Based on the cost model producing a true cost value, external users of facilities should pay the same as internal users, i.e. the true cost. There has been a clear steer on the VAT position, which is in effect confirms that VAT is not chargeable in these circumstances. Commercial work is outside this remit and can be charged at a commercial rate.

A summary of the financial questions that need to be asked in setting up a Research Facility is provided in Table 2.

Table 2. Key financial considerations involved in establishing a research facility

Category	Comments
Running costs	May include staff time to run or supervise the equipment; energy to run the equipment; materials and consumable items need to run the equipment; maintenance, spares and repairs; staff time spent administering access to the equipment; maintenance of the space which the equipment occupies (heating, lighting, cleaning, security).
Depreciation	Recognises the cost of capital equipment and helps to ensure that funds are available to replace it when it becomes obsolete. The depreciation period can be different across equipment types.There also may be differences in where depreciation costs are recovered (e.g. through Estates rates, or directly through the facility).
Replacing equipment at the end of its useful life	Replacement cost is likely to be higher than depreciation though changes in equipment price and capability need to be monitored.
Calculating the charge for users	Factors to be considering in calculating the charge include: – Charging basis (per day, per event etc.); – The full cost of running the facility/equipment including the replacement cost depreciation (see above); – Likely demand for use of the facility/equipment and a 'reasonably efficient' level of use of the facility where this differs from the likely demand (estimated over the whole useful life and then divided by number of years)
Under or over recovery of costs	Any larger amounts should be factored into a review of charge-out rates on an annual basis. Research Councils do not allow 'profit' elements in rates applied to their projects hence the maximum rate is capped by estimated replacement cost in addition to maintenance and running costs.
Charging costs to research projects	The rules for costing and pricing research on a Full Economic Cost (fEC) basis require institutions to charge for large items of equipment and research facilities either as a 'directly allocated cost' or as 'directly-incurred cost' depending on the circumstances and the institution. Directly allocated costs are those where the cost is not attributable to a single project but are shared across a number of projects or activities. These charges should be made to projects at least annually.

4.1.2 Access

As discussed in Chapter 3, the availability of equipment needs to be ascertained but following that it is necessary to identify and communicate spare capacity and then to put in place arrangements to prioritise, grant and schedule access to the equipment. A considerable additional administrative burden can arise from booking instruments, arranging training and subsequent invoicing the costs. One way in which this additional burden can be reduced is by using a robust on-line booking system. This is not a trivial task as such a system must be sophisticated enough to treat each item of equipment differently, to provide automatic costing data and to be secure against users hacking into the administrative side of the system. Such a system may also need to implement 'fair-play' policies to ensure users book equipment in ways that encourage co-operative behaviours and maximise utilisation. A system is currently being developed at the University of Sheffield that, while developed for use there, will have a core that can be used as a generic tool for other research facilities.

It is also desirable that the system should be extended to cover non-financial arrangements such as safety management. Equipment is potentially hazardous and safety training is needed for visitors (or a means to ascertain that such training has already been experienced).

4.1.3 Legal arrangements

The legal and intellectual property rights agreements need to be based around a standard sliding scale template and agreed on a case-by-case basis. For example, if a guest organisation is paying industry rates to use the facility, then the data is owned by that organisation; equally, where the guest user is paying full cost and is providing an equipment operator, then the guest user would expect to own the IPR. However, guest users/organisations not paying full cost/industry rates or who rely on the intellectual input of the host equipment operator would negotiate with the facility manager and agree an individual IPR arrangement. The need for strong data management and security is a key issue. Data storage back up is essential for internally and externally owned data, with the associated costs recognised in the cost model. There are also likely to be open access implications.

The liability for damage caused by visiting researchers was something that the facility owner must take into consideration. In practice, the facility owner takes a view on the skills of the guest operator and can decide whether the risk is acceptable, that the risk would be acceptable with further training or that the risk is unacceptable and an existing operator should be provided. In practice, the host Research Facility generally takes the risk that it will have to pay for damaged equipment. It is difficult to legislate for a model that can deal with extreme circumstances such as low probability, high cost damage. More routine repair costs can be factored into charges on the basis of past experience.

4.1.4 Technical arrangements

The degree of service support provided with access is an important issue. Questions include whether the equipment available on a "service", "managed access" or "self-service" basis and what level of support and training are available? These arrangements needed to be considered on a case-by-case basis relative to the sophistication of the equipment available in the facility. In order to ensure that facility managers have the relevant knowledge and understanding to provide a bespoke and responsive service, they needed to be appropriately technically qualified. Equipment sharing requires that there are sufficient staff to cover training on the instruments, or to provide a service. This must be taken into account when the running costs of the service are considered.

4.1.5 Administrative arrangements

These cover the management of the equipment and associated financial transactions. General payment process management would be based on agreed university terms and conditions and executed on an individual basis for each facility. Securing payment upfront is a methodology currently utilised by many facilities which lessens the administrative burden of issuing individual bills and invoices. A facility may function on the Directly Allocated model but a user without previous DA funding can access and pay in a Directly Incurred mode.

4.2 Degree of cost recovery

As illustrated in the Light Microscope Facility (LMF) case-study in Table 3 it can be challenging to recover all costs – in this case the University is meeting much of the cost of the Senior Experimental Officer while seeking to transfer it over time to users. This situation is evident in a number of facilities across the universities – it is challenging to achieve sustainability over a long period unless there is substantial revenue from commercial sources, in which case questions could be raised about the degree to which that is desirable given that the capital investment was intended for publicly funded research. The most typical area of subsidy is that of staff time. Among users at LMF, charges are waived for users without current grants. This raises the issue of where the subsidy is coming from – is it a general input or do the funded users cross-subsidise the unfunded ones? There are also differential charges for local users and those outside the Faculty. The Sorby Centre featured in the second case-study does not differentiate between users except in charges for commercial users. Given the need for transparency of charges within TRAC rules there are significant challenges.

The case study from York University in Table 4 confirms many of the issues raised in the chapters so far. It shows users appreciating features such as the expertise provided by staff at the facility but also their concerns about the financial model applied, and in particular matching this to external grant funding.

4.3 Towards a common cost model

The work done on this topic has shown that functional arrangements can be put in place that constitute good practice for the user communities that they serve. These arrangements also offer useful guidance for others and make it clear what the requirements would be for a common cost model. However, they do not as of now provide a model that will work in all circumstances or across all institutions. It is desirable to standardise issues such as FEC approaches, depreciation and estates charges but these are tied to the broader financial policies of universities and at best will take some time to harmonise. Until that time the most important aspect from the perspective of sharing is to maximise transparency, seek efficiency gains wherever possible, and, as far as possible , communicate the costing basis and accompanying information to users in a simple and understandable format.

Table 3. Case Studies of Sharing Practice at Sheffield University

Facility	Charging models	Access	Legal	Technical	Administrative
Light Microscope Facility Interdepartmental multi-user facility underpinning research in biomedical and life sciences. 27 groups are regular users and 18 occasional. Core equipment is confocal, a and other microscopes.	Charges advertised openly per hour. Currently charge £16 per hour for first 500 hours and £8 thereafter. Users from outside Faculty pay higher rate of £30 per hour. Charges cover maintenance, contribution to salary of Senior Executive Officer, consumables including network storage, software parts and add-on equipment. THE SEO position was funded by Wellcome for the first 5 years and is now paid by the University with a contribution from the LMF which is expected to rise annually. Charges are waived for users without grants.	Website open to Sheffield users with direct contact for LMF manager. All information downstream of this is open to those allocated a password. Tabbed webpage allows users to manage bookings, time and support.	Follows departmental regulations and principles of Good Laboratory Practice. Damage and injury covered by departmental & university policies.	Support and training offered but all users must demonstrate competence before they can use the equipment independently.	Facility manager for day-to-day management, data management and charges. Backed up by Management committee and Faculty finance team.
Sorby Centre for Electron Microscopy Comprehensive series of electron microscopes (four TEMS, seven SEMS and a Focused Ion Beam) ranging from training and routine to high performance	Charges are equal for internal and external academic users but not commercial work. The cost is calculated taking account of costs of maintenance contracts, spares (based on the previous three years spend), staff (apportioned to instruments according to usage levels over the last three years), depreciation over 10 years, fair usage (to allow for downtime), and a space charge. VAT is not charged for academic work.	Approved users can book the appropriate instrument with a maximum booking allowed on each instrument (typically two sessions). External users contact the Centre and request access, which is normally granted, following discussion of need. There is very little spare capacity – where one instrument is in high demand certain users are encouraged to move to an alternative lower demand instrument, which often have lower charges.	Users own the data but when the instrument is operated by Sorby staff with significant skill input recognition of IPR is expected typically through co-publications. Visitors are covered by University indemnity. Liability for damage is met by the centre unless it results from reckless use.	The equipment is available at all levels. Each case is judged individually. Where the work is extensive, the "customer" will be trained. Where the work is limited, or the skill level of the "customer" is adjudged to be inadequate, the Sorby staff will perform the work. The Centre operates with four staff, all of whom provide training.	Academic Director, plus four experimental staff. A professional on-line booking system provides data in a number of important categories: microscope usage levels, automatic charging and reports to supervisors of the expenditure, individual user statistics etc. This saved a great deal of staff time and helps promote equipment sharing with external users who get access to it.

Table 4. Bioscience Technology Facility at University of York

Facility	Activities	User views
Originally established in 2002 as part of the £21million Joint Infrastructure Fund grant to develop the Biosciences in York, the facility comprises a 2,000m^2 purpose built lab space with £9million equipment spend to date including 19 expert core staff. Available to both internal and external (academic and commercial) users, and now nationally recognised as a leading example of how to provide research support in the 21st Century. The facility provides a range of technology training opportunities: One-to-one instruction, extended visits to work alongside the experts, a range of short training courses, confocal microscopy, flow cytometry, T-flask to bioreactor, proteomics, QPCR, a Bioscience Insight Day Bespoke/tailored training courses and Masters and PhD Training. Much research is collaborative, with expert advice on application of the technology, experiment design, equipment operation, data analysis, data interpretation, trouble shooting and method development as well as project management. The Bioscience Technology Facility services a range of groups: – York academics (~90% of the Biology research groups) – Academics from other institutions (~35 different groups each year) – Corporate clients (~20 different companies each year) – Short Course Delegates (~190 delegates each year)	The facility operates as a cost recovery centre subsidised by the department, using a 'Pay-as-you-go' charging system rather than top-slicing grants. Operational charges are calculated for each piece of equipment. Operational costs are FEC, including staff costs, and for external commercial work an uplift is applied. The overarching TF budget provides budget stability, though this is monitored at lab level. Development of new technology applications, new uses for existing technologies, development of existing technologies and adaptation of emerging technologies are all very important parts of technology development at the York facility. Interactions with equipment manufacturers are also fostered, with York acting as an Alpha- and Beta-test site and demonstration site. This interaction also includes formal and informal consultancy, method development and application notes, sample access and training collaborations.	This facility has undertaken user surveys to highlight issues, and positives include: – Access to the kit is the primary reason to approach the TF, but expertise is the reason customers come back; – The availability of cutting edge equipment and the expertise of helpful and skilled staff; – Innovative experimental design, developing new techniques; – An integrated facility. The Survey also highlighted issues: – Ensuring like-for-like cost comparisons with competitors; – Managing tensions between internal, external and teaching demands; – Equipment maintenance, upgrading and replacement; – Costing issues between directly allocated and directly incurred and meeting EU auditing requirements; – Difficulties in recovering the time costs of specifying projects.

5. Strategic collaboration and forward look

The N8 project has also involved work to identify opportunities for collaboration around future assets and sought to achieve a broader regional rationalisation in equipment provision. This is not to say that members will reduce their collaborative activities with universities outside the region – all of our institutions place high value on their national and international partnerships. However, for many types of capital assets proximity remains a factor, particularly in the context of the time pressure that most researchers operate under in the current environment. This work draws in part on Workstrand 4 which addresses medium-scale facilities.

It has also proved the case that beginning a discussion about collaboration in assets is starting at the wrong end of the argument. Discussions about capital provision need to be rooted in a strategic consideration of the opportunity to perform excellent science. This involves both an intersection with the individual research strategies of the groups and institutions concerned and of the broader institutional directions.

Rather than present this argument in the abstract we present here two case-studies of collaboration towards establishing medium-scale regional facilities, one of which (HPC) has been rapidly realised while the other (NMR) is in progress. This work draws in part on Workstrand 4 of the study which addresses medium-scale facilities.

Case-study on High Performance Computing

N8 universities had a background of sharing high-performance computing capability and this had already been identified as a target for cooperation. The area was important both for multi-disciplinary research and as an enabler for collaboration with industry (who would also wish to have direct access to the facility). Hence when an EPSRC call for proposals was announced at short notice in December 2012 making available £10million to establish up to six centres including Regional High Performance Computing Centres of Excellence a rapid decision was possible to proceed with a proposal. The timescale was highly challenging – the bid had to be agreed by PVCs and VCs by 16th December, submitted by 5th January and with a requirement to complete procurement and capital spend by 31st March if successful.

With leadership from Chris Taylor of Manchester and David Hogg from Leeds some key decisions were made early on. Among the Universities only Leeds had the physical capacity to site the equipment (5000+ cores using the latest Intel technology and costing £3.2 million). A governance model was developed whereby Manchester would be the lead bidder and commission the facility from Leeds on behalf of all N8 members. This was intended to make all actions transparent for partners.

Key components of the proposal were a strong science and engineering case founded on world-class computational science and engineering, support from industry and the local economy, the procurement and technology partnership and building in capacity for future upgrade and sustainability. The established N8 relationship with its high degree of mutual trust was critical for success – early results from the assets-sharing project were used to structure the partnership and its rules of operation. Running costs will be allocated on a fair share basis.

Engagement from industry was strong with 28 letters of support received. There was an early cross-over with another activity, the N8 Industrial Innovation Forum. At a workshop held to establish multi-institutional collaboration in the area of advanced materials with several major firms, the forthcoming HPC facility proved a major factor in establishing a suite of projects. The N8 is also attractive for equipment suppliers who have themselves sought a strategic partnership and prioritised the delivery of leading edge new technology.

Computing is perhaps an easier area then other types of equipment being a 'vanilla' technology which is largely location-insensitive from a user perspective. As the facility comes on line the challenge now is to capitalise upon it in a virtuous circle of bringing in leading edge users from the academic and industrial communities and also ensuring that all partners make best use of it.

Case Study on developing the case for a shared asset facility – N8 Nuclear Magnetic Resonance

1. The vision:

The Pro-Vice Chancellors of the N8 universities have agreed to pursue the following vision as a strategic priority for N8. "To provide world class, efficient and competitive NMR infrastructure for biomedical and life sciences in N8".

2. Strategic importance to the UK research base

A national strategy for high field NMR infrastructure for life sciences is currently being developed, led by the Collaborative Computing Project for NMR (CCPN); N8 is fully involved in these discussions and the proposal below is consistent with the national strategy. Nuclear Magnetic Resonance (NMR) spectroscopy is an essential platform technology for research in the biomedical and life sciences and currently makes a major contribution to UK research priorities such as ageing and infectious disease, characterizing biomolecular structure, function and dynamics. Upgrading and maintaining NMR capability is essential for N8 to retain international competiveness, and to attract and retain the best talents.

3. The team

The N8 executive is driving the capital asset sharing agenda. The N8 capital asset sharing project is due to report shortly and identifies benefits of, and challenges to, capital asset sharing. Challenges include psychological barriers to sharing, logistical barriers, finding appropriate cost models, and providing expert technical support for shared assets.

With learning from this project in mind, the N8 executive has mandated a team of 8 NMR experts to write an application for funding to support the vision for NMR in N8. The team is led by an independent leader with experience in leading large scale organisational change in R&D (Dr John Weir) and championed by a Vice Chancellor who is a recognised NMR expert (Professor Mark Smith, The University of Lancaster). The team (called RESON8) has so far met four times and has proposed a vision and outline strategy which the N8 executive has endorsed. The team is now identifying the organisational and financial options which would be appropriate to implement the strategy.

4. The N8 strategy

Although NMR facilities in N8 are currently competitive, the increasing sophistication and cost of leading edge NMR demands continuous updating. This favours an integrated N8 asset sharing approach for NMR. The N8 strategy has four essential components: building collaborations, upgrading and maintaining existing equipment (integrated across N8), increasing capability and sharing/pooling of expertise. The scope of the strategy includes NMR machines with field strength greater than or equal to 600MHz. The strategy aims firstly to build on strength in solution-state NMR for biomedical and life sciences and then improve capabilities in solid state NMR for the same fields.

It is fully intended to broaden the scope of this strategy beyond biomedical and life sciences once the principles and practical implications have been fully established. A ten year capital plan has been designed and a feasibility study for the major investment (1GHz NMR) drafted. The potential benefits of the strategy are: Step-change in science quality and the way infrastructure is shared; Efficiency – easier to do science on a competitive timescale; Training – exposure to a broader group of scientists; Recruitment – cutting edge science and an excellent working environment; Cost savings in purchase and maintenance.

Annex 1 The N8 Project

N8 Research Partnership: Sharing for Excellence and Growth

This short term project aims to develop some policy proposals and practical approaches to address some of the key opportunities and barriers associated with equipment sharing with a focus on achieving yet greater research excellence.

Workstrand 1: Benefits, barriers and cultural factors
Leads: Dr Thordis Sveinsdottir, Ms Deborah Cox and Professor Luke Georghiou – University of Manchester

Workstrand 2: Identification of equipment sharing opportunities
Leads: Professor Edmund H Linfield, Dr Gavin Burnell, Dr Catherine L Wearing, Mrs Kathy Brownridge, Professor David Hogg – University of Leeds

Workstrand 3: Business models for access and costings
Lead: Professor Mark Rainforth – University of Sheffield

Workstrand 4: Opportunities for optimising use of medium scale facilities
Lead: Professor Tom McLeish – Durham University

Annex 2 Lessons and Success Factors

Organisational success factors for driving asset sharing

Collaboration needs to develop at several levels within and between partner organisations for asset sharing to succeed. We have identified the following key success factors.

1. Establish a clear objective and approach
The vision of "N8 has a world leading Research asset base in chosen areas beyond 2012" and comprehensive overall brief was agreed by the N8 PVCs. A learning-by-doing approach was adopted early by making the case for a high performance computing shared asset and for NMR for life sciences, and this has informed the project.

2. Agree and align strategic priorities – locally and nationally
The N8 has identified four strategic areas (e.g. NMR for the life sciences) where it is developing the first integrated asset sharing and research strategies. These were selected in consultation with funding bodies and PVCs, and have been communicated in the RCUK consultation on capital equipment, thus aligning activities.

3. Sequence events appropriately
Certain elements of the asset sharing project provide the foundation for the success of the overall project and must be addressed first. The most fundamental are: agreeing the asset taxonomy and completing the asset register, establishing appropriate business models and mechanisms to enable asset sharing. Barriers to asset sharing must also be understood before a realistic plan can be developed.

4. Dedicate appropriate leadership
Organisational development requires leadership. An experienced leader in multipartner research collaborations was appointed to manage the project and "glue" the separate workstrand together into a coherent whole. Workstrands with dedicated resource and leadership have made the most effective progress. A lead PVC was appointed to champion the project and work with senior external stakeholders.

5. Give the project priority by placing it on every agenda of the key meetings
The Asset sharing and development project has been on every N8 PVC meeting since its start, thus providing energy for change. It has also featured regularly at the N8 Board meetings. Regular engagement with National stakeholders and research officers has provided important feedback for direction.

6. Engage appropriate communities to inform the design and approach
The Leeds team (Professor Edmund Linfield, Dr Gavin Burnell, Kathy Brownridge, Jennifer Johnson, Catherine Wearing) made excellent progress on taxonomy and asset register design and implementation. A key success factor was academic leadership and championship of the project coupled with dedicated administrative support. Design of the taxonomy was a collaborative venture involving wide consultation with a range of discipline experts at Leeds and more broadly across N8 institutions to ensure it was fit for purpose. The N8 Director organised review meetings inviting senior external stakeholders to ensure regular dialogue and mutual understanding

7. Establish trust
Asset sharing will not work without trust between PVCs, Research officers, collaborating academics, and of the systems established. Regular meetings will be key to building trust.

Dr John Weir, Sarah Jackson, Kathy Brownridge May 2012