Chapter 4

Build a strong bioprocessing sub-sector within UK bioscience

EXECUTIVE SUMMARY

Bioprocessing is a critical part of the bioscience sector. The issues and technology underpinning the translation of bioscience inventions into safe and economic medicines are fundamentally different from those involved in conventional chemical pharmaceutical manufacturing. The bioprocessing skills set is crucial in driving speed, efficiency and cost effectiveness in the development and production of advanced bioscience products. As these products become more complex, the importance of bioprocessing will inevitably increase as 'product' and 'process' become ever more closely linked. To meet the challenge this sector has both to attract more talent from a range of disciplines and increase the level of invention and innovation.

The BIGT is seeking Government support for initiatives across three areas that are crucial for growth and success, through support of business-driven activities and catalysing a step-change in the way the UK is viewed as a centre of expertise for inward investment. The centrepiece of these initiatives is the creation of specific Centres of Excellence for bioprocessing research and training. A pool of highly trained individuals would act as a mechanism for retention of the industry within the UK, despite the financial incentives offered by other nations.

4.1 Build a network of bioprocessing Centres of Excellence across the UK.

4.1.1 Establish Centres of Excellence across the UK in leading HEIs, with strong leadership from international 'heavyweights' (directors should be supported by three other academics and 6-8 post-doctoral researchers), a clear mission, and secure funding.

The Centres of Excellence will focus on an ambitious three-pronged mission:

- **Deliver graduate training** designed to create interest, interdisciplinary awareness and expertise in bioprocessing.
- **Develop leading edge research** resulting in strong IP positions in emerging areas of bioprocessing

- **Build collaboration with leading UK-based companies** to ensure real-life experience.

Secure funding will be vital. BIGT recommends £5 million per year in total for all Centres from research councils, for eight years, with matching investment from host HEIs and/or RDA's.

4.1.2 Focus the research agenda of Centres of Excellence around 'next horizon' bioprocess-related technology areas where the UK has an existing foothold and the potential to develop global IP leadership positions.

4.1.3 Develop training programmes and agendas in Centres of Excellence and expand training options across the UK to build skill levels among the existing bioprocessing workforce.

4.2 Attract significant inward investment in bioprocessing assets.

4.2.1 Contract a specialist company to identify and respond to potential inward investors and liaise with a bioprocessing dedicated individual appointed to InvestUK.

4.2.2 Develop a more coordinated approach for facilitating the evaluation of potential foreign inward investors.

4.3 Foster bioprocessing community development.

4.3.1 Sponsor a Bioprocessing Industry Development Director.

4.3.2 Develop an agenda-setting programme of industry events, including a focal point annual National Bioprocessing Forum.

WHAT IS BIOPROCESSING?

Bioprocessing/biomanufacturing (referred to collectively as 'bioprocessing' and reflecting the linkage between the two) is a crucial component of the life sciences sector. Bioprocessing encompasses a wide range of techniques used in the development and manufacturing of bioscience-based medicines known a biopharmaceuticals or biologics. Today this includes molecular biology, microbial fermentation, mammalian cell culture, transgenics, purification, analysis, and covers all aspects of the production process: from lab-scale development, through to large-scale manufacturing of active ingredients, their formulation and delivery.

However, it is evident that the pace of change in medical discovery will demand additions and changes to this list. Because products are far more complex, bioprocessing is fundamentally different from the chemical synthesis methods of small molecule pharmaceutical manufacturing, and presents distinct challenges. It is a highly skilled, knowledge-based activity, with a large number of variables, to the point, for example, where the same biologic drug, manufactured through the same series of steps, at two different locations can have different pharmacokinetic profiles.[1]

Therefore, definition of 'product' is inseparable from its production 'process' and manufacturing operation. This close linkage between 'product' and 'process' means there will not be a quick advent of low-cost alternatives or biogenerics, as differences in process (e.g. different expression system or fermentation method) mean any 'generic' molecules will probably have to pass through a lengthy and expensive approval process before they reach market.

Why bioprocessing matters

Development of bioprocessing technologies will be pivotal to the future success of modern medicine. Current processes tend to be technologically immature, expensive to establish and operate, and are inefficient and unsuitable for the next generation of gene and cell-based medicines. Considering the impact of stem cells and tissue engineering, the step changes required to meet the challenges of these next generation medicines can only be made through radical, rather than incremental, R&D in the bioprocessing area. To a greater extent even than now, the process will become inseparable from the product, with the interface between drug development and production becoming increasingly intimate and interactive.

Bioscience products are already recognised as expensive medicines that push the limits of economic acceptability. Many of the trends in medical treatment will compound this issue as a linkage is seen between genetic pre-diagnosis in disease, reducing the total volume of material and requiring more product customisation. Similarly the personalisation of medicine that comes with tissue replacement will reduce manufacturing-scale efficiencies. Speed of response, small-scale manufacture and process flexibility will therefore become increasingly important.

New bioprocess technology and innovative manufacturing applications are fundamental prerequisites to achieving future generations of medicines, which can deliver safety and efficacy in an economic manner.

This is the strategic industry view. The near-term, company-specific view, emphasises the importance of getting the manufacture of bioscience products right for commercial success. High R&D costs, limited patent lives, and intense competition, mean companies must capture every day of revenue possible by guaranteeing adequate and safe supply, while ensuring new products are economically viable.

Bioprocesses require specific process and analytical expertise. Manufacturing facilities are also expensive to build and operate. Risk management is

1 As was the case, for example, with Xanelim, an antibody used in treating psoriasis, manufactured by both Xoma and Genentech: "Xanelim: Who got what?", BioCentury 8/4/02. www.biocentury.com

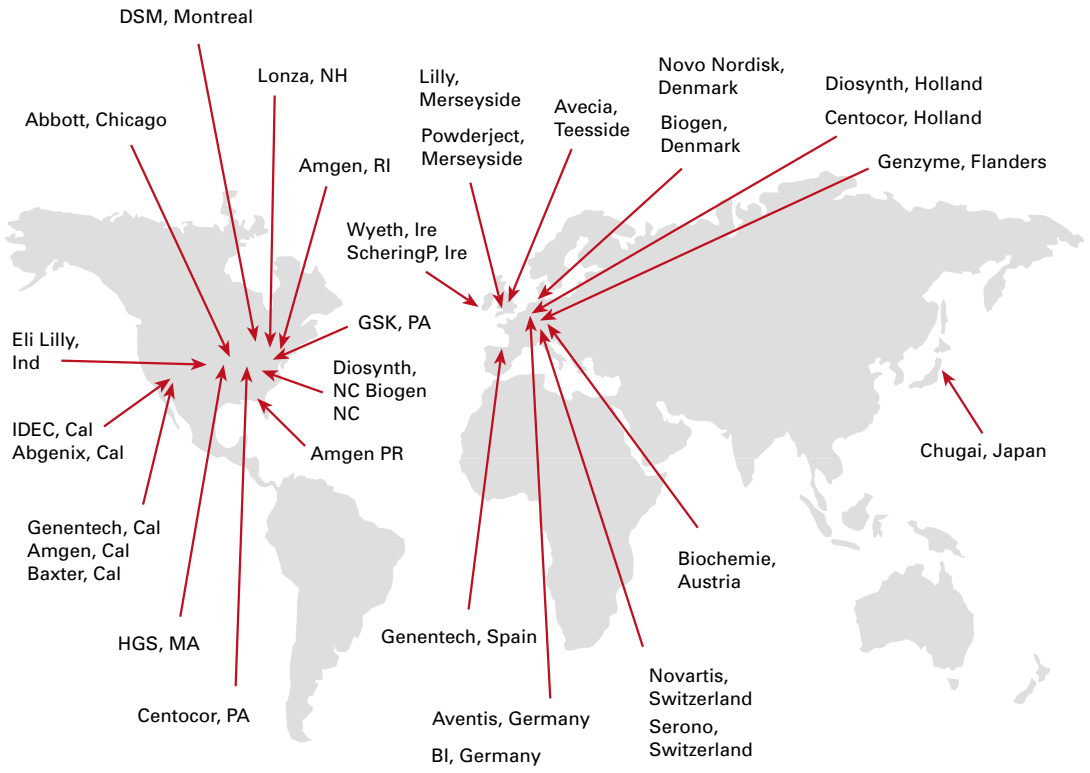
therefore a major issue, since investment decisions need to be taken when products are in early clinical trials (and may fail). As a result, a contract manufacturing sector has emerged in recent years to help address this issue, balancing the risk across a product portfolio.

Recently, biopharmaceutical production has been capacity-constrained. There has been very real loss of value due to lack of capacity in the market. Immunex's inability to produce sufficient quantities of its 'star' product, Enbrel, cost over $200 million of lost revenue in 2001 alone.[2]

Whilst facility investment will inevitably follow a market pattern, even major players admit the more worrying constraint is the shortage of expert bioprocessing staff for new bioprocessing technology. The need for highly qualified staff in these knowledge-based assets is the key factor driving the location of the world's major bioprocessing facilities (*Figure 4.1*)

The skills issue, and the importance of links to bioprocessing development centres means the industry is relatively resistant to commoditisation, or export of jobs and infrastructure to developing, low labour cost markets. This is especially true for new bioscience products where the links to advanced bioscience research are close.

Figure 4.1 Locations of major bioprocessing facilities worldwide[3]



Source: Avecia, BioPharmServices

2 Ameet Mallik, Gary S. Pinkus, and Scott Sheffer, "Biopharma's capacity crunch", McKinsey Quarterly, 2002. www.mckinsey.co.uk
3 Source: Avecia and BioPharmServices. Map shows location of the majority of bioprocessing companies (recent bioprocessing investment of > $50 million +) disclosed publicly. www.avecia.com www.biopharmservices.com

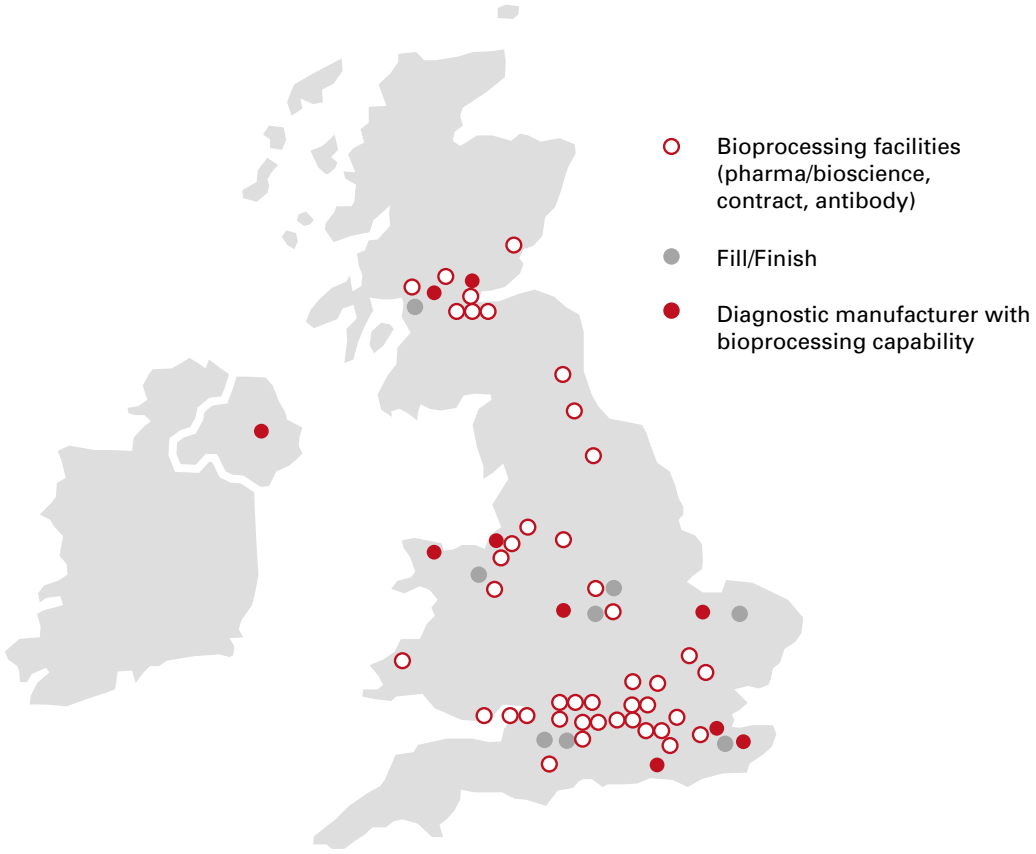
Bioprocessing impact on the UK

A strong bioprocessing sector will bring direct benefit to UK plc. By way of example, the total supply chain (including raw materials, production, and distribution) represents ~20-25% of the value of a biopharmaceutical drug (i.e. $200-250 million annually for a drug with sales of $1 billion). This is significantly more than for a conventional medicine. If the UK bioscience industry creates five blockbusters or their equivalents, ~$1 billion in direct manufacturing value could be captured by UK plc.

While there is no single localised bioprocessing cluster within the UK, there are already strong pockets of activity on which to build a larger sector (*Figure 4.2*). In the UK, the bioprocessing sub-sector is comprised of faculties and facilities at HEIs (e.g. University College London), in-house process development activities (e.g. Celltech, CAT, GSK), and manufacturing facilities for vaccines and biologics (e.g. Powderject, Eli Lilly, GSK), specialist third party contract manufacturers (e.g. Avecia, Lonza, Cobra) and contract testing organisations with a UK presence (e.g. Q-one, Bioreliance). The National Biomanufacturing Centre at Speke will also become operational in 2004/5.

Despite this base, the UK is not yet in a leadership position. The US and mainland Europe, both Holland and Germany, have stronger bioprocessing operations.

Figure 4.2 Locations of UK bioprocessing facilities[4]



Source: BioPharmServices, DTI

4 Source: Biopharm Services, 'Bioscience Innovation and Growth Team: Manufacturing Headcount Estimate'. Supplemented with additional information from DTI. www.biopharmservices.com, www.dti.gov.uk

While manufacturing operations are desirable, major value can be generated through bioprocessing-related intellectual property. IP can provide significant revenue streams for a company, supporting expansion and profitability. For example, Celltech's Boss antibody engineering process patents generated over £50 million in revenues in 2002. This licence income has been a key component in Celltech's development story. Celltech's discovery and development programme put it at the front of the 'antibody revolution'. Innovation is essential for capturing IP value from 'next horizon' technology areas.

The technology for biopharmaceuticals applies in many cases to new generations of diagnostic agents. There is a comparable UK market (which will be addressed by the ABHI/DH-led Health Industries Task Force (HITF)), as diagnosis is becoming an ever more important component of drug therapies.

Vaccines are an important part of the overall biopharmaceutical sector. The trend towards use of recombinant technology for new vaccine products presents the same bioprocessing challenge. During the course of the BIGT meetings, the House of Lords Select Committee on Science and Technology issued a report on fighting infection[5]. They noted the potential weakness of the UK in vaccines provision, and the steps being taken by the US. It was stated that Government should address the matter by April 2004. The BIGT endorses these concerns and believes that partnership between the public and private sectors could offer a more secure position for the UK, and a valuable business opportunity in a world where 'jet spread' of viruses, and the risks from other infective agents is a growing threat.

As a key enabler of the whole healthcare sector, bioprocessing plays a vital, if unrecognised, role in the delivery of patient benefits.

Third party bioprocessing as an enabler

Most of the UK's biotech companies remain R&D-focused SMEs, lacking the capital to build their own manufacturing facilities or the depth of expertise needed to develop processes. A vibrant, third party bioprocessing sub-sector with the necessary infrastructure and talent in place can provide:

- Specific expertise and capacity to produce highly complex biopharmaceutical products to exacting quality standards – crucial in bridging the development-to-product gap.
- Vital freedom to manoeuvre. For example, Synergen – a top 10 US bioscience company in 1992 – illustrates the danger of over-committing to manufacturing plant capital expenditure, while a company is still in the development stage *(however advanced)* of a single product. When Synergen's lead product Antril failed in clinical trials, it could not afford its plant or its independence, and was acquired by Amgen.

Even as bioscience companies have grown larger and built their own manufacturing facilities (e.g. Amgen, Genentech), third party process development and contract manufacturing has become an important element of their manufacturing strategies. Nevertheless, when maturing UK bioscience companies do choose to establish their own manufacturing plant, it will be important to encourage them to do so in the UK.

5 House of Lords, Science and Technology, Sub-Committee, 'Fighting Infection' www.parliament.the-stationery-office.co.uk /pa/ld200203/ldselect/ldsctech/

An effective local presence is important and will become increasingly so. The development of complex bioscience products requires close interaction between development and production. Geographic proximity is therefore an advantageous factor for creating effective partnership.

Technical knowledge and expertise know no borders. Developing leadership in leading sophisticated bioprocessing technologies would establish the UK as a key part of the global industry, and an attractive location for inward investment. It could also generate IP value and act as an enabling factor for the domestic bioscience sector. Government can help create an infrastructure that makes the UK an attractive place to develop and sustain technology, and can facilitate knowledge transfer from innovators to UK-based industry.

ACTION REQUIRED

4.1 Build a network of bioprocessing Centres of Excellence across the UK.

The UK can only succeed in complex fields such as bioscience by having knowledge leadership. Therefore, it is vital to inspire and train strong talent to enter the bioprocessing industry and develop the necessary skill levels.

The interdisciplinary nature of bioprocessing development means talented people need to be educated to understand a combination of biological and other life sciences, physical sciences, mathematics, and engineering. Life scientists are rarely trained for the excitement and challenges of bioprocessing. There are also few undergraduate courses in biochemical engineering specifically focussed on this area. The result is a shortage of graduates and post-graduates motivated to work in the bioprocessing sector or suitably skilled. This shortage exists at all levels, and the bioprocessing sector needs to do more to train operational staff. A particular concern, however, is the lack of inventive people able to translate excellent bioscience into economic processes.

Avecia

Many UK companies face problems recruiting post-graduates and graduates conversant with bioprocessing skills. This skills gap is further exaggerated by the recruitment pull from overseas (e.g. the Wyeth facility in the Republic of Ireland). The present academic base needs rapid strengthening to meet this need.

4.1.1 Establish the Centres of Excellence across the UK in leading HEIs, with strong leadership from 'international heavyweights', a clear mission, and secure funding.

The BIGT proposes that several Centres of Excellence in bioprocessing training and research should be established at selected HEIs. An initial estimate by the BIGT suggests that four centres would be desirable. Scientific expertise of relevance to bioprocessing falls into several research areas and is currently located in a number of UK universities.

Therefore, location and precise composition of these centres should be the result of a selection of attractive bids from interested, qualified HEIs. However, it is possible that attraction of key leadership talent will assume priority, and centres could be formed around selected individuals. So the details below are provisional.

Possible leadership and composition of the Centres of Excellence

The centres are initially conceived to be based at HEIs with a solid foundation in bioprocessing expertise, and should be led by relevant scientific or engineering 'heavyweights' with an international profile. Although specific details will be down to the particular centres and the needs of the research area, these individuals could lead a team of around three other academics together with 6-8 post-doctoral researchers and support staff. Each centre could look to take on around six PhD students per year, and run other academic and vocational training programmes, focused on developing the necessary bioprocessing skill sets.

HEIs will be able to bid to become one of the four centres and receive the research council funding. Joint bids between multiple HEIs should be accepted. Assessment of bids should include criteria such as existing track record in bioprocessing and other relevant areas, expertise and infrastructure, industry involvement, IP commercialisation plans and outreach programmes.

Role of the Centres of Excellence

The Centres of Excellence should have three prime roles:

- Delivering graduate training designed to create interest and interdisciplinary awareness and expertise in bioprocessing.
- Developing leading edge research resulting in strong IP positions in emerging areas of bioprocessing.
- Building collaboration with leading UK-based companies to ensure real-life experience.

Although based at HEIs, the Centres of Excellence should be strategic partnerships between the HEIs, Research Councils (EPSRC, BBSRC) and the bioprocessing industry to encourage the cross-fertilization of ideas, experience and talent. This could be achieved, for example, through direct industry experience schemes (including placements), shared research and training initiatives and the creation of directed Masters and Doctoral level training of potential bioprocessing leaders. As some of the research conducted at the centres is likely to have a chemistry element to it, it will be important to liaise with the Chemicals Leadership Council.

Driving invention and innovation will also be a fundamental role of each of the centres. A new annual research council training account should be established to fund new postgraduate level researchers (suggested size 20 a year) across the centres on a competitive basis, as a means of producing potential innovative, next-horizon bioprocess leaders.

Indicative funding of the Centres of Excellence

Creation of these centres will require a significant commitment from all strategic partners. It is estimated that each centre will require Research Council funding support of £1 million per year to cover the necessary costs of people (post-doctoral research assistants, PhD students and a facilitator to develop and manage the industry university interface) and equipment. The Research Council funding support needs to be guaranteed for a material period,

such as eight years, in order to allow the centres to build the necessary critical mass of people, expertise and profile.

In addition to the funding of each individual centre, the training account for producing potential innovative, next-horizon bioprocess leaders should have an annual funding requirement of £1 million per year (spread between the centres), and have an eight year time horizon. Therefore, the aggregate Research Council funding commitment required to undertake this major programme of initiatives would be in the region of £5 million per year.

The HEIs themselves would need to find the funds for the permanent academic staff of each centre. Given the target profile of the centre leader, full-loaded costs for this individual alone, including research and equipment budgets, are likely to be significant: ~ £1 million by each HEI over the eight year timeframe. The profile of the leadership individual required is likely to mean that candidates may need to be attracted to the UK from overseas, and packages will need to reflect this. However, the HEI's costs need to be viewed in the light of the significant anticipated impact each centre (and its staff) will have on the HEI's research assessment performance.

4.1.2 Focus the research agenda of Centres of Excellence around 'next horizon' bioprocess related technology areas where the UK has an existing foothold and the potential to develop global IP leadership positions.

Current situation: The areas of technology development that will have greatest impact for value creation in bioprocessing are those where:

- The UK has already built scientific strength;
- There is greatest opportunity for technology development (i.e. the science is relatively immature); and
- The future demand and therefore value will be significant.

The recommendation: There are a number of key technology areas for potential focus:

Application areas

- Cell therapies and tissue engineering,
- Gene therapy,
- Formulation and drug delivery,
- Novel manufacturing approaches for proteins and other biopharmaceuticals that allow them to be prepared in their bioactive state.

Underpinning technology areas

- **High throughput bioprocess technologies:** The trend towards personalised medicines is likely to call for scale-out (where many small units are produced in parallel), rather than improving the economics of production through scale-up and large batch sizes. This demands a different way of achieving economies of cost that will depend on automation, and a strong use of disposable contact components
- **Bioseparation:** Given that up to 80% of the cost of producing biopharmaceuticals is in their recovery, any fundamental advances that can reduce this cost will be important. Novel separation methods could be an important part of such advances, as could improved mechanisms for determining the most efficient method of production of new target materials.

Each of the Centres of Excellence will be encouraged to focus on a sub-set of the priority areas to create the focus and critical mass necessary to build world-leading centres of expertise and IP. Centres will also be encouraged to develop effective routes where knowledge can be turned into value (e.g. strong links with technology transfer infrastructure, direct links with venture capitalists, etc.).

Some degree of central coordination will be important to minimise duplication and overlap, and to ensure information transfer and dissemination of important knowledge beyond the discovery centre.

Each centre will be expected to generate significant amounts of IP. It is anticipated that the centres will be a key source for generating spin-outs and/or transfering technology (possibly through joint ventures) to affiliated companies. Monitoring IP creation and commercialisation will form a critical part of the evaluation of the success of the centres. Innovative alternative ways of commercialising IP (such as through relationships with venture capital groups) will be encouraged.

It will be important to establish a formal group to define more fully the first draft research agenda contained in this report, and to ensure action is taken quickly.

Given the fundamental nature of this agenda, further consultation and syndication should be undertaken to derive a robust set of priorities. The relevant Research Councils, with advice from DTI, the bioscience industry and international experts, should formulate the details and refine the proposals in consultation with the scientific community. They should ensure that the scheme is sensibly related to other BIGT initiatives, such as those involved in interdisciplinary research and training.

As well as being the main priority for bioprocessing, this recommendation is urgent as it will take considerable time to assemble the centres, yet the need for their outputs is pressing.

4.1.3 Develop training programmes and agendas in Centres of Excellence and expand training options across the UK to build skill levels among the existing bioprocessing workforce.

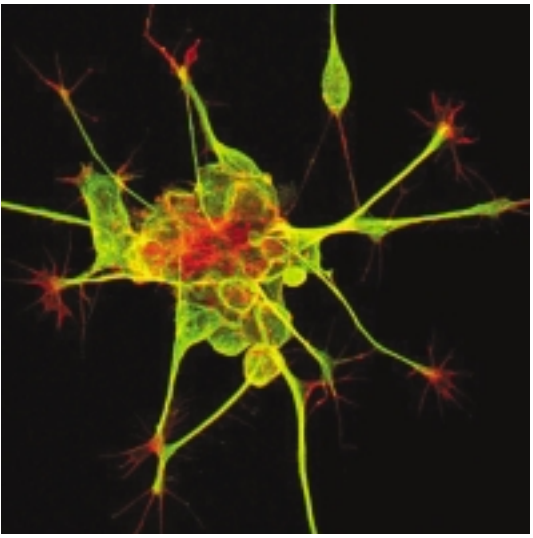
Current situation: Insufficient training is available for those currently in the bioprocessing sector. Access to training is frequently constrained by the abilities of SMEs to release key workers and by its limited geographical spread.

The recommendation: A network of bioprocessing training modules should be created through partnerships between the bioprocessing Centres of Excellence and local Further Education Institutions, for regional training of operators

and technicians, and nationally for potential bioprocessing leaders. Local/ regional modules are aimed at better serving SMEs.

It is anticipated that the programmes will have a combined budget of around £200,000 annually, split roughly equally between each programme. The funding commitment is recommended for up to 10 years (reviewed at five years) to provide a secure base of training module development, giving an aggregate funding commitment of £2 million over the 10-year lifespan of the programme.

These bioprocess training modules, both at the technician and potential leader levels, should additionally be covered by a Government-funded training voucher scheme, such as that previously operated by the DTI. The DTI training vouchers scheme for the bioscience industry (the Manufacturing for Biotechnology Initiative (MfB)) provided training grants of up to 75% (£800 per person) to SMEs to enable them to send employees on Master levels courses in bioprocessing. Unfortunately the entire MfB scheme came to a close July, 2003. This initiative should either be extended or replaced to cover training modules, such as those proposed here.



Wellcome Photo Library/Kate Nobes, Mark Shipman

A growing dorsal root ganglion. Microtubules directing proteins and membrane to the tips of the arms are stained green. Actin filaments are stained red and are involved in the sorting of vesicles at the tip of each arm.

4.2 Attract significant inward investment in bioprocessing assets.

In addition to homegrown companies, it is vital to attract inward investment in order to grow the sector. Although there are encouraging examples of this investment taking place (e.g. Eli Lilly's £45 million investment in Speke to increase manufacturing capacity for Humatrope(R)), survey evidence suggests that the UK lacks sufficient perceived distinctiveness in the eyes of many potential foreign inward investors.

A recent survey undertaken by BioNoW (the biosciences arm of the North West Development Agency)[6] asked a sample of potential inward investors how they viewed the UK. The UK was compared against both recognised bioscience clusters (e.g. San Francisco, Boston, Germany, Denmark) and emerging bioscience clusters (e.g. Singapore, Puerto Rico, Korea). The UK scored 3 or 4 out of 5 on all categories, which included research presence, workforce skill levels, infrastructure and economic incentives. The UK was average, but was not rated 'poor' in any area.

The UK did not excel in any area. However, distinctiveness across one or more dimensions can be the critical factor for attracting investment, to the extent of offsetting some clearly unattractive features. For example, of the 'highly attractive' locations, Boston scored very highly for strength of the local research base and top talent, but negatively for operational costs. Puerto Rico and Singapore, on the other hand, are seen as being attractive locations due to the tax incentive regimes, despite having

6 Cluster benchmarking study, BioNoW, September 2002. www.bionow.co.uk

little or no established bioprocessing sector or research base. The well-publicised activities of animal rights extremists, which are discussed in *Chapter 2*, also have an impact on perceptions of the UK as a possible location for inward investment. The BIGT needs to focus on, and communicate, what makes the UK distinctive as a site for investment.

The BIGT view is that the UK needs to be seen as a centre of outstanding research, expertise and bioprocessing talent and that this can be delivered by the proposed Centres of Excellence.

4.2.1 Contract a specialist company to identify and respond to potential inward investors and liaise with a bioprocessing dedicated individual appointed to InvestUK.

Current situation: There is no bioprocessing dedicated resource within the UK inward investment marketing effort. Bioprocessing is subsumed within broader pharmaceutical/bioscience efforts (where they exist), which inevitably are dominated by the agendas of larger industries.

The recommendation: While InvestUK has performed very well in attracting elements of the pharmaceutical industry to the UK, it does not have the experienced staff needed to address the new bioscience sector. The BIGT believes it is necessary for a specialist company to be contracted, which can first identify potential inward investors, build relationships and subsequently respond very quickly when opportunities arise. It would be important for such a company to have excellent links with InvestUK, and the latter would need an identified individual to deal with liaison, to drive the initial choice of contractor, and to monitor its performance. This individual would also coordinate the representation of the UK bioprocessing industry at international showcases (e.g. Bio2004 etc.). The dedicated individual needs to be supported by an appropriate marketing budget (£100,000). Furthermore, in order to be effective, a stronger commitment is required by InvestUK to build the foundations of a new industry like bioscience.

4.2.2 Develop a more coordinated approach for facilitating the evaluation of potential foreign inward investors.

Current situation: More comprehensive support should be given to potential foreign inward investors who are in the process of considering investing in the UK. Better methods of ensuring that advice and knowledge from a variety of sources (e.g. planning, tax, European sources of support) can be accessed quickly and easily should be investigated. Support also needs to be responsive to the circumstances of each bidder (e.g. nature and size of project, constraints on location, country of origin of potential investor etc.).

The recommendation: Greater co-ordination should be encouraged between the different bodies, focused on attracting foreign inward investment. Ways of linking the formation of joint or co-ordinated marketing programmes to funding support should be investigated. The newly appointed liaison officer within InvestUK should facilitate the coordination of the efforts of the various UK organisations involved in inward investment.

4.3 Foster bioprocessing community development.

Current situation: The UK bioprocessing industry is smaller and more geographically diverse than other bioscience sub-sectors, with full-time company executives attempting to play national 'industry' roles as their executive commitments allow. Communication both within the industry and to external audiences tends to be either informal or a follow-on from broader initiatives. This constrains potential knowledge and best practice-sharing opportunities within the bioprocessing sub-sector. It also limits external awareness of the industries' knowledge-driven basis and its broad impact. Two recommendations are made to resolve these problems.

4.3.1 Sponsor a Bioprocessing Industry Development Director.

The recommendation: A Bioprocessing Industry Development Director should be appointed and based at the BioIndustry Association (BIA). This individual would be tasked to develop and coordinate strategic initiatives to build links within the sector and across regions and promote the sector externally. The individual would also have a key role in shaping the knowledge infrastructure and agenda of the industry through coaching and co-ordinating Centres of Excellence.

4.3.2 Develop an agenda-setting programme of industry events, including a focal point annual National Bioprocessing Forum.

Current situation: There are currently a number of relatively small and fragmented bioprocessing related meetings and events.

The recommendation: An annual National Bioprocessing Forum should be held to maximise profile, impact and networking opportunities in a single, focal event. Whilst the nature of this event is likely to be determined by the Bioprocessing Industry Development Director, the critical mass of people stimulated by a single date and location should ensure that it becomes a 'red letter' day or days for participants and presenters alike. The forum could be hosted by a different group each year to ensure the event retains national appeal. The Forum should aim to become the international event for presenting the latest bioprocessing knowledge and sharing experiences with peers.

As with other industry events (e.g. polymers), initial pump priming funding will be required. But over time the event should become self-supporting through delegate fees and sponsorship. An initial funding contribution of £100,000 will be required because (unlike polymers) there is no established bioprocessing sector as yet. This funding will include substantial bursary support for knowledge development and travel.