Academic
Design Management
Conference

19th DMI: Academic Design Management Conference
Design Management in an Era of Disruption
London, 2–4 September 2014

Exploring impact through seating design

Kathryn BURNS[*a], David ROWE[b] and Prof Richard SNELL[a]

[a] Birmingham Institute of Art and Design, Birmingham City University,
[b] David Rowe, Designer

For a number of years publicly funded research and other activities in the UK have been expected to consider their impact as part of the bidding process as well as during its implementation. More recently, the UK Research Excellence Framework (REF2014, 2012) required case studies demonstrating the impact of research on its external environment.

Although often considered as less academic subjects, design and design management lend themselves to generating impact very well. The outcome of such research should be a product or process that is then used by a target group to improve the user experience or provide other benefits, which can be deemed as impact.

This paper uses the case study of a series of chair designs and associated research as the basis for an exploration of the various interpretations of impact in relation to the design process and its management. A framework for predicting and measuring impact for use in future work is proposed.

***Keywords**: design impact, ergonomic design, design management, knowledge exchange*

[*] Corresponding author: **Kathryn Burns** | e-mail: **kathryn.burns@bcu.ac.uk**

Introduction

For a number of years publicly funded research and other activities in the UK have been expected to consider their impact as part of the bidding process as well as during its implementation. For examples see HM Treasury (2003) and AHRC (2007). More recently, the UK Research Excellence Framework (REF2014, 2012) required case studies demonstrating the impact of research on its external environment.

This paper uses the case of a series of chair designs and associated research as the basis for an exploration of these various interpretations in relation to the design process and its management. Dating from 1989, the work began with an investigation into the postural and ergonomic requirements of musicians. It has since incorporated consideration of user needs and manufacturing technologies resulting in three separate design registrations and a US Design Patent encompassing:

- Opus seating – for orchestral musicians (Birmingham City University, 1990; Rowe and Snell, 1993);
- SE range – for schools and colleges (Birmingham City University, 2007); and
- Age Inclusive Seating (AIS) – addressing the needs of the elderly (Birmingham City University, 2013).

Based on the case study, the paper explores the impact arising from design and design management and proposes a framework for predicting and measuring impact for use in future work.

Background

This work has arisen from the necessity of providing impact case studies for the United Kingdom's Research Excellence Framework (REF) (REF2014, 2012). In operation from 2008, the REF is the United Kingdom's current system for assessing the quality of research in higher education institutions. The outcomes of the assessment are then used by the UK's four higher education bodies to inform the selective allocation of research grant. The exercise also provides evidence of the benefits of public funding for research as well as benchmarking information. Each institution's submission comprises five elements: research active staff; research outputs; completed PhDs and research income; research environment; and impact.

Impact forms 20% of the assessment. In its submission, each institution describes how it achieves impact from its research as well as providing a number of impact case studies, the number depending on how many research active staff are returned. The REF guidelines prescribe the format of the case studies including that the impact should arise from excellent research (2* or above) conducted in the institution (REF2014, 2012).

In the REF research is defined as 'a process of investigation leading to new insights, effectively shared'. Impact is defined as 'an effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia' (REF2014, 2012).

Design falls under Main Panel D – broadly defined as arts and humanities. The REF guidelines suggest that impact from these research fields may be seen in various areas including: civil society; cultural life; economic; education (beyond the submitting HEI); policy making; public discourse and public services. Examples of impact that may arise from design research and provided in the REF documentation include: developing new ways of thinking that influence creative practice; contributing to innovation and entrepreneurial activity through the design and delivery of new products or services and enhancing economic prosperity.

Seating design case study

In response to the REF guidelines, Birmingham Institute of Art and Design, Birmingham City University (BIAD) submitted an impact case study based on a range of seating designed developed over a period of 15 years. The following is taken from the REF submission describing the underpinning research and its subsequent impact.

Design research

BIAD's seating design research integrating posture analysis, user needs and manufacturing technologies has resulted in three separate design registrations and a US Design Patent encompassing:

- Opus seating – for orchestral musicians (Birmingham City University, 1990; Rowe and Snell, 1993);
- SE range – for schools and colleges (Birmingham City University, 2007); and
- Age Inclusive Seating (AIS) – addressing the needs of the elderly (Birmingham City University, 2013).

Figure 1 A typical Opus chair

The original work investigated the postural and ergonomic requirements of musicians in collaboration with the City of Birmingham Symphony Orchestra (CBSO) and other major orchestras and resulted in a registered design, Opus1 (Birmingham City University, 1990).

To address the complex needs of the various orchestral musicians, the design incorporated complex curved and laminated components for the seat and back. The design was developed through a constructive dialogue between the manufacturers and researchers to create seating that could be manufactured at a competitive price. It also took account of the architectural sophistication of the new Birmingham Symphony Hall.

The product was manufactured originally by Hostess Furniture Ltd and is currently manufactured and distributed worldwide by Amadeus Performance Equipment Ltd (Amadeus).

A period of evaluation and further postural research followed resulting in an improved design, Opus 2 focusing on the flexibility of the chair's upper back component (Birmingham City University, 2005). This design won a Birmingham Design Initiative Award in 2002 and was selected as an illustration of design and manufacturing capability for the Furniture West Midlands exhibition at the National Exhibition Centre in January 2006. A typical Opus chair is shown in Figure 1.

Figure 2 Hille SE chairs demonstrating the different sizes

Of particular significance in the research is the relationship of the lower back support with the upper back support. This was crucial in the development of the SE chair to meet the requirements of the BS EN 1729 standard published in 2007. The consequent design addressed not only postural issues, but also the need for several sizes to suit children of all ages as in the standard. Additionally, consideration was made of the market opportunities arising from the then government's 'Building Schools for the Future' initiative. This required a range of chairs that were attractive in appearance as well as being robust and affordable.

The design solution, resulting from a partnership between the researchers and manufacturers, is a modular system from which the eight size variants can be produced from a limited number of components. By minimising tooling, assembly and storage costs the range of chairs meets the financial constraints of the sector. The chair has been produced and marketed by Hille Educational Products Ltd (Hille) since 2010. The Hille SE chairs are illustrated in Figure 2.

Figure 3 A Cello chair, part of the age inclusive seating manufactured by hf Contract Furniture

The latest research has resulted in 'Age Inclusive Seating' (AIS) (Birmingham City University, 2013). Starting in 2011, exploration and analysis has been undertaken into existing care home chairs and the needs and ergonomic requirements of the elderly users as well as their carers. A major aim of this work is to design furniture that enhances the quality of life and independence of this group, leading to more people being able to live independently for longer.

There is now an agreement with hf Contract Furniture to develop the product range commercially, with the first units going on sale in July 2014. A Cello chair is illustrated in Figure 3.

Research impact

The seating design research has had significant impact across a number of areas including market and business expansion and development; user benefits; design for manufacture and corporate identity.

Market and business expansion

Licensing the designs has proved to be a major spur to developing new products and markets for the licensee. This includes a measurable effect on jobs and profitability, not only for the principal manufacturer, but also

subcontractors. Licensee of the Opus designs, Amadeus (www.amadeus-equipment.co.uk), based in Battle, Sussex, has grown from a sole trader to a business employing five people. It subcontracts to build the frames for the chairs, thus safeguarding further jobs and turnover.

In the case of the SE chair licensee, Hille (www.hille.co.uk), it was purchased from the administrators in 2009 by the injection moulding company that had developed the plastic components of the chair. The new company brought together the expertise of both resulting in significant synergies, reducing the time to market, providing scales of economy and decreasing manufacturing costs. Relocating to Ebbw Vale, Gwent, South Wales, the company now employs 64 people in an area of high unemployment.

Licensing and the development of the AIS range is proving to be a catalyst for the development of hf Contract Furniture (www.hfcontracts.com). It will be the first home-grown design for the company, resulting in a new approach to the care home marketplace as well as opening different markets, such as those in China.

User and organisational benefits

For individual users the postural and ergonomic features contribute to wellbeing. For the organisation the visual language enhances the appearance, appropriateness and context of its environment. For example, still in use in the Symphony Hall, Birmingham, the Opus seating has provided user benefits in terms of players being able to rehearse for longer as well as a contemporary design that complements its surroundings.

The sleek appearance of the SE chair has proved to be very popular with the new academies. It too has provided user benefits with children sitting still for longer and improving their concentration.

Modular design

In the case of the SE seating, by producing the chair in two moulded parts (instead of the more common single component), the number of moulds required to produce the eight sizes of the BS EN 1729 standard is three. Clearly, eight different moulds would be required for a single component version. The moulds are also smaller. Added together, this results in a substantial reduction in tooling costs and the level of pre-production investment required.

Corporate identity

The final area of impact is that of the seating designs and values being used to reinvigorate the whole of a firm's design led ethos. Again this is particularly evident in Hille, as evidenced by its website www.hille.co.uk, as well as its liveried delivery vans that feature the SE chair.

Summary

Seating research in an academic environment has led to a number of novel designs. The resulting design registrations have been licensed to UK manufacturers. The designers have worked, for a period of time, with the licensees to realise seating products that are economical to produce and competitive in, as well attractive to, the marketplace.

Over 15 years, the work has resulted in a number of impacts some of which are more easy to measure than others.

Discussion

Reflecting on the seating design case study as well as the pertinent literature, it is proposed that a framework to identify the potential impact of design research should encompass:

- the definition of impact;
- types of research;
- types of impact;
- the routes to impact; and
- measuring impact.

The following describes each of these areas and the apposite findings with regard to the seating design case study.

Definition of impact

As given above, the REF defines impact as 'an effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia' (REF2014, 2012).

Other bodies see impact slightly differently. One of the first UK government publications to highlight how publicly funded work may realise benefits was the Green Book (HM Treasury, 2003). The Green Book does not define impact, but does discuss outcomes which are defined as 'the eventual benefits to society that proposals are intended to achieve' (HM Treasury, 2003). Later OffPAT, in relation to committing public money to the

delivery of capacity-building or infrastructure projects through the now defunct regional development agencies, defines outcomes as 'the impacts on, or consequences for, the community of the project activities' (OffPAT, 2006).

In considering self evaluation by its research grant holders, the Arts and Humanities Research Council (AHRC) defines impact as 'the fundamental intended or unintended change occurring in organisations, communities or systems as a result of programme activities' (AHRC, 2007).

In all definitions, there is a key reference to impact being about change. As described by Holden (2004):

> *The value of culture cannot be expressed only with statistics. Audience numbers give us a poor picture of how culture enriches us.*

In the case of the seating design research described above true impact comes from user benefits and the reinvigoration of the commercial concerns which have implemented the research in the form of physical products. Not only have sales resulted from the work, but also the licensees have changed systems, process and promotional activities in order to maximise the commercial benefits.

Additionally, it is worth recognising that impact can also be described as benefits or outcomes depending on context.

Types of research

In considering how research can have impact, it is important to have an understanding of what types of research can be conducted. For example, Davies, Nutley and Walter (2005) in their report arising from a symposium funded by the Economic and Social Research Council regarding non-academic impacts from social science research, state:

> *In any assessment of research impact it is important to take account of the different types of... research. This is not just a matter of making the familiar distinction between basic and applied research but also entails acknowledging that different forms of research lead to different types of knowledge, for example: 'knowing what works'; 'knowing how things work'; and 'knowing why things happen'. Assessment approaches need to be able to capture the impact of all these forms of research knowledge; they should not be designed with only 'what works' research findings in mind.*

Hughes, Kitson, Probert, Bullock and Milner (2011) in their exploration of how arts and humanities researchers can benefit or impact on the wider community entitled 'Hidden Connections' use a model developed by Stokes in 1997 to discuss pure and applied research. Stokes described three types of research: the Bohr quadrant where research is 'solely concerned with the pursuit of fundamental understanding' the Edison quadrant where 'research concerned solely with considerations of use' and the Pasteur quadrant where 'useful and important reflexive interactions between applications and fundamental understanding take place'.

Hughes et al (2011) find that most art and humanities researchers define their work as 'pure research'. It would be interesting to limit this to design researchers only. The Pasteur quadrant would seem more applicable. Indeed, a prime motivation for the seating design work was to produce items that had a sound academic underpinning but which would be useful and appeal to their users and eventually result in impact.

Types of impact

AHRC (2007) acknowledges that the types of impact are numerous. They include learning and skills for the researchers; effects on government policies and standards; the commercialisation of research through spin-outs and licences; development of new curricula and courses; new research activities; and the benefits to society at large which in economic terms can be categorised as direct, indirect and public good values.

Also AHRC (2007) cite the Kirkpatrick Model to provide four levels of potential impact which are:

- reaction – the initial response to participation;
- learning – changes in people's understanding, or raising their awareness of an issue;
- behaviour – whether people subsequently modify what they do; and
- results – to track the long-term impacts of the project on measurable outcomes.

Investigation of the model shows that the states actually arise from consideration of how training can benefit those being trained so, though useful, it may not provide a comprehensive set of impact stages.

In considering cultural value, Holden (2004), suggests two types of impact: intrinsic and instrumental.

> *Intrinsic values are better thought of as the capacity and potential of culture to affect us...Instrumental values relate to the ancillary effects of culture, where culture is used to achieve a social or economic purpose...culture does have significant value, but that instrumental value on its own does not give an adequate account of the value of culture, and that, moreover, better methodologies need to be found to demonstrate instrumental value in a convincing way. (Holden, 2004)*

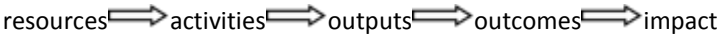
Meagher, Lyall and Nutley (2008) in studying social science research also propose two types of impact arising from research. As well as instrumental impact they also advocate conceptual impact which is a 'a more wide-ranging definition of research use, comprising the complex and often indirect ways in which research can have an impact on the knowledge, understanding and attitudes of policy-makers and practitioners', (Meagher et al, 2008).

In the specific case of the seating design research that leads to registered designs and consequent commercial products, the notion of conceptual impact seems valid and a useful approach in considering how impact might arise from design.

For a broader consideration of design research projects stakeholders can impart different meanings to impact. In the case of funding bodies, impact tends to be quantified through hard measures such as businesses assisted; visitor footfall or new sales generated. For external partners, beneficiaries or users, impact may also be seen in similar financial terms, but may also include softer outcomes. These include: finding new markets; introducing new processes; enhancing capabilities; increasing capacity and improving the user experience. For the grant holder, possible outcomes include building links with external partners; publicity and esteem as well as feedback into the curriculum and the student experience. Finally, impact for the delivery team or individuals can include skills and personal development; satisfaction from helping others to improve; a record of publications and being part of a collaborative network.

Routes to impact

There has been a move in various funding streams, both structural and research, to request project logic models or project logic chains from applicants, for example, see AHRC (2007). These comprise a number of stages:



where:

- resources are what is needed to achieve the project's aims and objectives
- activities are the things to be done to address the aims and objectives
- outputs are the products that will be delivered by the activities
- outcomes are the changes in knowledge, skills and behaviour that the activities will lead to
- impact is the fundamental changes in service, organisation or community that will result from the activities

For the seating research, the resources are the designers and the manufacturers, the activities are user research, design and prototyping, outputs are the design registrations, outcomes include the furniture and the impacts cover the commercial and user benefits described above.

As advocated by the AHRC, 'in measuring the impact of research it is essential to draw a clear distinction between 'activities' or 'outputs' and 'outcomes' or 'impacts'' (AHRC, 2007).

Davies et al (2005) term this a linear model of research to impact. They suggest five further models including problem solving which starts with the problems of end-users and tracks back to find relevant research and the interactive model where the 'process is modelled as a set of (non-linear; less predictable) interactions between researchers and users, with research impact happening through complex social processes of 'sustained interactivity''.

Walter, Nutley, Percy-Smith, McNeish and Frost (2004) in investigating improving the use of research in social care suggest three models of research use.

1. *Evidence-based practitioner model: this model highlights the role of skilled individual practitioners who are able to express their*

knowledge needs in terms of researchable questions, and then search for and appraise the research base to meet these needs.

2. *Embedded model: in this model research is distilled and codified before being incorporated into organisational processes, procedures, protocols and guidelines. In this view, the incorporation of research evidence is a management responsibility, together with the establishment and maintenance of suitable compliance regimes.*
3. *Organisational excellence model: this understanding emphasises the importance of local strategies of continuous improvement that draw both on research and on local experimentation. What matters most here is reflexivity and research mindedness within organisations, together with a willingness to change.*

Although from a different discipline, this combination of practice and research does seem very relevant to the design arena and would merit further investigation.

Davies et al (2005) highlight the usefulness of this typology as it:

suggests the need for a customised approach to impact assessments contingent on the dominant modes of research uptake and use. For example, in environments characterised by evidence-based practitioners, impact assessments may focus on individual knowledge, skills and behaviour; in contrast, environments where the embedded model operates require us to look for impacts in the organisational processes and routines. A further significance is that each model emphasises the unlikeliness of significant research impacts occurring unless substantial organisational initiatives are already in place.

They also highlight that impact needs to be considered throughout the research process and not just 'seen as an end- stage activity', Davies et al (2005). Further, they acknowledge that:

Different models are suited to different circumstances and it is unlikely that any single model will capture adequately the variety of different types of research, the different forms which impact can take and the different reasons why we might be interested in these impacts. Davies et al (2005).

In discussing impact and outcomes OffPAT concedes that 'individual projects are unlikely to have a direct impact on the regional GVA (the productivity or economic health of a region)'. It is envisaged that a portfolio of regional projects will or should affect GVA, but also recognises that 'their impact can be significantly mitigated by external factors such as a change in the interest rates' (OffPAT, 2006).

Measuring impact

The REF provides a comprehensive list of examples of impact (REF2014, 2012, p91). These include: growth of small businesses in the creative industries; generation of new products; sales figures and income generated; employment data including evidence of jobs created; user feedback or testimony and evidence of third party involvement, such as how collaborators have modified their practices.

The AHRC in providing guidance regarding evaluation and impact discuss a number of issues regarding the measurement of impact. This includes an acknowledgement that impact can be difficult to measure, (AHRC, 2007). For example it is recognised that in the case of media impact while it is relatively easy to measure column inches or sales and readership figures, the actual impact on readers or listeners will be difficult to collate.

AHRC (2007) suggest that 'tracking people with whom you have engaged over an extended period is the most straightforward way of assessing long-term impact'. However, the importance of a control group and the resource and cost implications of a thorough impact assessment are contemplated.

Walter et al (2004) advocate that:

> *measuring non-academic impacts of research is difficult for the following reasons:*
> *Timing — it is generally recognised that the impact of academic research is long-term and often indirect.*
> *Problems identifying additionality — would the 'effects' we are trying to measure have occurred anyway?*
> *Serendipity — the outcomes, and therefore the impact, of research activities are by their very nature unpredictable. Serendipity is an important element but it may be difficult to trace the results of such chance uptake.*

For impact arising from the seating design research, it is relatively easy to measure sales. It is more difficult to measure real changes in

concentration in school children and the postural benefits for musicians. The expense of benchmark and follow-up surveys could be prohibitive.

Maximising impact

In moving towards a framework for the impact of design research the following need to be considered during the development of a design research project:

- type of research;
- the outcomes of the research and the codification of knowledge (eg, product, reports, workshop);
- the methods by which the outcomes are converted to impact and the types of impact;
- the external factors that may impede its take-up; and
- how the impact will be measured.

In the case of the seating design research a key factor in its moving from design registrations to commercially produced products has been the involvement of the designers. Davies at al. (2005) describe the importance of networks in ensuring that impact occurs. The current study and its longevity would support this view.

The work also used a novel tool, David Rowe's design wheel. The wheel for the SE chair is shown in Figure 4 below, illustrating how all relevant aspects are explored in developing the final product.

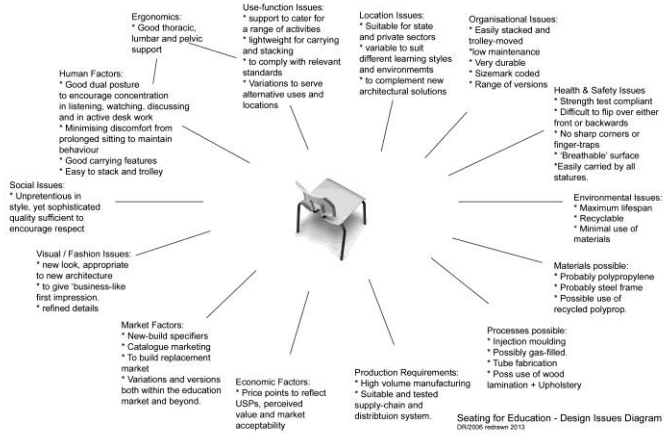


Figure 4 Design wheel for the SE chair

Conclusions

The impact from design research is complex and underexplored. Insights from other non-scientific disciplines may provide a sound basis for future work and research. The outcomes from the recent REF will provide food for thought, as well as material for increasing the impact of design research. In the words of Davies et al (2005):

> *Once we move towards models of knowledge co-production, the idea of research impact cannot be captured by phrases such as knowledge transfer. At the very least we need to think in terms of knowledge translation, knowledge mediation or knowledge interaction. Similarly, impact is no longer a uni-dimensional concept – the impact of research on policy and practice – but instead reciprocal impacts need to be considered.*

Acknowledgements: *Thanks go to Ruth Edwards and Adrian Burns for their unstinting support and to Birmingham City University, Advantage West Midlands and the European Regional Development Fund for funding various stages of the research and knowledge exchange work.*

References

AHRC. (2007). *Understanding your project: a guide to self evaluation.* Swindon: Arts and Humanities Research Council. Retrieved May 19, 2014, from http://www.ahrc.ac.uk/What-We-Do/Build-the-evidence-base/Impact-examples/Documents/Understanding-Your-Project-A-Guide-to-Self-Evaluation.pdf

Birmingham City University. (1990). UK Design Registration 2009754 (20 September 1990)

Birmingham City University. (2007). European Design Registrations 000756127-0001# and 000756127-0002#

Birmingham City University. (2013). European Community, *Seats [furniture] (part of -)* 002284406

Davies, H., Nutley, S. & Walter, I. (2005). *Approaches to assessing the non-academic impact of social science research. Report of the ESRC symposium on assessing the non-academic impact of research 12 – 13 May 2005.* St Andrews: University of St Andrews Retrieved July 2, 2014,

from http://www.esrc.ac.uk/_images/non-academic_impact_symposium_report_tcm8-3813.pdf

H M Treasury. (2003). *The Green Book: appraisal and evaluation in central government*. London:TSO

Holden. (2004). *Capturing cultural value: how culture has become a tool of government policy.* Retrieved July 2, 2014, from http://www.demos.co.uk/files/CapturingCulturalValue.pdf?1240939425

Hughes, A, Kitson, M., Probert, J., Bullock, A. & Milner, I. (2011). *Hidden Connections Knowledge exchange between the arts and humanities and the private, public and third sectors.* Swindon: Arts and Humanities Research Council

Meagher, L., Lyall, C. & Nutley, S. (2008). Flows of knowledge, expertise and influence: a method for assessing policy and practice impacts from social science research. *Research Evaluation, 17(3),* 163–173. doi:10.3152/095820208X331720

OffPAT. (2006). *Project advice note 2/06 a project logic chain (plc) approach*. Retrieved May 22, 2014, from http://webarchive.nationalarchives.gov.uk/tna/20110327135638/http://www.offpat.info/Publications/Publication.aspx?ID=2960

REF2014. (2012). *Panel criteria and working methods.* Retrieved May 19, 2014, from http://www.ref.ac.uk/

Rowe, D. & Snell, R. (1993) Chair US Patent Des. 336,795 (29 June 1993)

Walter, I., Nutley, S.M., Percy-Smith, J., McNeish, D., & Frost, S. (2004). *Improving the use of research in social care.* Knowledge Review 7. London: Social Care Institute for Excellence.