Notions of innovation in healthcare services and products

This item was submitted to Loughborough University's Institutional Repository by the/an author.


Metadata Record: https://dspace.lboro.ac.uk/2134/17185

Version: Accepted for publication

Publisher: © Inderscience Enterprises Ltd.

Rights: This work is made available according to the conditions of the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International (CC BY-NC-ND 4.0) licence. Full details of this licence are available at: https://creativecommons.org/licenses/by-nc-nd/4.0/

Please cite the published version.
Notions of Innovation in Healthcare Services and Products

Tom Page, Loughborough Design School, Loughborough University, LE11 3TU, UK. Email: T.Page@lboro.ac.uk

Biographical data
Tom Page graduated in 1988 from Napier College, and then worked for Ferranti Defence Systems as a design engineer. In 1990, he returned to Napier as a Research Assistant and obtained an M.Phil. In 1992, he took up a teaching post in Computer-Aided Engineering at the University of Hertfordshire where was awarded a PhD in 2002. He has worked with the Open University. Tom is a Chartered Engineer with full membership of the Institution of Electrical Engineering (IEE) and the Higher Education Academy (HEA). Since May 2003, he has been teaching at Loughborough University. His research interests include learning technologies, electronics design and manufacture and logistics management.

Abstract: This investigation explores the role innovations play in the healthcare system within the UK. Discussions include the debate surrounding the definition of the term innovation, as well as the importance of innovations on patients and the current barriers that halt innovations being implemented. The study concludes by suggesting that the term ‘innovation’ is overused and therefore it is unsurprising that many people become confused, suggestions are made for more detailed definitions and possibly clearer definitions within specific industries. Other conclusions include recommendations on the way innovations are approached by the healthcare industry as well as the believed barriers to innovations.

Keywords: Innovation, products, services, healthcare

1 Introduction
The healthcare industry is seen in many different lights, but one point of view that is hard to argue against, is the viewpoint that the National Health Service (NHS) in the United Kingdom is among the best in the world. In fact the UK’s health service is ranked eighteenth in the world, out of 191 countries, this places the UK in the top ten percent (WHO, 2000). The purpose of this investigation is to define the role innovation plays in this industry and more importantly how it affects patient care. The NHS is constantly in the press, whether it is regarding cuts to budgets or poor patient care, very rarely the positive work they do gets publicised. The main objective of this investigation is to gain an insight into the role innovative designs play in the rehabilitation process and whether such applications benefit the patients. This work aims to assess the challenges that designers face in bringing their innovations into this particular market place. As critical to this aim the following objectives were realised: identification the current innovations used during patient rehabilitation; establishing whether the current innovations are appropriate as well as whether there is scope for more; and defining the process that new innovations have to go through to become established, as well as any barriers that may make this process difficult.
2 Literature review

There is a wide array of literature based both in the areas of innovations as well as the role technology and innovations play in hospitals and the wider topic of patient rehabilitation (Kim, 2011). The first question to be answered is the question “what is innovation” and in turn “what is an innovative design?”. Firstly, the dictionary definition of innovation is ‘Something new or different introduced’. To gain a greater depth of knowledge, a document collated by Innovation Nation in 2009, goes into detail regarding the current state of the country and the important role innovation can play in the nation’s development. The report is clear in stating that innovation can come in different forms whether it happens to be a product, an individual, communities or a business. This is important to both consider and remember as it is too easy to just relate the term ‘innovation’ to new products that are different and provide a step change. The report goes on to reflect on the importance of innovation, stating that ‘innovation is essential to the UK's future economy, prosperity and quality of life’, as well as suggesting that ‘The UK must excel at all types of innovation’ (Innovation Nation, 2009). This can be particularly relevant within the health service and this viewpoint on innovation could be crucial for this investigation, especially as budget cuts are topical and according to this report innovation can produce growth and profit, for both companies and governments. The report goes on to highlight how currently the UK has some weaknesses regarding innovation, stating that ‘Moreover, there remain longstanding weaknesses in the skills base and in the number of employers investing in training’. Though the report clearly states that innovation is important to the country, it also argues that the country/government is not doing as much as possible. Interestingly the report also indicates that ‘Organisations are increasingly reaching outside their walls to find ideas – to universities, other companies, suppliers and even competitors’.

An innovation is ‘the successful exploitation of new ideas’ and ‘the action of introducing a new product into the market; a product newly brought on to the market’ (Holland, 2011). This suggests that innovations have to be successful and the presentation goes on to explain that the innovation process is centred around enterprise as well as entrepreneurs, whereas the Innovation Nation report, though collated by the government, is very much centred around government departments and businesses. When discussing ‘why is enterprise & innovation so important?’ the work touches on similar topics as the previous report though is more focused on the product lifecycle and how the use of innovation and innovative ideas can help a product that may be suffering from a lack of sales. It also raises the point that innovation can create jobs as well as maintain them.

Another definition that is slightly different to the previous, is a definition published on the Business Dictionary website, the definition is a detailed description on their view of innovation, once again this viewpoint is very much business orientated. ‘The process by which an idea or invention is translated into a good or service for which people will pay, or something that results from this process.’ This definition mentions the process in which an idea is realised as well as the product itself, which is interesting as the other sources see it as the final outcome or the initial innovative idea itself (Business Dictionary, 2012). The article also defines an innovation as the following, ‘To be called an innovation, an
idea must be replicable at an economical cost and must satisfy a specific need. Innovation involves deliberate application of information, imagination, and initiative in deriving greater or different value from resources, and encompasses all processes by which new ideas are generated and converted into useful products.’ This part of the definition is similar to earlier articles that have been reviewed, in the sense that it identifies that an innovation must be cost effective and be a useful product for the consumer.

There is in fact an argument against these definitions of an innovation, stating that it is impossible to actually define what an innovation is. The following quote was found on cloudave.com, ‘There is no set definition of innovation. It’s a concept where everyone has an intuitive sense of what innovation is, but would have a hard time formalizing a definition.’ Carpenter (2010) goes onto say ‘Sure there are dictionary definitions. Merriam Webster defines innovation as: “the introduction of something new.” But that’s really not satisfying. Just because something is new, is it really an innovation? If everything new is an innovation, nothing is.’ This is interesting as it disputes some of the definitions given by previous sources. To build a fair case the article also gives the other point of view, ‘On the flipside, in popular culture and the business press there is a common view that innovation is all-disruption, all-the-time. Radical technologies and overthrowing incumbents with new business models are the primary definition of innovation.’ It is interesting that the word disruption comes up as ‘Disruptive Innovations’ and is mentioned in several journals that have been reviewed so far, for example

It has been established that many organisations consider innovation to be vital to the growth of a business or indeed a country. Though in order to meet the objective of this investigation the view point of the designer needs to be considered. Websites such as Businesslink.gov.uk were assessed in order to identify the processes that designers and other business minded people have to go through in setting up a new business. This could be relevant regarding designers coming up with new innovations and bringing them to market.

Another design that has been developed for the hospital environment is the KwickScreen. The KwickScreen (Korn, 2011) is a screen that is designed to improve patient privacy as well as allowing better space management. This particular design won the 2011 James Dyson award and received a lot of recognition from other organisations, most importantly the HCAI Technology Innovation Programme, who work closely with the Department of Health and the NHS Purchasing and Supply Agency. This shows that the NHS is active in the pursuit of innovations and could suggest that they value the importance of innovative ideas. As a result of the awards and the media attention that was generated, the KwickScreen is a success and has begun to sell to a number of hospitals, taking around 4 years to do so.

Xsens is a company that specialises in technologies that capture the user’s movements. These are applied in many different fields, such as computer game simulation, film industry, and education and more importantly for this investigation they are used during gait analysis during patient rehabilitation. The technology used for gait analysis uses a series of sensors located on the body, without the need for external cameras. This technology has to be considered as a
true innovation and the fact that the technology has many applications is also
innovative. Unfortunately the motion capture technology is very expensive, some
sources stating that they can cost in the region of £30,000. The cost of this
innovation means that implementing it in rehabilitation units would be out of the
question, unless the centre was able to establish the funds from private sources.

The previous innovations that have been discussed are purely concepts at this
moment in time, though there are some innovations that have had the benefit of
more funding and more invested time such as the FitSplint. The previous
concepts quoted were projects almost certainly carried out by students whereas
the FitSplint was in fact produced by a university itself. This ties in nicely with
what was stated in the Innovation Nation report, which suggests that innovation is
best to take place in areas of concentrated talent, like universities and enterprise
zones. The FitSplint is a ‘new device that offers a more effective method of
splinting for wrist fractures.’ and on the whole it was well received so much so
that the FitSplint was set to have clinical trials in 2009.

All the articles that have been viewed so far have addressed the research
question ‘what is meant by the term innovation (innovative design) and what are
the current innovations. After this research base was established attention was
turned to addressing the remaining questions following a review of an article in
the Nursing Standard magazine. This magazine is a weekly publication targeted
at nursing and healthcare professionals. In the issue volume 26, number 19, an
article discusses technology in the NHS with reference to the electronic stock
control system. The title of the article is 'Time to raise the bar. Electronic stock
control at a Leeds trust is saving nurses' time and NHS funds'. The article was
written by Cosh(2012). In the article the Department of Health are quoted as
'hoping that a national bar code system, similar to that used by high street
retailers, will bring uniformity to trusts' stock control and record systems, save
money and promote patient safety'. This isn’t an innovation in the truest sense of
the word but it is certainly an innovative idea to use existing technology from
another sector. It is also important that the Department of Health believe that this
innovation will help patient safety, which has to be paramount. The article goes
on to say '89 per cent of hospital nurses spend time locating missing items'
(Source: Healthcare Report - Improving Patient Safety and Efficiency in the
NHS.GS1 UK. July 2010.) This further proves the importance of this application
and how this innovation can really benefit the NHS.

So far the literature has reviewed articles published on the internet or in
magazines and the next stage aims to review academic journals. The first journal
analysed a document published by the Harvard Business Review titled ‘Will
Disruptive Innovations Cure Health Care?’ (Christensen et al., 2000). Despite
this journal being based on the healthcare system in the US, the attitudes
displayed in the document are transferable to the organisation the United
Kingdom. In summary the journal talks about the health care service being
change-averse as well as the barriers that entrepreneurs face in their pursuit of
getting their innovations into the organisation. The document makes some
interesting points, using the phrase ‘resistance to low cost alternatives’ several
times. There is mention of an interesting case study when a portable x-ray
machine was invented and the entrepreneur believed it to have many benefits to the healthcare service, but peoples’ reluctance to lose jobs or change the way they do things got in the way. The journal states, ‘When the entrepreneur who developed the machine tried to license the technology to established health care companies, he couldn’t even get his foot in the door as it threatened their business models’. It is interesting to note that it may be the professionals themselves that stop innovation and not only the ability to gain funds, even if it is in the best interests of the patients. It is important to remember that this document was compiled with the American health care system in mind, which at the time of publication was in a crisis. Though many of the points made are transferable to the UK model.

The next journal reviewed was a paper titled, ‘disseminating educational innovations in healthcare practice: Training versus social networks’. The document mainly focuses on the training aspect of implementing innovations, not so much the innovative ideas themselves. Some of the more relevant points are made early on in the paper for example, ‘improvements and innovation in the health service organisation and delivery have become more and more important due to the gap between knowledge and practice, rising costs, medical errors and the organisation of the health care systems’ forming the basis from which the investigation takes place. Meanwhile a further quote from this article states ‘there are six forces which seem drive or kill innovation: players (friends and foes), funding, policy, technology, customers and accountability (Herzlinger, 2006)’. This shows that there may be more barriers to innovation than initially thought, as other sources only mentioned the barrier that is presented by the lack of funding. The remainder of the report was more focused on education and how training needs to be effective for innovations to flourish. This report came to its conclusions by using meta-analysis to combine all the results from the research as well as a long term controlled study.

This article holds similar views to the other journals but goes into greater detail regarding the factors that affect the implementation of an innovation. The report goes on to suggest that until these forces can be acknowledged and controlled then any of them can provide obstacles, indicating only legislation can truly solve this issue. The report clearly outlines three different types of innovations that can aid the health care system, ‘Customer focused innovations’ (the way in which the customer purchases and uses a product), and ‘Technology based innovations’ (new products) and ‘Business models’ (strategies and activities).

Firstly it has already been established that there are numerous definitions of the term ‘innovation’, with certain definitions including new clever products, to other definitions including process and ideas. This has led the term ‘innovation’ to become a well-used phrase with a broad meaning, with some even considering it as a buzz word, with it being used a lot by politicians and creative professionals. The empirical research shows that a large percentage of the NHS staff questioned were unclear as to what was meant by the term ‘innovation’, possibly proving that the term is too general. Interviews that were carried out involving academic staff also resulted in a range of different definitions.

Overall this question of ‘Is the Term Innovation Overused?’ could form the
basis of its own investigation. For the benefit of this investigation it may be fair to conclude based on the research carried out, that the term innovation is both overused and too broad. Overall the sources used can be classed as being reliable sources, with the academic journals being more credible than the others. The information gathered from journals is credible although they are related to health care services in others countries, both in America and the Netherlands. This makes the information less relevant though the information gathered was chosen with this in mind, and the facts are more general and not country specific.

The term innovation does seem to be slightly different in the way it is defined as well as the way it is approached. On the whole the secondary research methods have answered the first two research questions and to some extend the third. The primary research techniques have been tailored to solve the remaining questions.

3 Empirical research

3.2 Questionnaire results from healthcare professionals

This questionnaire was completed by fifty healthcare professionals. In regard to the question “Do you see new innovative ideas in use in the hospital or rehabilitation environments?”. The response to this question was undoubtedly yes, with the vast majority (forty eight) of participants suggesting that they see new innovative ideas in the hospital and rehabilitation environments. Though these results don’t truly reflect the answers as it was soon established that many professionals were unclear as to what is meant by the term innovation. It was soon explained that an innovation can be anything from a physical product to a process or service, which have to have a positive effect. After this minor confusion it was determined that three out of the fifty participants questioned, believed that they see new ideas in these environments. The unclear responses could possibly void this particular result.

With regard to the question “What is your opinion of current innovations?” answers comprised “Makes life easier”; “they offer good feedback”; “useful to have new ideas”; “Always a need for new ideas”; “Good innovations in patient safety at home”; “Flaws in limitations”; “Useful for some patients” and Patients can become dependent on innovations”. The key points that derived from this question range from improving patient safety, to limitation that halts innovations. These quotes are describing the innovations that are felt to be in effect in the healthcare environment, innovations such as balance trainers, biofeedback bikes, supports and comfort checks. The general consensus was that these innovations are useful and that they deliver a positive impact to the patient. It’s already became apparent that each person has a different view of innovations, both with their impact on the healthcare service as well as the definition.

With regard to the question “Do these innovations aide the patient’s rehabilitation?”. Again, forty eight respondents indicated yes, though 100% of the participants suggested that they see some benefits for the patient. This verifies the theory and definition that an innovation can only be called an innovation if it has a positive or worthwhile outcome. This answer to the question can be used to start to build a response to the research questions and the
The responses to the earlier questions already indicate that the professionals questioned consider innovations as positive applications that aide the patient. Therefore it is no surprise that 100% of the participants believed that more innovations are required. This could also stem from the fact that these professionals believe that the current state of care is inadequate and that innovations can solve this, though this is irrelevant for this investigation. With regard to the question “In your Opinion are there any barriers stopping innovative ideas being implemented?” thirty five respondents replied “yes” and the remaining fifteen replied “no”.

It is widely publicised that the NHS are constantly being scrutinised regarding their budgets and costs, therefore it is not a surprised that one of the major barriers to innovations seems to be the lack of funding. One hundred percent of participants questioned who choose to define a barrier quoted cost/funding. Another interesting topic was raised regarding peoples reluctance to change, this is a point touched on during the literature survey. These barriers are not specific to the healthcare system as they could be considered as barriers in any sector. One hundred percent of the respondents “Is the use of innovative design important during patient rehabilitation?”.

All the questions asked so far have led to the final question on this particular questionnaire, the final question is arguably the most important of them all as it is almost similar to the main research question of this investigation. Based in the feedback from the previous questions it is no surprise that the answer to question eight was answered yes by all. Even though this questionnaire was answered by a group of fifty healthcare professionals the results clearly show that in the eyes of healthcare staff, innovations play an important role in the service and are an integral part of the system if the healthcare industry is to continue to progress and develop.

Overall this questionnaire has provided a specific response in the sense that the participants targeted were staff nurses, physiotherapists and physiotherapist assistants, therefore there expertise is very specific and maybe not as general and as broad as possibly needed. This along with the fact that some questions needed to be explained, lead to the decision that another questionnaire needed to be drawn up and the audience altered slightly. Each questionnaire had a section allowing the individual to compose any further comments, comments such as, “service development is key as staffing and resources are becoming more limited”, “new ideas are always beneficial but need to ensure they benefit of the patients rehab and recovery” and “involving staff in decisions is a good idea”.

3.2 Questionnaire Results from senior health professionals

This questionnaire was directed to more senior healthcare professionals, in order to gain a different perspective on the issue. The questionnaire focuses more on their own experiences. Twenty senior healthcare professionals completed this questionnaire. With regard to the question “Have you ever thought of a new idea/innovation? (That would improve patient care or aide the way care is given for example).” Fourteen of the more senior healthcare professionals answered ‘no’ for this question, which can be considered as unusual as other initial primary
research carried out before this questionnaire was developed, suggested that true innovations in healthcare stem from the ideas on the front line, for example from surgeons and doctors, not necessarily from designers or engineers. From the six participants that had thought of a new idea, four of them had actually seen the idea through and implemented it into the service. As this figure is low it is impossible to gauge whether this ratio is a fair estimate for the whole health service, but it could be said that senior healthcare professionals are contracted and paid to do their jobs with patient care at the forefront of their minds and any additional time and effort needed to come up with new ideas may be few and far between.

Further to this question “How did you find the experience? Answers comprised “Easy to implement”; “Fun-Brain storming”; and “Difficult to get agreement from all parties involved”. The responses to this question are limited due to the lack of professionals that have thought of a new innovative idea and brought it to fruition. Though the feedback from this question is 50/50, with a couple of doctors suggesting that the process was ‘fun’ while others said it can be difficult to arrange.

In answer to the question “Do you feel you have enough time to pursue new ideas?” seventeen respondents indicated “no” and three “yes”. This result is not surprising considering that healthcare professionals aren’t scheduled to carry out enterprise activities. This is understandable as these senior professionals have high pressure jobs with greater priorities. It could be argued that if these professionals could come together with other professionals from other fields such as design and engineering then innovation could thrive, healthcare professionals could be given incentives or mentoring it an attempt to create more innovations in this sector.

In answer to the question “Would you know the process that is needed to bring a new idea/innovation to market” sixteen respondents indicated “no” and four “yes”. They feel that they don’t know of the correct process needed to bring a new innovation/idea to market. This alone is a big barrier towards innovations, as previously mentioned it is important that innovative ideas come from the front line, so surgeons and doctors, and if these people are neither encouraged or know of the correct procedures for implementing innovations, then how does true innovations happen?

A few of the doctors that participated in this questionnaire commented that they have studied the skills and processes that are needed while at university. Overall this second questionnaire has provided this investigation with a more in depth response compared to the first pilot questionnaire. This questionnaire was answered by more senior healthcare professionals, who may have more experience and expertise in their chosen field than a staff nurse for example. These professionals were chosen in a reaction to the comments from an expert in the application of design in healthcare who believes that the best way to innovate in this sector is to involve the experts who are at the cutting edge of the field within healthcare. For this interview a range of questions were outlined, such as, in your opinion what is an innovation? What are the barriers faced when bringing an innovation to fruition? And could you please explain on your experiences in this field? These questions where aimed at steering the interview in the desired
direction to ensure that the correct responses were given to answer the research questions of the investigation.

In an interview with a leading researcher in the design and development of medical products, experience, his opinion of innovations is that there are many different definitions for the term innovation, and the term itself could be considered as overused. He commented that innovation can be anything from the physical product to the actual way the product is marketed. The interesting theory of having industry specific terms for innovations was also discussed. It was learned that in order to design and develop a product for use within the healthcare service, there is a series of rules and regulations that have to be met. Each product also fits into one of three categories, categories that are determined by The Medicines and Healthcare products Regulatory Agency (MHRA). The first category, class one, covers products that patients use and interact with, products such as walking sticks and crutches. At the other end of the scale, class three includes products that are invasive, products such as needles and pacemakers. The barriers to innovation will be different for each of these classes.

A good example of a class one product is a walking stick. Walking sticks could be classed as a product that is easily developed and innovated to create an improved version. This is proved by the sheer abundance of walking stick concepts in the public domain at this present time. The Balancing Act walking stick shown in Figure 1 is just one of these, the unique element to this innovation is that the stick can stand and balance on its own, therefore limiting the need for the user to reach or bend over to retrieve the walking stick, overall providing a more comfortable application.

![Figure 1, The Balancing Act, (Feng, 2011)](image)

There are other innovations such as the Fiesta Flamingo Crutches, which offer a modern aesthetically pleasing solution to current walking sticks and crutches. There are other innovations out there such as the Fiesta Flamingo Crutches, as shown in Figure 2, which offer a modern aesthetically pleasing solution to current walking sticks and crutches. Even though it’s relatively easy to design, develop and implement these innovations, the impact they have is limited and the overall benefit they deliver to the patient isn’t as great as a pacemaker for example.
Pacemakers fall into class three, this is the most complex of all the classes available, this is because class three covers products that are intrusive to the patient. Unlike products such as walking sticks the products that fall into class three categories are hard to innovate, with obvious complexities involved with inserting products into the human body. Because of the inevitable risks involved there are lot of regulations and tests pacemakers and other similar products have to go through. Nevertheless, there are innovations out there in this field, one of which is called the Wi-Fi pacemaker, ‘This little device now takes an awesome technological step; new and advanced pacemakers communicate wirelessly with a monitoring service, (Figure 3) which in turn is accessed daily by the doctor’ (Elsagheer, 2011).

Figure 3, Wireless Pacemakers, (Elsagheer, 2011)

This innovation is adapting current technologies to improve the process for both patients and healthcare professionals. Though it was discussed that it’s
notoriously difficult to design and develop a product for this class, it also has to be considered that these innovations provide a massive impact on patients’ lives, which can ultimately have the potential to save lives (Loughborough University, 2008).

The impact these innovations can present make innovations popular as there is a real need that everyone can relate to, making it hard to argue that we don’t need innovations. All these rules and regulations can deter many organisations from innovating in this field. Innovations in this sector are almost necessary, and that more can be done to create more innovative solutions for the future. The point was also made that ‘are we too scared to innovate as a nation?’ Finally, that these ideas are developed and conceived by experts such as doctors and surgeons. The NHS has recognised this point and between 2002 and 2005 they set up localised innovation hubs, with the aim to encourage innovation within the NHS.

The Second interview conducted was with the Director the School of Design Research at Loughborough University. Whilst at this position he has been involved in a project that was in collaboration with a local company Codamotion, the project consisted of designing attachable sensors for Codasport (Figure 4). This first-hand experience is useful for this investigation and update. When questioned on his views on innovation and how you would define an innovation, his views were that an innovation can be anything from the way an idea is researched, manufactured, marketed and the actual finished article. This view is a little broader than some others discussed, but the principles are still the same, as long as the change is for the better then is shouldn’t matter what the change is or what part of the product lifecycle it is targeting.

Figure 4, Codasport, Codamotion, 2011

When discussing potential barriers to innovations, one of the main topics that were raised other than funding was the issue of academics not having enough timetabled time to engage in enterprise. This is interesting considering that the government seem to encourage small to medium companies to use innovation centres like universities. Another barrier that was explained was the topic of education, as it is argued that the current education system damages innovation in the youth of today. The point was made that in the United Kingdom children are
allowed to special their skills at both GCSE and A-Level, which can result in students choosing highly specialised courses, for example a student could study art, design technology and drama at A Level. In China, the education system is different where students have no option but to take certain subjects, such as a language, humanities, an art subject and a science for example. This method allows the students to keep their options open whilst broadening their horizons. Therefore a case could be made suggesting that a similar approach could be taken in the UK to improve innovative thinking/behaviour.

The final interview was completed with the head of enterprise at Loughborough University Design School, her experiences to date made her a suitable interviewee. The main question that was asked was regarding barriers to innovation, and has been involved in design projects in the ergonomic, healthcare and transport sectors. Interestingly, for a specific transport project a list of barriers was established, as seen in Table 1, this list is regarding another topic but some if not all the barriers can be related to the field of healthcare. Barriers such as publicity, encouragement and awards are all issues that have not been touched on before in this investigation, but that should be held as big barriers to innovation in healthcare, as all ideas need popularity and somewhat of a media spotlight in order to get investment or recognition no matter what the field.

Similar to the other interviews the question regarding the term innovation, and what they feel innovation is. This particular interviewee had very similar thoughts as the others interviewed, with the view that an innovation has to have a positive image to be classes as a true innovation.

Table 1, Enablers &/or Barriers, (Ross, 2012)

<table>
<thead>
<tr>
<th>Enablers (+) &amp;/or Barriers (-)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Immersion in the problem space</td>
<td>16+ 0-</td>
</tr>
<tr>
<td>Seeking to meet the needs of end users</td>
<td>16+ 0-</td>
</tr>
<tr>
<td>Creating a community of users</td>
<td>13+ 2-</td>
</tr>
<tr>
<td>Networking</td>
<td>14+ 5-</td>
</tr>
<tr>
<td>Collaboration with others</td>
<td>13+ 3-</td>
</tr>
<tr>
<td>Publicity</td>
<td>12+ 0-</td>
</tr>
<tr>
<td>Establishment proof of concept</td>
<td>11+ 1-</td>
</tr>
<tr>
<td>Able to start small</td>
<td>10+ 1-</td>
</tr>
<tr>
<td>Appropriate technical skills</td>
<td>5+ 6-</td>
</tr>
<tr>
<td>Appropriate business skills</td>
<td>7+ 4-</td>
</tr>
<tr>
<td>Time</td>
<td>7+ 6-</td>
</tr>
<tr>
<td>Awards and competitions</td>
<td>7+ 0-</td>
</tr>
<tr>
<td>Investment</td>
<td>7+ 0-</td>
</tr>
<tr>
<td>Government policy (local and national)</td>
<td>0+ 6-</td>
</tr>
<tr>
<td>Encouragement of family and friends</td>
<td>5+ 0-</td>
</tr>
</tbody>
</table>

Finally this interviewee opinion of enterprise was somewhat different that the previous academics interviewed. It was established that enterprise schemes are very much in the infancy with little time that academics can devote to these ventures.

4 Discussion
The majority of definitions for the term ‘innovation’ suggest that in order for something to be classed as an innovation, it has to have a positive impact, therefore for a product or service to be classed as an innovation within the NHS, it has to aid the patient or help the healthcare professional in the process. The result from the various questionnaires also suggests that such innovations do have a positive impact towards patients, with 100% of participants agreeing with the relevant statements.

In order to implement a new innovation there are costs involved in the research, development and implementation stages, and with a product such as a pacemaker the costs could reach into the millions of pounds. Though the cost of innovations can differ from innovation to innovation, for example the cost of introducing a new walking stick could be in the hundreds. Either way the cost of implementing an innovation into this sector would cost more compared to a similar product in a different sector. This is because of the stringent tests and processes an innovation has to go through.

Because such ventures can become very expensive, it is often the case that the smaller businesses seek grants or sponsorships in order to fund the innovation process. As previous mentioned a joint venture called Fit Splint received a grant from the Audi Foundation of £19,840. This figure was only sufficient to allow the project to complete its development and prototyping stages, leaving the venture waiting for clinical trials.

From this investigation it has been established that innovations in healthcare provide real value to the NHS, these innovations play a major part in driving the trust forward, and provide better care the patients. This is fair to say as the fact a product or service is being called an innovation, means it is providing a positive impact, this statement was also backed up from the feedback from questionnaires. The nature of the health service industry means that the innovations that have been implemented have been thoroughly examined meaning they are successful.

Overall the main benefit of innovations in this sector is that they have to potential to save people’s lives, for example, innovations in drug products have changed dramatically in the last 100 years, making it impossible to calculate the amount of lives saved through the development of antibiotics and the other medicines.

This investigation along has highlighted a number of barriers that hinder the rate and implementation of innovations. The main barriers that are highlighted from all stages of research were the lack of both time and funding, more specifically the lack of timetabled enterprise time for academics and healthcare professionals, as well as the lack of funding from large companies, though grants and sponsorships are becoming a more popular avenue for funding.

An interesting point that derived from an interview with Dr Ian Campbell was that a major barrier to innovation the UK was that the education structure, specifically that the youth in schools are encouraged to specialise their skills early on in their school life, for example GCSE and A-Level students in the UK can choose to do specialised subjects and not necessarily have the broad knowledge compared to other countries, particularly compared to China. This specialisation of students in the UK results in them narrow minded and concentrated from an early age and may stifle innovation.
Another barrier that was not identified from the outset was companies may be reluctant to innovate, as it is easier to play safe than to innovate in the tough healthcare industry. This is particularly relevant for the smaller companies. This, in addition to the lack of funding can result in it being difficult to introduce innovations.

5 Conclusions

Smaller groups of people result in an environment that encourages innovation, for example the majority of design consultancies in the UK are small in comparison to the larger multinationals and indeed the health service. Larger organisations by nature contain many different departments and as a result innovation can be difficult to pass, with many different avenues to go through. Therefore it might be fair to suggest that the health care service needs to take a step back and redefine the way innovations are developed. The investigation suggests that the best way to innovate is from getting people together with different skill sets and devising questions that need to be answered. It isn’t always the job of the designer to come up with the problem, need and solution, the experts themselves who have day to day hands on involvement with the patients should be considered as the most valuable asset.

Besides time constraints, another barrier facing the implementation of innovations is thought to be the education system in the UK. The youth are currently specialised with in certain subjects by the time they leave college. It has been suggested that if this wasn’t the case, and that students maintained to have a broad range of subjects, then they would be open to more opportunities are in turn feed innovation. On the whole the way innovation is perceived and approached needs updating and ultimately removing the barriers.

One of the overwhelming outcomes of this investigation is that the term ‘innovation’ is widely used, with some suggestion that it is somewhat overused. This overuse doesn’t help in the clarity of its definition, with some professionals being confused by what is meant by an innovation. In order the resolve this issue it could be suggested that a solid definition of the term ‘innovation’ is needed, or better still an industry specific term could be devised, in order to resolve the confusion, considering the terms common use.

Finally, this study suggests innovations in the healthcare service are important and are one of the main vehicles that drive the NHS forward. These innovations provide an unmistakeable benefit to the workers and patients within the NHS. Therefore the answer to the title, Is the use of innovative design important during patient rehabilitation? Would also most certainly be yes. Another limitation regarding this investigation would be the fact that the focus has been on the immediate NHS environment, the hospitals and rehabilitation centres and no other healthcare environments such as at the patient’s home. In addition, the healthcare service in the UK is much more than the NHS and this study would benefit from more research in other sectors, including more specialist areas such as dentistry or chiropody or other private institutions.

References
