ASSESSING THE VALUE OF MEDICAL DEVICES

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# Table of contents

Executive summary ........................................................................................................... 3

Introduction ......................................................................................................................... 4
  Supply chain research ........................................................................................................ 5
  A unified view ................................................................................................................... 5
  MATCH’s contribution to date ........................................................................................... 8
  Territories of interest ......................................................................................................... 8
  Findings and recommendations ....................................................................................... 9

Annex A. Health Technology Assessment ......................................................................... 11
Annex B. Procurement in the NHS – Overview and perspectives ..................................... 12
  Centre for Evidence-based Purchasing (CEP) perspective ............................................... 13
  Collaborative Procurement Hub (CPH) perspectives ...................................................... 13
  A Hospital Trust (Medical Physics dept.) perspective ...................................................... 14
  Conclusions from consultations with NHS bodies .......................................................... 15

Annex C. Perspectives on value ........................................................................................ 16
Annex D. Measuring quality-of-life for economic evaluation ........................................... 18
Annex E. Health economic evaluation .............................................................................. 20
Annex F. A simple cost utility evaluation example ........................................................... 22
  Notes to model ................................................................................................................. 23

Annex G. Multi-criteria decision-making ....................................................................... 25
  Decision-making within the multi-criteria frameworks ................................................... 25
  Creating a MCDM aid for purchasers .............................................................................. 25
    a) ELECTRE III .............................................................................................................. 25
    b) PRES ......................................................................................................................... 26
    c) TODIM ..................................................................................................................... 26
  Choice of MCDM aid ...................................................................................................... 27

Annex H. Glossary ............................................................................................................. 28
Annex I. References ......................................................................................................... 29
Executive summary

Although a relatively small percentage of the NHS budget is spent on bought-in products and services, the area is very important for two reasons. Firstly, it is one where the impact of industrial process and logistical advances may make a strong and early impact. Secondly, because procurement is on the whole easier than service redesign, it provides a good environment in which to learn about translating industrial process developments into healthcare.

As part of a project to link the supply-chain expertise of CRiSPS at Bath University with the assessment and economic evaluation strengths of MATCH (a collaboration between the Universities of Brunel, Birmingham, King’s College London, Nottingham and Ulster), this report considers the way in which supply-chain management may be supported in its decision-making by methods that focus on health outcomes or related measures. The report is based upon a short collaboration between CRiSPS and MATCH under the auspices of the NHS Purchasing and Supplies Agenda (PaSA).

The teams have explored various perspectives from which to view the procurement paradigm, and an important element has been to encourage each side to conceptualise its views diagrammatically. While the diagrams produced by each side bear many similarities, it has not yet been possible to generate a unified single view of procurement that fully reflects both a supply-chain analysis and health-related decision-making factors.

The most interesting piece of the analysis has consisted in partitioning up the procurement space into regions where decisions require extensive economic evaluation, regions where decisions may safely be made according to purely business or operational criteria, and those where some form of analysis with health-related measures may be needed.

This theoretical partitioning has very real implications for NHS procurement. It would appear that it should be possible to relate some of this territory to the different levels of procurement in the NHS, such as the new procurement organisation recently privatised under DHL and Novation, NICE (the National Institute for Health and Clinical Excellence), the Centres for Evidence-based Procurement (CEPs), and the Collaborative Procurement Hubs (CPHs). More work is needed to match the decisions being made by these bodies to the partitioning of the procurement space described in the previous paragraph, and such a result would represent an important conceptual achievement and provide critical support to the NHS.

The research needed to complete this picture and the development of underpinning methodologies to make an impact upon procurement, will enable communities to take a more responsive view of evidence and match the scope of evidence and the way it is applied to their particular need. Whether the methods are finally applied through training or deployed as simple tools is still an open question. However, providing open data on costs, utilities and other health-related measures is highly recommended, both to speed the process of evaluation and to ensure it is consistently applied across the nation.

To accommodate a wide range of readers, the main body of the report is a relatively succinct narrative that discusses the salient issues and runs through to a set of recommendations. For more material in the form of historical record, analysis or discussion, the reader is referred to a set of self-contained Annexes, including a Glossary (H) and a full set of references (I). In this way we aim to provide access to the main thinking, and to the detailed analysis as appropriate.

Recommendations:

The recommendations, discussed in the main body of the report are that efforts be made to:

- Research and develop a shared understanding of value that is understood by manufacturers, suppliers, buyers.
- Take a more responsive view of the type of assessment that is needed and is possible.
- Facilitate simple but appropriate local assessment of cost-effectiveness.
Introduction

More than ever before, today’s NHS must deliver uniformly high quality of care across the nation and to do so with increasing emphasis on value-for-money. For many years now, healthcare has looked to industrial methods to streamline processes and enhance quality. One such method, for instance, is Lean Thinking, which focuses on eliminating waste (Laursen et al., 2003; Locock, 2003; Spear, 2005), and the NHS improvement agenda appeals heavily to this and other such approaches. More germane to this discussion is the fact that industrial thinking has advanced significantly in terms of the supply chain, and it is expected that with such insight, it should be possible to reap healthcare benefits in terms of procurement. The same thinking is also expected to impact upon prescriptions (Department of Health, 2000b), but in that case, the NHS is not fulfilling the role of customer.

As discussed in Annex B, the exact budget for bought-in services and products is not clearly defined, but was probably around £5B, or <10% of the cost of the NHS, in 2004/5. About 80% of this was negotiated through the NHS Purchasing and Supplies Agency (PaSA). While this is quite a small fraction of the overall NHS budget, it represents ‘low-hanging fruit’ from which some savings may be made, and through which a valuable understanding of the role of industrial process in service provision may be obtained. In essence, industrial methods seek to improve performance against operational and business-related measures.

However, there are several other sources of knowledge that must also be brought to bear in considering how to improve the quality of services and products procured by the NHS and the value-for-money that they represent. Broadly, there is a massive literature on health technology assessment (HTA) – and some background is provided in Annex A. In terms of methods and tools, these range from tick-lists to assess patient satisfaction through to specialised tools to measure clinical and quality of life outcomes. An important area within HTA is that of economic evaluation, which can use a number of detailed methodologies all of which address the issue of the ‘value for money’ of interventions and technologies. HTA methods seek to assess outcomes with reference to users and the contexts in which they operate and, specifically in the case of health economic assessment, against patient outcomes, where possible.

In terms of the current scene, procurement is complex. At a national level, detailed economic evaluation of a relatively small number of high profile pharmaceuticals and medical devices supports their appraisal by NICE (National Institute of Health and Clinical Excellence) which then issues nationally relevant guidance. Its appraisal process is described below. NHS Trusts have their own purchasing departments and the NHS Purchasing and Supplies Agency (PaSA) has provided national support in bulk-buying and other logistical services. This role is being divided up, with the CEP (Centre for Evidence-based Procurement) being brought in as a distributed organisation with centres across the UK, being developed on the one hand and the logistical elements being privatised recently in a partnership with DHL and Novation (see Annex B).

While the NHS finds itself under particular pressure at present to make appropriate savings where possible, the danger is that driving the system by cost considerations alone may create disbenefit that fails to show up through standard accounting and performance metrics – and may ultimately endanger the clinical and healthcare goals of the organisation. In particular, there is a danger that short-term measures may lead to purchasing at lowest price, rather than purchasing of best value (in terms of health, safety and efficiency improvements).

The authors of this report have come from a background representing the clinical, healthcare-related and health economic communities alluded to above, under a collaborative programme called MATCH (Multidisciplinary Assessment of Technology Centre for Healthcare). The report has been produced as an initial attempt to scope the different factors that need to be considered in the range of decisions to purchase medical devices. From this, it explores how procurement within the NHS might tap a wider skill set and make marked improvements to procurement. Annex B (Procurement in the NHS) provides substantial background to the current NHS procurement scene and describes the evidence-gathering that went into this report.
Supply chain research

For many years, PaSA has collaborated with CRiSPS (Centre for Research in Strategic Purchasing and Supply) at Bath. As its starting point, this report uses a simple perspective provided by Professor Christine Harland and her team.

Figure 1. Systemic vs. health improvement for healthcare procurement (HITF/Harland/Gardner working document)

Figure 1 takes a supply chain perspective and casts the problem in two dimensions, the health improvement, and the systemic impact. The former aims to embrace the clinical and delivery aspects of care, while the latter is an attempt to express its scope and scale. It is not clear quite how such a perspective is to be unified with the perspectives represented by the other corpuses of knowledge alluded to above, or even whether it is possible to do so in this particular form.

We have taken Figure 1 as a prototypical proposition and although this itself is currently a work in progress, it has provided a base from which to proceed.

A unified view

Figure 1 has several strengths that have proved highly fruitful in this study. Firstly, it has set an example of encapsulating great complexity in a relatively simple format, and has encouraged the team to seek similar representations and to relate their axes, or dimensions of research to those of Figure 1.

Perhaps even more importantly, it is immediately clear from Figure 1 that the concept of value required for procurement decisions, varies markedly around the graph, and certainly from quadrant to quadrant. Some of these views are examined in Annex C (Perspectives on value). Without the question of clinical outcomes or quality of life measures, procurement in healthcare would be a relatively straightforward problem and would benefit immediately and significantly from wholesale importation of the logistical improvements realised in other sectors. Moreover, there will be many decisions where the change in health benefit is essentially too small to measure against the extra cost or cost savings (for instance in choosing between brands of equipment) or else it is widely agreed that all the products or
services under consideration are commodities that offer essentially the same benefit, in which case it is safe to make a decision on cost or operational grounds alone. It is interesting to note, however, that even procurement of furniture, which would once have been considered in such a category, is now subject to guidelines that relate back to health outcomes, at some level, in terms of strain injuries and eyesight.

Many purchasing decisions have a strong element of patient, or other user, benefit which is likely to have a complex effect over a long period of time. In such cases, a robust assessment of the overall gain in user benefit and the overall difference in cost of treatment is needed. Additionally, the value of added safety should be considered more explicitly to aid the purchasing decision process. Currently, a product is considered to be either safe or not, which ignores potential (incremental) improvements in patient safety and the associated (economic) value of this to the users and the NHS. It is important to add that learning from patient safety incidents is the mission of the National Patient Safety Agency (NPSA) and this learning process also leads to incremental improvements in product design and usage.

Some of these decisions are now handled through NICE and we must return to that in due time. Underpinning such an approach is the ability to measure health-related quality of life HRQoL (see Annex D), and then to incorporate such measures in an appropriate way to an economic evaluation. Annex E provides an introduction to some of the techniques and results obtained in such evaluation.

These extremes are easy to identify, and the more difficult position lies in identifying the value afforded by economic evaluation in more routine purchasing decisions, and then in matching the techniques, the amount of evidence required, and the locus for analysis to the decision-making need.

In trying to assess how other assessment methods and measures may be combined with a supply-chain view, a number of observations are pertinent:

1. In making decisions, health economists distinguish between **allocative efficiency** and **technical efficiency**. The former applies across activities of the health service (e.g. healthy eating versus late-stage cancer treatment) for which a common, broad measure of effect is required. The latter relates to the most efficient means of delivering a given service within a predetermined budget. It is difficult to see how this distinction relates to Figure 1.

2. The QALY is a contentious and poorly understood measure, especially for those not engaged in economic assessment. While the literature is alive to many philosophical and pragmatic concerns, the QALY is undoubtedly the best method currently available to put a wide range of outcomes onto a common footing and to provide comparative analysis on that basis. The incremental QALY is most useful where the effect is principally and (fairly) directly one of changing patient outcomes. Moreover, there are short-cut methods to estimating incremental QALYs, and sometimes there are surrogates for patient outcomes to which one might appeal. Thus, while a formal evaluation such as NICE might conduct, could take 18-24 months overall, there are reports of useful analysis for hospitals that might typically take 3 months to complete (see Annex A). Part of MATCH’s contribution lies in presenting some ways to perform useful assessment in short periods of time (see Annex FF).

3. The role that NICE plays in the UK requires elucidation in this context, since the various strands do not map well onto the schema shown in figure 1. For instance, NICE is unique in at least two senses. Firstly, it provides an open and inclusive process that pays high regard to ensuring that the evidence has been appropriately gathered and processed, and that it has been seen to be managed in this way. Secondly, it admits a range of evidence from a range of stakeholders – including health technology assessments from manufacturers. As a result of this, it provides guidance that is both technically and ‘legally’ robust. Importantly it also does so in a political context where the desire is to reduce local variation and to combat the ‘post-code lottery’ by setting national ‘standards’.

4. In principal, it is possible to provide much quicker appraisals based on an HTA undertaken to inform a one-off decision. There is much in the literature about the desirability of HTA that is tailored to the local needs and responsive to local demands and timescales. This is possible on a limited evidence base, but it may become subject to challenge as more evidence is appraised. How best to manage the trade-offs between timeliness and responsiveness to local needs on the one hand, and robustness and
national standard-setting on the other, could be the subject of important research and procedural development in this field.

The critical issue is the need to link an appropriate analysis to the decision to be made. Figure 2 is again a little speculative, but captures the fact that where there is high patient impact and high total cost implications at a national level, then one would want a NICE-type, appraisal. However, there will be other procurement decisions – whether more local; or because the impact on patient outcomes is very much smaller; or because of the need to make a swift allocation of local resources; or even to be responsive to unusual local needs or specific procedures – where a ‘cut-down’ appraisal may be appropriate. As a counter example, however, we note that a one-off decision to build or redevelop a local hospital would still be subject to formal review using complex analysis.

Provided this could be appropriately specified, HTA evidence might be furnished entirely by the manufacturer or vendor! In such a circumstance, it would fall to third parties in the NHS procurement chain, firstly, to define carefully what evidence is required, and, secondly, to appraise such evidence when it is presented.

In terms of the shortest period required to make a decision, this is presumably where standard commodities are to be purchased and where price, delivery, or other operational measures will dominate the decision-making. The great danger here is that what might look like a commodity to a procurement agency may look like a more specialised product or service to the clinician, patient or other end user. Tomkinson et al (2005) provide an salutary example of this effect in the purchase of disposable instruments for tonsil and adenoid surgery. In this case, it turned out that only selected disposal instruments obtained the same low rates of haemorrhage as reusable instruments, while most disposals doubled the rates of patients being returned to theatre for remedial treatment. This example also highlights the need to explicitly include the value of potentially safety losses or gains in the equation, even if the medical device is CE-marked.
**MATCH’s contribution to date**

MATCH has engaged in methodological development and, as a community of researchers, also reflects a number of health-related perspectives. However, it is in trying to make simplified versions of more rigorous practice available to communities that need to make decisions quickly, that MATCH’s work to date most closely aligns with this agenda.

Although focused more on the industrial problems of identifying and articulating value, MATCH has explored a number of approaches that may prove fruitful on the purchasing side of the medical device sector. Moreover, there is much to commend a common approach on both the supply and demand side, since both purchasers and vendors have much to gain from a common view of what constitutes value.

MATCH has taken a pragmatic view and has learned through practical case study e.g. Dong and Buxton, 2006. The critical question was whether the extra accuracy of alignment that computer assisted surgery could provide would be worth the extra cost of the computational and alignment technology. The diagram indicates that a relatively sophisticated model is required – although it was possible to answer the question with a few months of effort. To make this type of analysis more accessible to industry, the team has experimented with ‘cut-down’ versions of a full evaluation. As described in Annex F a very simple version of a decision-tree has been turned into a spreadsheet tool and is being taken out to see how industrial partners might use it. Clearly, this approach takes some of the rigour, and to an extent, some of the insight, from the process. However, it should be possible to obtain basic results within a few hours.

Finally, there are a variety of decision-making scenarios in which several factors must be weighed together. In an industrial context, this might involve using several factors to choose a few successful candidate concepts for further development, from many tens of ideas on offer. In a procurement environment, it may involve addressing a number to factors raised by different stakeholders in a decision. Some examples and discussion are provided in Annex G.

This work demonstrates that there are a number of ways in which quite complex methodologies may be made available to communities. Specifically, training through short courses, and the development of tools, are two ways of introducing some of the economic evaluative thinking to communities whose interest has traditionally lain elsewhere.

** Territories of interest**

As illustrated by Figure 3 it appears that there are at least three regions of interest as far as procurement processes are concerned. Firstly, there are those areas of procurement of commodities whose performance is well understood and where there is essentially no differential impact on outcomes to patients.

![Figure 3. A tentative view of decision-making responsibilities for NHS procurement](image-url)
Syringes, for instance, might fit into this category. In such circumstances, procurement is all about supply chain and logistics. A second area is one where formal, robust, legally-defensible appraisal is required – the NICE territory – and covers cases where there is significant patient impact. This may be on a national scale – but some cancer treatments, for instance, have great potential for good outcomes even though they affect relatively small numbers of people and are not necessarily expensive on a national scale. Furthermore, many health economic evaluations are deemed necessary to assess the value of drugs or vaccinations, for instance, that makes little impact on average, but are delivered to the whole population. Finally, there is the territory between, or beyond these boundaries in which a more limited economic evaluation may be useful, and where a purely business assessment would be unacceptable. Specifically, in this region, more restrictive measures of success may be applicable – especially if the local provider is not under pressure to provide a particular product or service, or if it has choices as to how to do so.

Figure 3 shows how these regions might lie on the axes of Figure 2 – although they are indicative, rather than exact at this stage. Just as MATCH has started to develop cut-down assessment methods for industry (Annex FF), so it might be appropriate to consider what measures are appropriate for the new procurement hubs and to augment the services available from the centres for evidence-based procurement.

There are essentially two broad ways forward:

1. Greatly extend the reach of NICE to provide preliminary appraisals based on a much more limited evidence base on a much wider range of devices and interventions. This focus on the speed of assessment rather than the scope of evidence could meet many of the demands for more and for more timely appraisals. NICE is currently experimenting with such an appraisal process, but beyond noting this, such an option is not within the remit of this report.
2. Develop procedures and a training regime or a tool set to enable the procurement hubs and centres for evidence-based procurement better to specify and assess the data they require and also to conduct appropriate, independent evaluation.

However, in line with the three types of procurement discussed in this report, it is possible, and probably better to recast the proposals in terms of:

1. What should be assessed, appraised and determined centrally; i.e. adopt the NICE style which recommends what is best guidance for the NHS.
2. What should be assessed by a single agreed body; which appraises the evidence but does not attempt to determine which is necessarily the best which may depend on local circumstances (akin to a ‘Which’ report). So assessment is not duplicated but decision-choice is local; the assessment could be as sophisticated or as simple as the technology required.
3. What has to be assessed locally because it is entirely locally dependent (e.g. configuration of services).

**Findings and recommendations**

The main finding of this report is that a purely operational or business oriented methodology will fail to provide the various procurement functions within the NHS with the evidence needed to make high value, cost-effective, legally defensible decisions. Melding the enormous progress made from this perspective, however, with a more outcomes-based view of evaluation is a fascinating area and requires more research.

In the meantime, we recommend that measures be put in place to initiate, implement or accommodate the following:

**Research and develop a shared understanding of value that is understood by manufacturers, suppliers, buyers.** This initial study indicates that it should be possible to define some common ground, but further research is needed to pull the various disciplinary perspectives together into a robust and unified view of the problem. For instance, more research is needed to align some of the critical issues in economic evaluation (including the value of incremental safety) to a purely supply-chain view of the world.
Take a more responsive view of the type of assessment needed – and possible. New and better criteria are needed to match the decision-making requirement to choice of evidence and analysis to be used to reach a robust decision. This may range from economic evaluation based on incremental QALYs, through to well-chosen surrogate, or more restricted measures. MATCH methods already developed to help industry demonstrate the value of their devices could, for instance, be applied to purchasing. Some independent work is being done in the Collaborative Procurement Hubs (CPH) on developing tools, and finding ways to align these with new work would be useful.

Facilitate simple but appropriate local assessment of cost-effectiveness and appropriate training in essential and specific tools. One element would be readily accessible tables of costs, utilities and other evaluation-related material, as would appropriate training and tools. This would meet the dual aims of simplifying and speeding up evaluation on the one hand, while standardising the findings on the other.
Annex A. Health Technology Assessment

HTA can be defined as scientific research towards a healthcare technology focusing on medical effectiveness and at least one other aspect of healthcare, as for example costs, organisational aspects or quality of life, with the explicit aim to provide input to decision-making in policy and practice. Technology must be understood in the broadest sense of the word here. Not only medical instruments or medication are meant, also organisational arrangements can be captured by this term (Banta, 2003). The most crucial element of HTA is the health economic evaluation (see Annex E).

Under pressure of rising healthcare expenditures, rapid technological change and the necessity to rationalise healthcare technology, the field of HTA has grown fast within the last decade, especially in Western Europe. However, most people dealing with HTA have not tended to be academics involved in scientific, comparative analysis. Initially, there was a lack of pressure to develop the conceptual clarity of HTA, although with the emergence of NICE, considerable advances have taken place. Instead, HTA was applied to the demanding everyday business of supporting policy makers and industries to solve difficult problems (Banta, 2003). Thus, NICE methods basically evolved from these less sophisticated, regional or local, attempts to address the same issues. One of the ideas behind NICE is that it is better to do one excellent HTA, instead of spending resources on several flawed ones. However, it is also recognised that for technologies that are likely to have only moderate impact on health or the health care system, and for which the outcomes might heavily depend on local circumstances, an abbreviated HTA process might be preferable. An abbreviated, or ‘single HTA’ process (i.e. single technology, not single assessment) would involve less consultation and rely more on manufacturers submissions. Using mini-HTAs to reduce the time would greatly benefit the procurement process. However it would have added benefits to the vendors, too, enabling them to provide answers to such questions as: “Should we proceed to develop this technology further or not? or, “How much effort should be spent on marketing this product, given the likely gains that are going to be made from it?”.

Still, for either large or small scale HTAs, there needs to be sufficient justification of the data sources, in order to determine the internal and external validity of the outcomes.

Experience with mini-HTAs is reported in the Danish and Canadian literature (Ehlers et al., 2006; McGregor, 2006) These papers report a reduction in the time taken for the production of these HTAs down to an average of three months. Critical success factors in both cases were the availability of local information and a management team strongly supporting the HTAs. This proximity to the data promoted understanding of the assessments and resulted in all policy recommendations being accepted. In addition to enhancing understanding of HTAs by using ‘familiar’ data one could also focus on better training of decision makers regarding HTA.
Annex B. Procurement in the NHS – Overview and perspectives

The Healthcare Industries Task Force (HITF 2004) estimated that in 2004/5 the NHS would spend £8.6B as a combination of strategic capital and operational capital, and further £4B (around 6% of NHS revenue) on products and services negotiated through the NHS Purchasing and Supplies Agency (PaSA). The procurement covered in this report is probably a combination of the operational and PaSA spend and may have amounted to £5B in 2004/5 – perhaps 8% of the total cost of running the NHS.

It is not easy to understand how all this money is spent, and the study team has undertaken a combination of desk-based study and interviews. The latter included:

- A meeting organised by PaSA and CEP with CRiSPS at Skipton House (August 3 2006, Dr Michael Craven, Dr Julie Eatock).
- A meeting with Kevin Pritchard of the Greater Manchester CPH at Nottingham University (August 16 2006, Dr Michael Craven, Dr Steve Morgan).
- A meeting with Dr Daniel Clark, a Medical Physicist from Nottingham University Hospitals Trist at the University of Nottingham (August 21 2006, Dr Michael Craven, Dr Steve Morgan).
- A meeting with Ian Shephard and Ian Poxon at Re:Soruce, East Midlands CPH (August 29 2006, Dr Michael Craven and Dr Steve Morgan).
- A MATCH internal meeting at the University of Nottingham (August 31 2006, Dr Michael Craven, Dr Julie Eatock and Dr Steve Morgan).
- A second meeting at Re:Source, with Melanie Evans (September 7 2006, Dr Nick Botterill and Dr Michael Craven)
- A MATCH internal meeting at Brunel University (September 11 2006, Prof Martin Buxton, Dr Michael Craven, Dr Hengjin Dong, Dr Steve Morgan).

In addition, Stuart Williams (Forum for the Future) submitted e-mail evidence to Dr Michael Craven on August 30 2006.

In general terms there are a number of changes and drivers for change to procurement in the NHS at several levels. The following were noted:

- Current HITF recommendations include the need for increased use of objective evidence in order to broaden the concept of Value for Money (VFM) in NHS procurement.
- Move of the DES from MHRA to join PaSA, as recommended by HITF, renamed CEP. PaSA is tasked with providing a commercial strategy for healthcare procurement.
- Outsourcing/privatisation of NHS Logistics to DHL/Novation. “This deal will give DHL and Novation control of almost one third of a total NHS medical supplies and equipment market worth around £3.7bn a year. However, the DoH makes clear that DHL/Novation will be expected to increase that market share by as much as possible over the course of the 10 year contract.” (Association of British Healthcare Industries, 2006)
- Formation of regional NHS collaborative procurement hubs (CPHs), bringing together multiple stakeholders in order to reach savings targets in non-pay spend, and attempt to reconcile savings across a silo-budget environment within Trusts and across Trusts in the region.
- National eTendering frameworks that operate through bidding on basis of lowest bid.
- Drive for sustainable ‘greener’ procurement informed by Forum for the Future initiative.
- Finance deficits in some NHS trusts (resulting in regional & local reconfigurations e.g. Trust mergers), which can be attributed in part to “cumulative under-spend between 1972 and 1998 calculated as £220b in 1998 prices.” (The NHS Confederation, 2005)
These changes have had a significant effect on the roles and perspectives of the various parties. A series of perspectives are now reported below.

**Centre for Evidence-based Purchasing (CEP) perspective**

Device evaluation centres within the CEP aim to be the first independent bodies to carry out evaluations of CE-marked equipment in their respective areas of expertise. Cost savings are due to avoiding complications by correct choice of equipment. For example if glucose monitoring motivates the patient to monitor their diabetes correctly, other downstream costs may be saved.

Previously the centres concentrated primarily on safety, and although this is still important, device performance is now the most important aspect of value considered by CEP. However, if added value of (incremental) safety improvements would be valued on a more continuous scale, as opposed to a rather crude ‘safe or not safe’ classification, this would allow to incorporate this aspect in the performance measure of a medical device and herewith aid to a more informative value measurement process. The value measurement of a device is dependent on both the type of device and whether it a simple ‘new for old’ type technology replacement, or if it is a disruptive or innovative technology. For example, in ‘new for old’ technologies then performance among the patient group is taken into consideration, whereas in a disruptive or innovative technology with a completely different clinical pathway there is more reliance on evidence from literature reviews and results from RCTs or appropriate clinical trial.

The CEP have to demonstrate value to different stakeholders depending on the device. For patient monitoring in an ICU, evidence is provided for the Trust rather than the patient, so value is measured on behalf of the provider and their staff. For assistive technologies, value is about a patient living a fuller life and to reduce burden on NHS, carers, parents, teachers. Therefore one size does not fit all in terms of determining value for different types of device – different tools may be needed.

**Collaborative Procurement Hub (CPH) perspectives**

CPHs are ‘owned’ by the Trusts within a SHA and implement a business plan. The CPH is supported by NHS PaSA and the Commercial Directorate to increase commercialisation, to co-create solutions through interface to clinical need, and to align goods across regions. Current focus within CPHs is in minimising costs by intelligent procurement and breaking down barriers of silo budgets.

Category managers undertake a base-line assessment of the supply category in question. Strategy Teams consider the whole treatment pathway for that category based on advice from clinical procurement specialists (nursing teams), and work out if it can be done differently. Clinical advisors may draw on ECRI assessments for input to the base-line phase. Options for change include contracting and/or restructuring. Performance management provides feedback to assess the changes made.

Trust finance directors have bottom-line cost-targets, which dominate most Trust steering groups, whereas the SHA has health outcomes targets. It can be difficult to convince Chief Executives about the validity of creative cost-minimisation proposals since thinking may be dominated by unit cost minimisation, savings that would allow the closing of whole wards, and annual budget reductions. It is likely to be more difficult to convince Chief Executives to spend more for better patient quality of life or improved safety. Within any decision-making aid, the weighting of priorities for Trusts will depend on its financial position and they will decide how to do this e.g. a less financially healthy Trust might prioritise financial governance over a sustainability strategy (MATCH comment: this is not to say that sustainable procurement won’t save money in the long term, but the results may be difficult to measure over a shorter period).

A way forward is to build clinical networks within Trusts to make decisions about options for change within a silo, then extend to the whole Trust, and then over multiple Trusts within the region. Further to this, ‘adoption hubs’ are being used to bring patients into the process of assessing innovations. Procurers might be resistant to use of QALYs, however they should just be treated as a number representing patient benefit. A strategy for improvement of quality
and safety of care together with cost saving is to use the ISIP quality and value models to inform delivery of Packages of Care or a ‘Voice of the Customer’ model.

Nine principles of care are set out by the Department of Health (DoH) though the Integrated Service Improvement Programme (ISIP) Care Delivery System. The 9 principles are:

- Health equality across populations
- Support individual well-being
- Care provided in the right setting
- Appropriate access and choice for all
- Timely, convenient and responsive services
- High quality clinical outcomes
- Optimised workforce capacity and capability
- Efficient and effective delivery of services
- Financial balance across the local health economy

Finding a ‘clinical champion’ still seems to be the recognised way of getting a device into the NHS, but this will change with new strategies within the NHS. Some companies are now coming directly to the CPH with business cases. They need to think creatively about finance e.g. charge on a per-scan basis, or leasing, because, for instance, £50k initial cost for equipment may be hard to justify. The evidence that is acceptable to a CPH in coming to a decision can include: good examples/case studies, independent peer review, but generally not a company or laboratory test. Further evidence can be obtained from ECRI.

Sustainability of procurement implemented by the CPH is being informed by the Forum for the Future initiative (Stuart Williams has created FfF tool for PaSA: NHS Sustainable Procurement tool). A flexible framework for sustainability is based on a number of ‘foundation levels’ that must be reached by given dates. Short term focus of NHS budgeting is a problem for this since the NHS Sustainable Procurement tool is capable of measuring savings up to 30 years.

One area lacking is the patient perspective. The CPH cannot easily directly consider quality of life for the patient because they don’t see the patient. Adoption hubs may be a useful way of overcoming this.

A Hospital Trust (Medical Physics dept.) perspective

One of the problems with NICE appraisals of new technologies to the Trusts is that they cannot always afford to implement the recommendations. One of the reasons for this is that tariffs and a one-year budget cycle dominate. Moreover, some procedures may not cost more than Payment by Results (PbR) rewards the institution. Some kinds of endoscopic procedures fall into this category. Another feature is that ‘spend to save’ schemes are over 5 years which benefits treatment centres. This is because PFI contracts are based on predictive loading which are easier for them to predict.

Note that hospital Trusts have to compete for activity – which has the best A&E etc. There is a possibility that this may result in them not wanting to talk to the CPH in case of ‘leaks’ to other trusts.

Types of evidence used by the Trust are, audit information, in-house user trials/studies to determine usability and user preference, and journal papers (the medical physics dept. doesn’t tend to believe company provided information). Given the funding position of an individual Trust, it may be difficult to convince the Director of Finance to purchase with respect to patient benefit.

The Trust meets to decide on spending of capital equipment budget:

- Capital accountant informs when money is or might be available
- Medical planning group helps prioritise and assess needs – including historical replacement programme
• Look at bids and evaluation risk of not buying (rather than benefit). 3 risk categories (Low, Mid, High).

• An order is written and taken to tender if over £25k

• Whole life modelling of costs – including consumables and maintenance is considered but patient QoL or length of hospital stay is not.

In the case of suppliers to Trusts, SMEs can get left out as they can often not be considered as a reliable supplier, even if it’s a better system. The Trust asks for 5 years notice for removal of support and maintenance on obsolete devices, which is a problem if the supply chain collapses. Guidance changes can be a problem for suppliers e.g. resuscitation devices that lead you through the procedure are made obsolete if the step-by-step process can’t be upgraded, even if only 3 years old, and companies refuse to upgrade.

**Conclusions from consultations with NHS bodies**

Due to the present financial climate, the NHS as a whole appears to be dominated by a perceived need for cost (or ‘waste’) minimisation. Hospital Trusts especially are finding it difficult to see beyond 1 year cost-cutting targets and they are feeling financially constrained by PbR tariffs on one hand, and pressured by NICE policy towards introduction of new technologies and patient demands on the other. It is a challenge, but it is possible to justify spending money on a device that will reduce costs elsewhere in the clinical pathway. It appears to be difficult to justify investment in a device (or device-related procedure) which increases costs but improves patient benefit or safety. Each CPH has a target for cost reduction across its region. From these enquiries, it appears that CEP is focused more on technical performance rather than on cost effectiveness.

Evaluations of different kinds of devices currently provide evidence for different audiences, some more directed at the practitioner (e.g. intensive care monitoring equipment), some more directed at the patient (e.g. disability aids). This presents a challenge for development of general evidencing methods. For these NHS bodies, acceptable evidence from third parties appears to be either in-house trials, or independent peer-reviewed published results rather than company data. ECRI is a useful source of evaluation information and was mentioned in all consultations. The Hospital Trust also sees it as their responsibility to carry out their own trials prior to making procurement decisions.

The regional CPHs are attempting to introduce assessment models based on ISIP Care Delivery System principles or Voice of the Customer models, and are finding some areas for cost savings across silos and across regions. They are also attempting to implement the sustainability programme which is a priority in the PaSA Corporate Plan.

There is currently a perception that the use of QALYs as a method of measuring patient benefit is the domain of NICE alone. This has perhaps much to do with lack of experience and training in Health Economics and the perception that it is always necessary to spend many months developing sophisticated models to come to a decision. The Forum for the Future is working towards an NHS-specific sustainable procurement tool that can be taken for local use, and in providing such a tool for use across the NHS there is recognition that there is a potential for ‘tool overload’. A similar approach could be taken to the introduction of tools for introducing Quality-of-Life and other value-based evidence into procurement decision-making. This would require development of simpler health economic procurement tools and models than those used by NICE. A further challenge will be to integrate the different value measures (e.g. safety) into a multi-criteria decision aid in such as way as to allow flexibility in their weightings that is appropriate to the priorities of different Trusts.
Annex C. Perspectives on value

Value clearly means different things to different people in healthcare organisations, its users, the medical devices industry and the wider society. Drivers for making purchasing decisions include the need to meet cost savings targets, to achieve waste minimisation/sustainability goals, to improve patient health, to encourage innovation, to meet regulatory standards, to ensure corporate responsibility (e.g. fair-trade considerations), to improve safety or manage risk. We note the following:

- Pressure from government to introduce Gershon-type Public Sector efficiencies (Gershon, 2004)
- Needs of individual Trusts to balance their books (and carry through annual deficits).
- Health outcomes targets of the Strategic Health Authority.
- Remit of Collaborative Procurement Hubs to facilitate NHS savings across silos and regions.
- Remit of National Institute for health and Clinical Excellence (NICE) to carry out evidence-based Health Technology Assessment to inform national health policy for new procedures.
- Remit of Centre for Evidence-based Purchasing (CEP) to evaluate devices to inform NHS purchasing.
- Sustainability initiatives to reduce waste and for ‘greening’ the supply chain e.g. from Forum for the Future.
- Specific needs that are being articulated by patient groups.
- Encouragement for introduction of new technologies that benefit both patients and society by the NHS Innovation Hubs/National Innovation Centre (NIC).
- The business aims of companies who are developing new medical technologies to sell.
- The strong focus of the NHS on improving the quality of care for patients through appropriate investment (Department of Health, 2000a)

For purchasing with respect to value to succeed in a meaningful way, it will be necessary to devise a common definition to inform decisions and use this to create a suitable decision-making aid for procurement, at the very least between buyer and supplier. We note that any decision-making tools so devised should always aid, not replace, decision-makers.

Given the multiple perspectives of NHS purchasing, can an appropriate decision-making aid be developed? No single technique will be able to evaluate every NHS purchase since different purchases will demand to be measured by different criteria. For instance, we cannot easily compare the purchase of a tongue-depressor with the purchase for a new cancer therapy. Being more of a commodity item, we might expect to select tongue-depressors on some combination of best-price together with consideration of safety, fitness-for-purpose from user and patient perspective, whereas a new cancer therapy might require more detailed cost-effectiveness analysis against competing therapies. Therefore there is a need for some type of multi-criteria decision-making (MCDM) tool.

The following are high level questions we would like to answer with respect to a value-based model:

- What are the dimensions of Value for Money (VFM) that need to be considered (e.g. quality-of-life, usability, safety, sustainability) and how can we weight the priorities?
- What different sources of evidence already exist that have the potential to (or already do) feed into the procurement process?
- Is it desirable to classify different kinds of devices/procedures that will require enhanced evidencing of VFM (thinking that some commodity items may not)?
- What is the potential of health economics to support purchasing on the basis of value, and what are the limitations?
• What are the challenges involved with accommodating additional dimensions of VFM into an environment of eProcurement (using lowest cost-based methods such as eAuctions/eTenders) and outsourcing to supply chain organisations that may also work mainly to lower price?
• What is the interface between the organisational aspects being looked at by CRiSPS and MATCH’s work on evidencing methods?
Annex D. Measuring quality-of-life for economic evaluation

There are many quality of life measures – many of which are used quite apart from economic assessment. However, to give a specific idea of the sort of measures available for economic analysis, we report on a widely used approach – the EQ-5D.

A measure of a person’s health state is given by a ‘utility value’ generally rated between 0 (death) and 1 (perfect health), although negative values may sometimes be applicable where a particular health state may be deemed to be worse than death.

EQ-5D, from the EuroQol project (The EuroQol Group, 1990), is one standardised instrument for determining utilities that is applicable to a wide range of health conditions and treatments (See Table 1 and Table 2). It provides a simple descriptive profile that can be completed by the patient which can be linked to a single index value for health status. EQ-5D was originally designed to complement other instruments but is now increasingly used as a 'stand alone' measure. In the UK, NICE guidance that requires the use of measures like EQ-5D with value sets that reflect the preferences of the UK population.

An aggregated measure of health state taken over time is captured by the Quality-of-life Adjusted Life Year (QALY) (Phillips and Thompson, 2003) so that a patient living in a health state with a utility of 0.4 for 10 years would gain 4 QALYs over that time, whereas a perfectly healthy person would gain 4 QALYs in 4 years.

QALYs provide a common currency with which we can compare different health interventions. The cost-effectiveness of a treatment is then measured by the cost per QALY gained (CQG) by that patient undergoing that treatment.

Table 1. EQ-5D scores (after Phillips and Thompson, 2003)

<table>
<thead>
<tr>
<th>Health state</th>
<th>Description</th>
<th>Valuation</th>
</tr>
</thead>
<tbody>
<tr>
<td>11111</td>
<td>No problems</td>
<td>1.000</td>
</tr>
<tr>
<td>11221</td>
<td>No problems walking about; no problems with self-care; some problems with</td>
<td>0.760</td>
</tr>
<tr>
<td></td>
<td>performing usual activities; some pain or discomfort; not anxious or depressed</td>
<td></td>
</tr>
<tr>
<td>22222</td>
<td>Some problems walking about; some problems washing or dressing self; some</td>
<td>0.516</td>
</tr>
<tr>
<td></td>
<td>problems with performing usual activities; moderate pain or discomfort;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>moderately anxious or depressed</td>
<td></td>
</tr>
<tr>
<td>12321</td>
<td>No problems walking about; some problems washing or dressing self; unable</td>
<td>0.329</td>
</tr>
<tr>
<td></td>
<td>to perform usual activities; some pain or discomfort; not anxious or depressed</td>
<td></td>
</tr>
<tr>
<td>21123</td>
<td>Some problems walking about; no problems with self-care; no problems with</td>
<td>0.222</td>
</tr>
<tr>
<td></td>
<td>performing usual activities; moderate pain or discomfort; extremely</td>
<td></td>
</tr>
<tr>
<td></td>
<td>anxious or depressed</td>
<td></td>
</tr>
<tr>
<td>23322</td>
<td>Some problems walking about, unable to wash or dress self; unable to perform</td>
<td>0.079</td>
</tr>
<tr>
<td></td>
<td>usual activities; moderate pain or discomfort; moderately anxious or depressed</td>
<td></td>
</tr>
<tr>
<td>33332</td>
<td>Confined to bed; unable to wash or dress self; unable to perform usual</td>
<td>-0.429</td>
</tr>
<tr>
<td></td>
<td>activities; extreme pain or discomfort; moderately anxious or depressed</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. EQ-5D health state valuations (after Phillips and Thompson, 2003)
There is an implicit upper threshold of £20-30k per QALY in order for NICE to be able to recommend a technology or intervention. However, the rule is by no means hard and fast (Devlin and Parkin, 2004; NICE, 2004)

There are some a number of acknowledged philosophical problems associated with the QALYs (see McGregor, 2006) but their usefulness as a means for comparing different types of interventions outweighs their drawbacks. QALYs are not a perfect measure but they do provide a gauge against which to base decisions, which is better than having no basis.
Annex E. Health economic evaluation

Health economic evaluation is a widely accepted method to support decision making about adoption or rejection of pharmaceutical and medical products and procedures by health service providers. It aims to jointly capture the costs and consequences of, for example an innovative medical device, and compare this to a competitive medical device (technical efficiency), another treatment (allocative efficiency) or usual care.

Generally, there are four forms of health economic evaluations; cost-minimisation, cost-effectiveness, cost-benefit, and cost-utility evaluations (Drummond et al., 2005)

Cost-minimisation analysis assumes the effectiveness of a new technology to be equal to its comparator. Therefore, only the costs of the new and the old technology are studied, with the cheapest alternative being the preferred one. Unlike pure cost-minimisation, use of more sophisticated health economic evaluations allows for a trade-off between the cost of a technology and its consequences. In this context, cost-effectiveness analysis refers to an analysis in which costs and the number of occurrences of a specific desired outcome are assessed for each technology (e.g. costs per successful hip surgery). In cost-benefit analysis, a monetary value is placed on the desired outcomes (for example, the value, or willingness to pay for a successful hip surgery might be GBP 20,000). When utilities are employed as a measure of the value a technology, we refer to this as a cost utility analysis. The results of cost utility analysis are typically expressed in terms of cost per quality-adjusted life year (QALY) gained, by adopting one technology instead of another or instead of usual care. Figure 4 shows how health economic evaluation can help make purchasing decisions based on cost-utility analysis.

![Cost-Utility Analysis Diagram](image)

**Figure 4. How cost utility analysis can help make purchasing decisions based on value to patient in terms of QALYs**

If the costs and utilities are known or otherwise determined, it becomes possible to reason about the cost-effectiveness of healthcare innovations in the context of individual interventions or over an entire care pathway. An illustrative example can be found in treatment of osteoarthritis of the knee where a patient may elect to have surgery for a prosthetic replacement. Clinical trials have recently shown that computer-assisted surgery (CAS) can give a better aligned prosthesis more often than standard surgery, and it is already known from the medical literature that poor alignment leads to major complications like loosening, which require costly revision surgery to be carried out. In addition there is a risk of complications such as infection that will require other treatments, and there is always a small probability of death. How are we to model this to see if CAS really is a cost effective procedure? It will be necessary at least to take into account the capital cost of the equipment and training required, and the costs for theatre time and anaesthesia, bed-stay and follow-up for both of the manual and CAS operations, plus the cost of revision.

A full HEA study undertaken by MATCH for Computer-assisted Total Knee replacement was conducted as a research partner project (Dong and Buxton, 2006). This full health economic analysis uses a Markov model technique which includes the probability of being in each of a
number possible health states and this is run over time to determine the cost on the patient population. Although this kind of analysis may take several months to work out the correct patient pathways and gather data for the health states and their probabilities, it can be carried out within the timescale of evaluation trials undertaken by DES/CEP, and it is helpful in allowing both supplier and purchaser to reason about the cost-effectiveness of a treatment.

Economic evaluation can be scaled to be appropriate to the circumstances from ‘back of the envelope’ to major long-term study. However, whatever scale the economic evaluation takes, the basic question remains: what is the incremental cost and incremental benefit of (using) this technology in a particular context? Also for small-scale analyses, incremental QALYs are considered the most useful outcome measure, provided that the effect is expected to be principally and fairly directly one of changing patient outcomes. For many medical devices, however, this may not be the case. Then, more restricted measures of effect are probably more useful, particularly where the technology does not comprise the introduction of a new technology for patients but merely influences the means of delivering existing services.

Although costs are always important, it may occur that at a local level other factors are the main short-term constraint. In considering alternative procedures in theatre, for example, the main constraint may be theatre time. In this circumstance, the choice may need to be made on a basis of maximizing theatre throughput subject to satisfactory costs and outcome.
Annex F. A simple cost utility evaluation example

If an answer is required more quickly, a simpler model may suffice. MATCH has been working with industry partners to develop a software tool to help industry make decisions about whether they should continue with the development of a device based on its value from the perspective of clinical cost-effectiveness. The notes at the end of this annex show the theoretical basis of a MATCH software tool that has been designed to carry out cost and quality-of-life modelling (using utilities) for a diagnostic test performed by a new medical device. The model consists of two decision trees, one for the case where a test is not used where the decision to treat or not is made by expert opinion of the practitioner alone (current clinical practice), and the other for the case where a test is used to help the practitioner make the decision about treatment (the proposed change in clinical practice). Each decision tree has two main branches, one for the decision to treat and one for the alternative decision not to treat. The decision to treat has a probability of it being made, denoted $p$, and has a value between 0 and 1.

![Decision tree](image)

**Figure 5. Decision tree populated with cost and utility data for the outcomes of a device-related test compared to existing decision not using test. The probability of treating is denoted by $p$**

MATCH has been working with its industry partners to populate such a model for their devices with values for $p$, cost data and where possible, utility values. Figure 5 shows an illustrative simplified decision tree model populated by data (see Notes to model for the assumptions that go along with this simplification). Although there is a cost associated with purchasing the device which is £100 pounds per patient in the example, the cost saving is shown to be £850 per patient as a result of reducing the probability for treatment and also from more efficient targeting of treatment with the test. Using hypothetical utility values, calculation of the ICER shows that overall patient benefit is increased as well. This simple model is appropriate for many types of medical device. An example provided by a CPH is of bladder scanning pre-catheterisation since the bladder scanning is likely to reduce the probability of a patient being catheterised. Another example is a device for determining the depth of a burn which could used to determine the need for skin grafting and the amount (area) of graft that is required.
It should be noted that the examples provided here fits into the 'lower cost, more benefit' quadrant of Annex E’s Figure 4 (bottom right), which should be a relatively straightforward purchasing decision. A more difficult decision for a purchaser is when the result falls into the 'higher cost, more benefit' quadrant (upper right) and in this case the amount of patient benefit (measured in QALYs) needs to be considered, along with other factors such as the needs of users, cost minimisation, sustainability, safety and supplier reliability.

**Notes to model**

**Decision Tree**

- **Treat**
  - Probability \( p = az \)
  - Utility = \( U_{T} \)
  - Cost = \( A + X \)
  - Total Cost = \( P \)
- **Don't Treat**
  - Probability \( 1-p = (1-az) \)
  - Cost = \( B + X \)
  - Utility = \( U_{T} \)
  - Total Cost = \( P \)

- **Treat**
  - Probability \( p = a \)
  - Utility = \( U_{T} \)
  - Cost = \( A \)
  - Total Cost = \( Q \)
- **Don't use Test**
  - (current practice)
  - Cost = \( B \)
  - Probability \( 1-p = (1-a) \)
  - Utility = \( U_{T} \)
  - Total Cost = \( Q \)

**Assumptions for best case (manufacturer’s point of view):**
- Treatment and non-treatment always results in healthy outcome
- Diagnostic test is 100% accurate

**Costs:**

\[
P - Q = a \left[ A(\alpha z - 1) - B(z - 1) \right] + X
\]

- \( A \) : Cost of treatment (without test)  
- \( a \) : Probability of treating without test  
- \( Z \) : Treated population modifier (due to testing)  
- \( \alpha \) : Cost modifier (due to testing e.g. better targeting of treatment)

**Utilities:**
\[ \Delta U = [azU_{iT} + (1-az)U_{i'T}] - [aU_{iT} + (1-a)U_{i'T}] \]

\( U_{iT} \) Utility of test and treat
\( U_{i'T} \) Utility of test and not treat
\( U_{iT} \) Utility of not test and treat
\( U_{i'T} \) Utility of not test and not treat

**Incremental Cost-Effectiveness Ratio (ICER):**

\[ ICER = \left( \frac{\Delta \text{Cost}}{\Delta \text{QALYS}} \right) = \frac{a[A(az-1) - B(z-1)] + X}{\tau [azU_{iT} + (1-az)U_{i'T}] - T[aU_{iT} + (1-a)U_{i'T}]} \]

(For timeframe = \( \tau \) years)
Annex G. Multi-criteria decision-making

There are a number of occasions on which several different criteria need to be applied in order to make a decision. Most of the time, it is possible to order these requirements within a single method and manage each appropriately. However, there are times when it is not clear how various criteria should best be applied. For instance, in choosing between a number of possible product concepts, one might wish to weight the business potential, the potential to meet a new user need, some clinical parameter and perhaps the likelihood that each will overcome regulatory hurdles or attract reimbursement. This type of problem faces large companies, which have a greater ability to generate new ideas than they have funds to take them forward. Analogous situations may face procurement agencies, particularly during times of upheaval.

MATCH has been investigating methods that enable one to make decisions based on a range of criteria, and to investigate the way in which the relative weightings applied to each criteria affect the ultimate decision. There are a number of these in the literature, and some are even available on the Internet. Here we report on some of those techniques.

Decision-making within the multi-criteria frameworks

If we consider the framework depicted in Figure 1 we can conjecture that criteria for making purchasing decision for different kinds of devices will vary across the impact axes. For instance as we move along the patient impact axis, quality-of-life might be less important in purchasing an office desk but might be the main criterion in assessing a customised prosthesis. Both could be expected to have low total cost implication since they concern a single (or small number) of users. An NHS IT system such as electronic patient records will have a high total cost implication but will be much less customised to individual patients than cancer treatments.

Different metrics can be used in each of the quadrants of Figure 1 (main section of report). For example, unit cost may be an important measure in the bottom left-hand quadrant, whereas waiting time to see a consultant may be a more relevant measurement for the top left-hand quadrant. As another example, across the bottom of the grid we might emphasise unit cost savings on the left through to a more patient-specific quality-of-life improvement on the right, illustrating how the focus could change from pounds to QALYs as one moves along the horizontal axis.

Creating a MCDM aid for purchasers

As illustrated by the examples in the preceding section, a decision tool for aiding purchasing decisions must have the ability to weight criteria depending on where the device falls on the priorities of the decision-maker. Initially all products and services would need to be ‘filtered’ to ensure that they meet minimum regulatory and safety requirements. Once the initial filter has been applied, purchasing alternatives can be compared using a multi-criteria decision-making (MCDM) aid that allows weights to be assigned to each criterion (e.g. user satisfaction and potential safety improvements beyond the minimal required level) separately, allowing the weights to change as you move across the axes and across decision-maker boundaries. Once criteria and weights are agreed (which could potentially be standardised for different categories of products) decision-makers assign a score for each product alternative. Finally the tool itself ranks the alternatives based on these scores and weighted criteria. The result should not be seen as ‘the answer’ but rather an indication based on the information provided. It would inform the decision by having formalised the process by which the decision maker selects and scores the alternatives based on each criterion, and by providing an insight into how the different possible choices compare overall.

Several applicable MCDM methods have been devised including ELECTRE, PRES and TODIM. These could form the basis of a practical multi-criteria decision aid for NHS procurement.

a) ELECTRE III

“ELECTRE was conceived by Roy (1991) in response to deficiencies of existing decision making solution methods. ELECTRE is more than just a solution method; it is a philosophy of
decision aid - the philosophy is discussed at length by Roy. However, for this report we shall concentrate on the method and specifically on what is referred to as ELECTRE III. ELECTRE has evolved through a number of versions (I through IV); all are based on the same fundamental concepts but are operationally somewhat different. It is important to note that ELECTRE is not being presented as the “best” decision aid. It is one proven approach.”

Excerpt from Buchanan and Sheppard (1998)

The ELECTRE method includes the two concepts of outranking and indifference threshold that allows for small differences to be ignored. The example given by Buchanan and Sheppard (1998) is that if you have two cups of tea, one with 10mg of sugar and the other with 11mg sugar, could you tell the difference? Traditional ranking methods would put one above the other, whereas ELECTRE allows us to rank them as equal. The indifference thresholds are designated by the decision maker, and can be different for each criterion.

The thresholds provide us with the following functions taking into account our preferences. So a is strongly preferred to b when the difference is above an upper threshold (p), a is indifferent to b if the difference is below the lower threshold (q), and weakly preferred if it falls between the thresholds.

\[
\begin{align*}
&a \text{P} b \quad (a \text{ is strongly preferred to } b) & & (g(a) - g(b) > p) \\
&a \text{Q} b \quad (a \text{ is weakly preferred to } b) & & (q < g(a) - g(b) \leq p) \\
&a \text{I} b \quad (a \text{ is indifferent to } b; \text{ and } b \text{ to } a) & & |g(a) - g(b)| \leq q
\end{align*}
\]

Whilst choosing the threshold may not be easy, it does allow for ‘fuzziness’ within the scores. This ‘fuzziness’ may arise from the existence in the decision-maker’s mind of zones of uncertainty, half-held belief or conflicts and contradictions – a realistic feature of decision making.

Furthermore, this method also allows a particular alternative to be vetoed if it fails to attain a particular level on any criteria. This feature however may not be necessary if the alternatives are screened prior to the reaching this stage of the decision-making process. The use of these thresholds has a large impact on the ranking algorithm and therefore they need to be carefully chosen.

One of the drawbacks of ELECTRE is that the calculations are evaluated for a single decision maker, so a consensus on the score would be needed to evaluate a ranking for a group of people. It also, due to the preference thresholds, is more likely to rank alternatives as equal in comparison to the other methods, which in turn may not aid the decision process.

b) PRES

PRES (Aragones et al., 1999) on the other hand is of more traditional nature where no ‘fuzziness’ is allowed. So in the previous example of a cup of tea containing 10mg or 11mg of sugar it would actively rank one above the other. For the lesser alternative a zero is placed in the dominance matrix, giving no indication of whether the alternative was slightly less desirable, or much less desirable for that particular criterion.

It has the advantage of providing the user with a numerical figure giving an indication of how much better/worse an alternative is relative to the other alternatives it is being compared against. In this way it aids the decision-making process. Again this method does not allow for multiple decision makers, so again a consensus must be reached on the scoring of alternatives.

c) TODIM

TODIM (Nobre et al., 1999) has the advantage over the other tools as in that it can evaluate the ranking for a group of decision-makers. However it too does not allow for ‘fuzziness’ with scoring, but does provide a value in the dominance matrix giving an indication of how it fared against the other alternative for that criterion. This method provides a numerical indication for each of the individual decision makers, but the overall results are simply a ranking, giving no direct indication of the benefits of one alternative over the other.
**Choice of MCDM aid**

The choice of which MCDM aid to use can be difficult if alternatives have very similar weights and scores, so that the different aids may not rank them in the same order. This is another reason to emphasise why these methods are intended solely to *inform* the decision rather than provide the definitive answer.

Each of the three MCDM methods described has advantages and disadvantages over the other methods, preventing one from being selected as 'the most appropriate'. For example, ELECTRE allows the use of weak preference/strong preference/indifference in making the decision, but in order to gauge the differences extra information is required for each criterion. In PRES an overall score relative to the other alternatives is obtained but an alternative that is slightly worse for each criterion will score zero, where the reality is that the difference may be negligible.

Finally TODIM allows groups of people to be decision makers combining everyone’s scores and though each decision-maker may be informed by the process, it doesn’t follow that there will be consensus of opinion on which criteria to include, and the relative importance of those criteria. These differences are summarised in Table 3.

<table>
<thead>
<tr>
<th></th>
<th>ELECTRE</th>
<th>PRES</th>
<th>TODIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weak/Strong preferences/'fuzziness'</td>
<td>✔️</td>
<td>✗️</td>
<td>✗️</td>
</tr>
<tr>
<td>Group of decision makers</td>
<td>✗️</td>
<td>✗️</td>
<td>✔️</td>
</tr>
<tr>
<td>Overall score given</td>
<td>✗️</td>
<td>✔️</td>
<td>✗️</td>
</tr>
</tbody>
</table>

*Table 3. Comparison of the three MCDM methods*
Annex H. Glossary


Brunel University of Brunel (one of the five MATCH hubs). http://www.brunel.ac.uk/

CEP Centre for Evidence-based Procurement (was DES). http://www.pasa.doh.gov.uk/evaluation/

CPH Collaborative Procurement Hub (regional NHS procurement organisations)

CRiSPS Centre for Research in Strategic Purchasing & Supply, University of Bath. http://www.bath.ac.uk/crisps/

DES Device Evaluation Service (now CEP)


ECRI Emergency Care Research Institute, international horizon scanning and assessment organisation

HEA Health Economics Assessment


II Institute for Innovation and Improvement. http://www.institute.nhs.uk/

ISIP NHS Integrated Service Improvement Programme. 9 point Care Delivery System. http://www.isip.nhs.uk/

MATCH Multidisciplinary Assessment of Technology for Healthcare, Brunel/Birmingham/Kings College London/ Nottingham/Ulster. MATCH aims to support the healthcare technology sector and its user communities by creating methods to assess value from concept through to mature product. The research programme addresses three crucial perspectives on medical devices: new methods to assess value employing economic modelling; decision-making tools to facilitate optimised processes for design and manufacturing; and methods to ensure better engagement with users over the entire development cycle. http://www.match.ac.uk/


NHSC National Horizon Scanning Centre. On behalf of the new Centre for Evidence-based Purchasing (CEP), the NHSC has agreed to identify technologies that are innovative, relevant to the UK NHS, and in the 12 months prior to UK launch stage.


NPSA National Patient Safety Agency

PaSA NHS Purchasing and Supplies Agency http://www.pasa.doh.gov.uk/

QALY Quality-of-life Adjusted Life Years, a measure of the health state of a patient that can be used to assess the cost effectiveness of a treatment with respect to quality-of-life of the patient population.

QMC Queens Medical Centre, Nottingham University Hospital NHS Trust (now merged with Nottingham City Hospital NHS Trust as Nottingham University Hospitals NHS Trust).


UoN University of Nottingham (one of the five MATCH hubs). http://www.nottingham.ac.uk/match

VFM Value for Money
Annex I. References


http://www.nhsconfed.org/publications/briefings/briefing122.asp