

Academia and industry: managing knowledge transfer to improve patient safety

Ed Matthews, Senior Research Fellow, Helen Hamlyn Centre Royal College of Art Kensington Gore,
London SW7 2EU, t. 0207 590 4242 f. 0207 590 4244, ed.matthews@rca.ac.uk

Rama Gheerawo, Research Fellow, Helen Hamlyn Centre Royal College of Art Kensington Gore,
London SW7 2EU, t. 0207 590 4242 f. 0207 590 4244, rama.gheerawo@rca.ac.uk

Jonathan West, Senior Research Associate, Helen Hamlyn Centre Royal College of Art Kensington
Gore, London SW7 2EU, t. 0207 590 4242 f. 0207 590 4244, jonathan.west@rca.ac.uk

International DMI Education Conference

Design Thinking: New Challenges for Designers, Managers and Organisations

14-15 April 2008, ESSEC Business School, Cergy-Pointoise, France

KEYWORDS

People-centred design; knowledge transfer; patient safety

INTRODUCTION

Traditionally, design research in academia has been funded via two typical routes, influencing both the approach and the results delivered.

The academic research approach, funded through research councils, focuses on framing the key question, robust methodology and breadth of input and dissemination. This leads to research findings, new knowledge, methodologies and identification of areas that need further research. Translating ideas into products for manufacture is outside the funding remit of the councils and is not normally common practice.

Research funded from commercial sources is rarely able to stray beyond the market focus of the benefactor. This research may be less free to explore, respond to an emerging evidence base, or to indulge the objectivity or curiosity of the researcher. Whilst business needs occasional disruption in order to survive, it is often difficult to enable this type of change.

Historically, managing knowledge transfer from academia to industry has been difficult. Academic timetables run differently from the financial year, expectations and outcomes can be mismatched and each party may have a different working culture. All of this makes communication, much less collaboration, problematic to accomplish.

INCLUSIVE DESIGN AND PATIENT SAFETY

Inclusive design has been recognised by the UK government as a potentially important driver of change; it is described as ‘a process whereby designers ensure that their products and services address the needs of the widest possible audience’ (UK Department of Trade and Industry, 2000).

Inclusive design targets the needs of those groups of people in society who are marginalised by conventional design practices. Designing in a manner that places people at the centre of the design approach can significantly increase corporate competitiveness and value whilst acting as an innovation trigger for designers to think laterally and invent new solutions.

A central part of the inclusive design focus at the HHC is the need to improve patient safety and healthcare. Design can play a strong role in achieving this as there is already strong evidence to suggest that design can help to reduce the incidence of errors in healthcare packaging, communication and environments. (Clarkson, 2003). This is equally true for private, paid-for services as well as state-funded systems. Packaging alone can cause problems – an estimated third of medication errors are caused by confusion over packaging and labelling instructions (Berman, 2004).

In other industries, design has been successfully used to transform products, services, systems and even entire organizations, but the medical and healthcare sector has been slow to catch on to the value and benefits that effective design can offer. Confusing, complex and outdated designs are often present in hospitals and care facilities, and the financial implications of replacement are beyond the operating budgets of most institutions. This makes it even more important to produce designs that function correctly and meet user need from the start. If this requirement is not met, the resulting designs will be, at best, less effective than they could be, at worst they are potentially dangerous to medical staff and patient. Against a background of increased number of law suits against medical staff and facilities, the industry needs to realise that managing design into the process can provide critical support and benefit beyond the hospital ward.

CRITICAL ISSUES

The health service is a highly pressured, complex system where the potential for error and accidents is ever present. International research suggests that ensuring patient safety is becoming one of the most important challenges facing healthcare today, not just in the UK but worldwide. In 2003, the UK Design Council and the Department of Health commissioned a report named 'Design for Patient Safety – A System-wide Design-led Approach to Tackling Patient Safety in the NHS'. The report was to look into these issues and present strategies where design could positively intervene in the UK National Health Service (NHS). The HHC was one of the participating organizations. It had five key findings as follows:

- The NHS is seriously out of step with modern thinking and practice with regard to design. A consequence of this has been a significant incidence of avoidable risk and error.
- There is little evidence of design understanding or practice within the NHS equivalent to those which are commonplace in other safety critical industries and leading commercial organisations.
- There was cause to question not simply the design of medical devices, products, packaging and information, but the way the NHS as a whole uses design in an effective way and its understanding of what design thinking can bring to an organisation.
- There are no quick fixes. On the contrary, it is of the utmost importance that single design initiatives are seen in the context of the 'big picture' of the healthcare system as a whole and the way it impacts on patient safety and risk management.
- Such 'big picture' understanding is not present and the highest priority must be attached to remedying this without delay.

These five findings underpin the thinking of the work outlined in this paper and design management structure that provided a framework for co-operation.

PATIENT SAFETY CHALLENGES

In the field of Patient Safety, even though the research may lead to tangible, exciting design propositions supported by an evidence-base, a long, challenging process still lies ahead if we are to make an impact through commercially marketed products and systems.

To deliver a marketable product, we have to design it, mock it up, define it, prototype it, test, develop and typically subject it to a number of clinical trials, (themselves a process of design, submission, approval and execution). The product then needs further refinement, regulatory approval, and production methods established for manufacturing ramp-up, as well as all of the marketing preparations. This process is complex and difficult, requires significant funding, and needs to harness many skills.

A key question becomes ‘how can we gather the resources we need – such as design research, knowledge, skills, equipment, people, access to funding – to create innovative medical design that is based on robust research?’

This has been achieved at the HHC by bringing together the necessary groups in partnership projects that meet both individual and collective need whilst focusing strongly on patient need.

KNOWLEDGE TRANSFER TO INDUSTRY

One vehicle that aims to do this is the Helen Hamlyn Centre’s (HHC) Research Associates Programme which is a response that aims to bring the academic and commercial worlds together. It demonstrates a process in which academia can work with business to transfer design knowledge, capability and understanding, allowing companies to use design as an organisational asset to invent, create and improve.

The programme creates a working relationship between graduate designers and business managers. It takes recent Royal College of Art (RCA) design graduates and teams them with business partners to work on year-long design research projects. Each project addresses an area of interest for the partner organisation, where a people-centred design approach can be practically implemented within a 'real world' business context. As well as realising the design concepts and exemplars, each design researcher produces an extensive report cataloguing the research process and results typically including an assessment of potential business impact.

The Research Associates (RA) Programme works by taking new RCA graduates from a range of design disciplines and partnering them with an industry organisation. Basing them within the RCA design studios allows them to draw on the creativity of the RCA whilst developing user-centred design skills through the Helen Hamlyn Centre network. By maintaining close contact with the research partners, the industry relationships grow as innovative design research partnerships rather than goal-directed, problem solving design consultancy. The programme maintains a core interest in working with medical staff to understand real need and improve patient safety.

Between 1999 and 2006 the Centre has undertaken projects with more than 60 companies from the corporate and voluntary sectors. These include:

- large multinationals including Levi Strauss, Philips and Ford
- architecture and design firms including IDEO, Geoffrey Reid Architects and Pearson Matthews
- technology firms including Hewlett-Packard and mobile network company Orange
- charities including the Laura Ashley Foundation and the British Heart Foundation
- public sector bodies such as the National Patient Safety Agency
- international pharmaceuticals such as GlaxoSmithKline

The Research Associates Programme operates on an annual basis, running from October to October. Each year ends with a symposium and exhibition launch event for research partners and collaborators. Around 300 people attend the symposium, and there are more than 1000 visitors to the exhibition.

WORKING WITH USERS

Designers often find it easier to design for themselves, to their own aesthetic values and to their own likes and dislikes, and this often leads to design exclusion (Moggridge, 2001). Designers have to step outside of their own ego and work with real users as nothing can really replace the value of this process (Warburton, 2003). A key part of the Research Associates programme is to involve users within the process so that projects move from being ego-centric expression of design expertise to having social relevance and value for the end user. This is especially important when a young designer attempts to design for the hospital ward or the health service, situations they might not have had firsthand experience of as healthy individuals.

Whilst projects on the programme have addressed industries ranging from the automotive to the architectural, this paper describes work done in a critical sector – the modern-day healthcare industry. Managing design in organisations and companies presents its own challenges, but designing for government-run organisations, under-resourced hospitals and in the highly regulated medical industry brings new challenges for designers, managers and researchers alike.

Projects employ a diverse range of design research methodologies to identify and include the needs and requirements of older people including questionnaires, expert consultation, user diaries, interviews, observation 'in situ', testing with prototypes, and research 'kits' requiring a range of responses from photographic to emotive. Working closely with small groups of users encourages empathic bonding between designer and user, creating a space where they can both act as equals to address the problem in hand. Bonding with the older user helps the designer understand lifestyle and aspirational factors that are all too often overlooked, moving beyond ergonomic problem solving into an area of creative thinking and user-facilitated innovation (Coleman, 1997).

STAGES IN THE PROCESS

This paper outlines the stages involved in the HHC design research process and includes both academic and commercial points of view. The different stages in the design management process will be presented with a focus on knowledge transfer. These include:

- 1) Developing a convincing business case
- 2) Identifying capable industry partners
- 3) Negotiating fair contracts and resolving intellectual property issues
- 4) Adapting design for manufacture
- 5) Conducting clinical trials
- 6) Iterating these steps as required
- 7) Market product on basis of proven benefits and regulatory approval

These are of relevance to design practitioners, researchers, managers and decision makers and anyone involved in commissioning design or working in knowledge transfer from academia to industry.

RESUSCITATION TROLLEY



Figure 1 – Example of existing resuscitation trolley

The case study used to illustrate these stages in design management is the redesign of the resuscitation trolley. Existing resuscitation (or ‘crash’) trolleys are standard tool trolleys adapted for hospital use

(see Figure 1). They became the focus of a National Patient Safety Agency (NPSA) call for a redesign after NPSA figures revealed that poorly stocked trolleys led to a number of patient deaths. A collaborative team of designers, academics, clinicians and clinical psychologists from the HHC and Imperial College at St. Mary's Hospital, Paddington worked with the NPSA to develop a new trolley (see Figure 2). The two year project began with a year long research and redesign phase, followed by a year working on iterative improvements and commercialisation.



Figure 2 – First prototype of new resuscitation trolley design

1) Developing a convincing business case

Attracting commercial investment often requires the construction of a sound business case. At the HHC, business cases can be built around products and research outcomes. This illustrates the academic/commercial split, as constructing a business case is not necessarily within the realm of the academic. This remains an area where industry can inform academia.

In the case of the resuscitation trolley, a formal business case was not developed by the collaborative team. The first year focused on user centred design and development, and the results were exhibited in September 2006. The background and benefits of the new crash trolley were explained and published in conferences, and the design was put in the public domain, explaining the user benefits

and the purpose of the design. This attracted press interest from the design world as well as the clinical world, and won two prestigious Medical Futures Innovation Awards. Manufacturers became interested in the potential of the design on its merits as presented in the research; at this stage the sound business case had not been constructed. The knowledge of the market size, projected share, annual sales and so on could have been researched by the collaborative team, but manufacturers are better positioned to thoroughly understand this. As manufacturers began to see the benefits of the design, they built business cases internally (often with confidential knowledge and information) to sell the idea to their own decision makers. This meant that the business cases carried more weight, and the design remained rooted in the original research rather than speculative commercial figures researched by academics.

2) Identifying capable industry partners

Identifying the correct partner is crucial in a product's route to market. The research focus at HHC has necessarily been the user and bodies used to inform the design process, rather than aid its roll-out. Again, learning from industry is vital here in order to assemble a list of potential partners and their competitors, suppliers, contractors and any company with an interest in realising the final product.

Throughout the first year of the project, a large group of interested stakeholders was built up, from clinicians on the ward to board level directors. The professional bodies were useful in providing links with manufacturers, and this, combined with standard research techniques and using the internet, led to a large database of manufacturers. Links were developed further by cold calling companies as well as managing contacts from interested parties who had heard about the project through the press. The database expanded to include companies who do not currently manufacture trolleys, yet had a commercial interest in resuscitation. The exhibition of September 2006 was useful in revealing the extent of the design work and meeting the potential industrial partners for further development.

Criteria by which to judge potential industrial partners was agreed upon by the collaborative team (including such qualities as manufacturing capabilities, design engagement, quality of existing product

range etc.) through a series of meetings. These were then used during site visits to manufacturers to further assess the suitability of the academic/commercial match. The shortlist was whittled down to two companies before deciding on one clear favourite for negotiation.

3) Negotiating fair contracts and resolving intellectual property issues

The new design was developed entirely by a non-commercial collaboration and funded by the NPSA and Helen Hamlyn Trust. All the institutions involved are not dependent on the commercial success of the design for their future funding.

This meant that there was no reason for over aggressive negotiation over the profit split with the manufacturer; the intent instead was to aim for longer term involvement by both parties to ensure the success of the product. The aim in this particular case was to retain ownership of the intellectual property and licence this to the manufacturer, allowing them exclusive rights in the UK and Europe. The retention of the intellectual property was important in this case, as it allowed the freedom to pursue other avenues of development further in the future with other (unrelated) companies.

4) Adapting design for manufacture

Designing for manufacture in such an academic/commercial collaboration means that both parties are learning by doing. The agreement between the two must be clear and up front in order to facilitate the working relationship. If there are potentially opposing design goals (manufacture vs. user centred design), the final say must be assigned to the relevant party from the outset. Clear communication at all stages is important – the industrial partner must learn the main thrust of the design work to date and agree to maintain it; the academic partner must respect necessary changes in order to mass produce the product.

In the case of the resuscitation trolley, the timing of the Medical Futures Innovation Awards facilitated the initial relationship between the industrial partner and the collaborating institutions. It fostered an enthusiasm for the project, and allowed for good communication between designers on both sides.

This relationship was of paramount importance, as without it, the design intent of the research and initial prototype would have been lost. It was crucial to agree on a method of working which allowed the industrial partner's design team to have authority over matters of design for manufacture, but for the academic research team to retain the overall design authority from the users' viewpoint. By this stage in the project, the design had already been through a first iteration and initial testing. This meant that there was already a point from which the design could continue, and also a direction in the form of initial user feedback. Clear communication meant that the manufacturer's design team fully understood and were enthusiastic about the design direction. The design for manufacture never seriously compromised the initial design intent, as the collaborative design team were involved in every manufacturing decision. This process came right down to dimensions and tolerances as well as the selection of materials. The advantage of a collaborative team meant that it was feasible to involve end users in this decision making process.

The deadline of a second exhibition in September 2007 helped to drive the work forward, and the schedule of the first clinical trial is acting as a similar milestone. Feedback from this exhibition has informed subsequent design work for the prototypes for the clinical trials.

5) Conducting clinical trials

If a trial is to be truly objective, the relationship with the commercial partner must be sensitively managed. Gathering an evidence base to support the product must mean that the trial must be designed, carried out and written up independently of the industrial partner.

The collaborating institutions included individuals with a wealth of academic and clinical expertise. This proved to be invaluable in clearing the necessary ethical hurdles for a formal clinical trial. In addition, the hospital had been involved with the project right from the outset, and getting approval from the various boards was made easier as the research had been communicated to them throughout.

The industrial partner had links with hospitals, though the existing links with St. Mary's afforded more benefits, as well as funding opportunities. Had the industrial partner led on the clinical trials, objectivity may have been compromised. Their involvement was to provide enough prototypes for the trial.

The clinical side of the team had the expertise to design the trial such that the findings stood up to the academic rigour of analysis, something which would be much more difficult for the design team to achieve. There are elements to the trial which do, however, have design interest. Whilst the trial is intended to be an objective assessment of the impact of the trolley on the resuscitation process, there is an element of investigation into user experience. The opportunity for ongoing and in-depth user feedback on the new prototype on the wards in real life situations could not be missed, and so users will be allowed to inform the designers of any improvements before the final iteration for manufacture.

The funding of the trial will come from the relevant bodies, and again the clinical side of the team had the relevant expertise to seek this, as it is necessarily clinically led. The benefit to the design process is that there will, pending the success of the trial, be an evidence base to support the benefits of the new trolley design over the old.

6) Iterating these steps as required

The broad process outlined for this case study above demonstrates a three-iteration process to manufacture, with the user input and critical refinement becoming more and more extreme as the project progresses. Clearly this is not always the case for every medical device or design, as time constraints, ethics, costs and design complexities can vary wildly, not to mention the degree to which it is possible to involve the end user.

The broad approach is still applicable provided sensitivity is shown regarding when (and to what degree) to involve user testing, manufacturers and the necessary negotiations. Design is often an iterative process, and can go on indefinitely.

7) Market product on basis of proven benefits and regulatory approval

The aim is to produce a marketable trolley with an evidence base proving its patient safety benefits, making a financial case for its advantages and thus improving sales. In this case study, this is a future step, as the project is still in the stage of clinical trials. Eventual market rollout and regulatory approval are firmly in the area of the manufacturer's expertise. Other expertise may be drafted in to provide alternative perspectives, particularly regarding regulatory hurdles.

Bringing the product successfully to market is not solely down to the success of the particular design or innovation. A complete marketing and sales force, contacts with purchasing, a logistics network and many other factors come into play, and these were key attributes when assessing the merits of any industrial partner (*point (2)*).

FINDINGS AND LEARNINGS

This type of collaboration can be very beneficial to both academic institutions and to industry. The knowledge developed in research-lead processes finds an outlet while business gets the necessary disruption it needs to innovate and think anew. The year-long timescale undertaken in the resuscitation trolley project provides a good framework for this to happen. It strikes a balance between the formal three year qualification of academia and the rapid, typical three month product development process.

One area where knowledge transfer between academia and industry was discovered to be important was in the direct involvement of the end user including clinical staff from ward through to board level. These techniques have been typically developed in academia and are now successfully delivering

benefits in a commercial context. Working with end users can bring inspiration to the design process as well as information to the design brief. In this project, the users who were studied during the design research phase gave important insights that directly impacted on the final design for manufacture.

It is essential that design in the medical arena is managed appropriately and distinct from other areas of commercial design development. Products and services for the healthcare sector will perform differently and need to fulfil specific requirements. A mobile phone for example will generally have a shorter shelf life and completely different cost structure to a piece of hospital equipment. Hospitals have limited budget and are only able to purchase new equipment infrequently. This differs from the high street, fast-moving consumer goods market.

CONCLUSION

The HHC occupies both the academic and commercial worlds. A successful route to market for any medical design negotiates them both. It can be beneficial to see engagement with each as distinct processes but not to isolate or separate them to such a degree that they do not work together. In the case study given above, the research was lead by the academics and the manufacturing was lead by the industrial partner. Likewise, a clinical trial exists in the academic realm whilst ‘rollout’ of the design becomes a commercial concern. The skill that designers and design managers need to develop is in seamlessly switching between the two as appropriate, and this needs to be done sensibly and sensitively. This work explores a different way in which design management can create positive change. Instead of encouraging impact at just an institutional level, responsibility should be fostered at an individual level, and design managers helped to facilitate a dialogue between the two worlds.

This implies change at an individual level rather than at an institutional level.

REFERENCES

Berman A (2004) Reducing Medication Errors through Naming, Labeling and Packaging. *Journal of Medical Systems*, Vol. 28, Issue 1

Coleman, R., 1997. "Working Together: A New Approach to Design". Royal College of Art, London,

Clarkson P, Buckle P, Coleman R, Stubbs D, Ward J, Jarret J, Lane R & Bound J. (2003) *Design for patient safety: a system-wide design-led approach to tackling patient safety in the NHS*, Department of Health Publications, London, ISBN 1-84182-765-7

Department of Trade and Industry (2000). "Foresight: Making the Future Work for You". Department of Trade and Industry, UK.

Moggridge, B., 2001. "i Magazine: Magazine for the Design Council, issue 6". The UK Design Council, UK, pp 12-13

Warbuton, N., 2003. "Everyday Inclusive Design". In: Clarkson J, Coleman R, Keates S, Lebbon C (eds.) *Inclusive Design – Design for the Whole Population*. Springer-Verlag, London, 15:254.

SELECTED BIBLIOGRAPHY FOR CASE STUDY

Pittman J, Turner B, Gabbott DA. Communication between members of the cardiac arrest team--a postal survey. *Resuscitation* 2001; 49(2):175-177.

Gabbott D, Smith G, Mitchell S, Colquhoun M, Nolan J, Soar J et al. Cardiopulmonary resuscitation standards for clinical practice and training in the UK. *Resuscitation* 2005; 64(1):13-19.

West J (2007) 'Resus:station; a redesign of the resuscitation trolley' in *Include2007*, Royal College of Art, London.