

# Service Innovation and the Role of Science, Technology, Engineering and Mathematics: Ten Challenges for Industry, Academia and Government



A White Paper

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# Service Innovation and the Role of Science, Technology, Engineering and Mathematics: Ten Challenges for Industry, Academia and Government

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## Introduction

"All innovation begins with creative ideas . . . We define innovation as the successful implementation of creative ideas within an organization. In this view, creativity by individuals and teams is a starting point for innovation; the first is necessary but not sufficient condition for the second" (Amabile et al, 1996)

Service innovation is a challenging topic. There is a perception that 'service' is all about the 'soft, flaky stuff'. As one manager puts it: "Service is 'what else can I do for you sir, and a curtsy'". There is an attitude amongst organisations that 'service just happens' (as opposed to the production of tangible products). Such attitudes often impede service innovation. With the advent of Knowledge Intensive Business Services (KIBS) such as consultancies, media and internet companies, knowledge intensive service organisations such as Microsoft and Google are now playing lead roles in the growth of economies. For many of these organisations, innovation is the key to staying ahead of the competition.

Yet, the understanding and promotion of innovation by academics and policy makers are still goods-centric. Service is seen to be a 'value-add' to many manufacturing organisations, and the 'core' value is still seen to reside within the good. Similarly, indicators and metrics used to measure innovation in many countries are still goods based, measuring tangible and formal research and development or patent and intellectual property activities. Historically, research and development (R&D) has supported the manufacturing sector (e.g. in engineering, management, technology etc.), but with economies shifting to services, R&D have been slow to focus on the technology and techniques that will enable organisations in the service economy to function effectively and productively. Even traditional manufacturing companies (e.g. Kone, Rolls Royce) now count service as more than 50% of their revenues. Yet, the technology, knowledge and expertise required for an organisation to deliver a *service*, i.e. intangible activities, inseparable between production and consumption, perishable by nature and heterogeneous in characteristic, are clearly deficient. It is widely recognised that services R&D has not kept up with the demands of the economy.

In addition, the lack of adequate R&D in services at an abstract level has resulted in knowledge in the service industry becoming increasingly sector-driven, with practitioners and researchers socialised within their own industries (e.g. health, finance, tourism, transportation, telecommunications). This in turn perpetuates more contextual, jargonised language that is becoming less inclusive, resulting in more embedded and tacit knowledge. This has inhibited the transfer of knowledge between industries and between industry and academics, who are traditionally seen as providers of a higher abstraction of learning for knowledge transfer. Rather, our evidence suggests that much of service innovation relies now on industry and its

driving need to compete and grow. Until and unless the academic community rises to the challenge of abstracting much of what is innovation in practice, and to provide further research and development insights, this trend looks set to grow.

## **The role of Science, Technology, Engineering and Mathematics (STEM) in service innovation**

While there is growing recognition of the importance of innovation in services, there remains poor understanding of the role of Science, Technology, Engineering and Mathematics (STEM) in service innovation.

This is because there isn't obvious recognition of the fact that STEM tools and techniques are useful for the service sector, particularly for industries where *people* (rather than widgets) deliver value to the customer. There is a need to recognise service as a deliberate and organised system, not merely the 'front end bits' that 'just happens.' It is also important to understand that service innovation is about empowering people in the system to think creatively and put ideas to work in a systematic, scientific manner. In other words, we need more science in service for service innovation.

Perhaps one of the barriers to this is the baggage that comes with the term 'service'. To this end, the term 'service science' (first coined by IBM) could be used as a catalyst to change mindsets. 'Service science' can be seen as the vehicle for the use of STEM tools in service, and for getting organisations signed up to the idea that there is a science to service. This has been found to be particularly effective in bringing organisations to the table to talk about service innovation, research and development.

The following highlights 10 challenges to developing service innovation with STEM tools. Evidence for the analysis comes from:

- (a) Proceedings of the Service Science Forum meetings convened by the Centre for Service Research twice a year.
- (b) Proceedings of the Service Innovation Roundtable in May 2008 at Cornell University in Ithaca, New York, with 30 top global organisations in attendance including the Jumeirah group, American Airlines, Yahoo, Thompson Hotels, Deloitte and American Express.
- (c) Published papers and proceedings by researchers in the Centre of Service Research and in the University of Exeter Business School.
- (d) Anecdotal contributions from the researchers involved in research projects with telecommunication companies, defence contractors, energy companies, hospitality, leisure and health organisations.

- (e) Anecdotal contributions from companies who are members of the Service Science Forum and who have responded to our call for evidence.
- (f) Anecdotal discussions with service organisations at Executive Education programmes, service conferences, SSMEnet-hosted events and service research project discussions.
- (g) In-depth interviews conducted while working on EPSRC and ESRC research programmes with organisations looking to transform themselves into service organisations of the 21<sup>st</sup> century.

## **Ten Challenges to Developing Service Innovation with STEM tools**

### **1. *Development and execution of Service Innovation is often simultaneous***

Reports from service organisations showed that service innovation development is different from traditional product innovation. The inseparability characteristic of services results in the *development* of service innovation as not being easily separable from the *execution* of innovation. “You can’t do service innovation in a lab or a petri dish”, was a comment made. Hence, much of the innovation activities are “real-time, dirty and bareknuckled”. The difficulty in predicting the cost of service innovation development due to its real-time nature is another challenge faced.

Due to the ‘live’ nature of service innovation, there are insufficient STEM tools that could be deployed to develop or execute service innovation. The perception is that current STEM tools work better in static, rather than dynamic, environments. This makes formal research programmes between service organisations and researchers a bigger challenge to scope, deliver and execute.

It is also difficult to assess the success or failure of service innovation using STEM, or indeed how or why it has been successful or has failed. Due to its real-time nature, innovation becomes fused with current practice and “there is no ‘control group’” to compare against. As another organisation puts it: “How do you draw back a service innovation that doesn’t work”?

### **2. *The lack of intellectual property (IP) protection reduces potential investment in service innovation***

Due to the fact that service innovation is about people and processes and its outcome is quite intangible, it is difficult to patent. Service organisations claim that this difficulty in patenting and demonstrating payback to the organisation results in lower investment in service innovation. In addition, the difficulty of evaluating how much a creative idea will cost to implement makes it a further challenge to raise funds internally.

It is difficult to set boundaries on what is innovation that is patentable, and what is just good practice and common sense. The much-derided Amazon.com 1-Click

patent is a case in point. Just 23 days after the 1-Click Patent was issued, Amazon.com sued Barnesandnoble.com to stop them from using their "Express Lane" shopping process on the grounds that it infringed upon Amazon's patented 1-Click business method. Amazon's suit was successful but it has created a backlash against business process-types and software patents from various patent offices around the world, which are now more stringent in patenting service innovation of this nature. The US Supreme Court has consistently held that abstract ideas—including mathematical algorithms—are not patentable, and this seems to be the case in the UK as well. Unfortunately, much of service innovation consists of abstract ideas developed into intangible processes and activities (service), resulting in immense difficulties in patenting. As one manager said, "If I can't hold it, chances are I can't patent it". Difficulties in patenting service innovation ideas inhibit potential projects with the centre.

*Some successes:*

The difficulty in patenting services has resulted in more organisations embracing STEM, in their attempt to create something more patentable. Most of these efforts seem to lie in 'productising' or 'tangibilising' services in some way. Some organisations have done this with some success, as it achieves repeatability, scalability and consistency. The caveat to this success is that the innovation seems to be about patenting the 'productisation' of service; the original challenge of patenting services remains however.

### **3. *A lack of history impedes service innovation***

Relating to the lack of IP, service organisations have commented on a lack of history in service innovation from which they could learn. One organisation remarked: "You can see how a photocopier has advanced, just by looking at old ones and taking them apart. Or search the patent office. You can see where and how it has improved. I would like to see how healthcare service provision has evolved over the years. Are we all reinventing the same wheel?"

From an economic standpoint, the lack of shared knowledge in services has an impact not merely on the spatial distribution of innovation in the service sector, but on the level of innovation as well. It is difficult to access any history of service innovation in any specified areas and for researchers, almost every project has to be scoped as a new project.

### **4. *Lack of a common language across sectors impedes service innovation***

The diversity of the service sector makes it challenging to share best practices and innovate. The sector comprises a heterogeneous set of activities such as financial services, telecommunication, retail, restaurants, transportation, entertainment, education, public services, not to mention not-for-profit activities. Each industry is still dominated by its own terms and language that is highly context-driven; this impedes the transferability of knowledge. In addition, there is a perception amongst

organisations in the service sector that everything is DIY or guesswork, as each industry is distinctive in its own way and each problem faced is unique. As one manager puts it, "What can Virgin Media learn from British Airways and how?"

STEM tools are often a good way of finding common understanding across sectors. Organisations have reported that STEM tools for technology, pricing, capacity, scheduling, and measurement cut across sectors and are useful enablers of service innovation. However, such innovation is then embedded within a sector, and becomes relevant only to the sector due to the nature and language of how it is documented. Research and development within the sector often becomes contextualised and even research collaboration with practice is often published in its industry form e.g. in Transportation Science, Journal of Banking & Financial Services, Healthcare journals, without much attempt to abstract the concepts to a higher level for sharing amongst sectors. This results in a duplication of efforts, and in turn, lowers productivity in innovation.

*Some successes:*

Generic service journals are starting to gain recognition, motivating researchers to publish at a more generic and abstract level. Service organisations are starting to become aware of the possibility of having 'innovation leaps' by collaborating with academics who are better able to transfer knowledge; interest in this has picked up substantially over the past 2 years.

**5. *Lack of boundaries in services makes innovation easy to attempt, but less measurable in terms of its successes and failures***

Several managers have commented: "Anyone can innovate in services because many of us are delivering a service. If we change what we do to become more effective, isn't that innovation?"

STEM tools and techniques are often used by those who are technically trained. In many services, there is a lack of use of STEM tools and techniques simply because less people know how to deploy them even while *more* people are participating in service innovation development. Consequently, there seem to be evidence of many innovative practices in services, but they are not well captured nor are they well analysed or well documented. Hence their impact is not easily measured.

In trying to capture, analyse and document service and service innovation, managers often not only encounter a lack of STEM-based analytical tools, but also a reluctance to learn such tools due to numerical/analytic anxiety. STEM-based tools do not often have materials that can help ease discomfort and reduce such anxieties. The result is that analysis in services is often anecdotal and qualitative, and this lends uncertainty to the generalisability and reliability of studies.

In engaging with service organisations to assist in this challenge, difficulty is faced on two fronts; first, technically trained people do not understand *service* in an inter-

disciplinary sense, and second, organisations have to recognise that service elements require STEM tools as well. Often, service organisations would accept the 'soft stuff' as a form of uncertainty and something they have to 'live with'.

**6. Behavioural issues are paramount in many services, resulting in a lack of measurements**

In many services, the principle 'value creators' for the customer are often not tangible widgets, but people. This means that value creation is less systematic, riddled with uncertainties and does not lend itself easily to analysis, resulting in greater challenges when using STEM tools and techniques. Thus, service organisations have found that STEM techniques are lacking when dealing with behavioural issues.

A manager from the cargo handling section of an airline, when comparing notes with his passenger counterpart, made the following observation:

*We have all sorts of optimisation techniques and algorithms to move our cargo from point A to point C, even routing it through point B when timing is unimportant but cost is. We have techniques to store, schedule and send. It's not a difficult job coz our cargo don't care when they are packed like sardines, shifted around or left alone. Most importantly, our cargo don't talk back.*

**7. STEM-based language and the language of service**

There is a perception that many STEM-based techniques are still product focused. Much of the service sector has a language that is not manufacturing- nor engineering-based (or indeed, some might argue that it's not STEM-based). One anecdote, recently encountered, was a discussion between a STEM-based academic and a service organisation manager. (The following is not verbatim, only presented here from memory)

*"It's about people working together with equipment to deliver the service"*

*"So it's all about soft systems then"*

*"Er.. maybe... but people aren't usually easily managed"*

*"Ah... soft systems with high level of uncertainty.."*

Experience with STEM-based academics has led us to conclude that unpredictability, uncertainty and change characterises many services, which leads to a high level of discomfort when STEM-based researchers work with service organisations.

**8. Lack of ownership in a service and the lack of boundaries in services makes the use of STEM tools and techniques a challenge for service innovation**



STEM tools and techniques often require firm boundaries, whilst services are often fluid and its boundaries are not entirely obvious. In cases where boundaries are set (e.g. for analysis), they may actually stifle innovation. In addition, organisational structures inherited from product-centric thinking results in a lack of ownership of the service as a whole, with people working within their own functional silos (operations, marketing, IT etc.) and there is no one department or person responsible for the service system in the organisation. This raises the question of what kind of innovation the firm should invest in; investment in a particular area of a service without consideration for another area may be counter-productive.

For example, a large telecommunications company introduced a new mobile phone with free Sky downloads, and found that they had insufficient base station capacity to cope with it - they needed a model of the base station capacity and a way of working instead of conducting a series of local optimisation.

**9. *Product-centric STEM-based tools and techniques often fall short in dealing with service characteristics, resulting in the inhibition of service innovation***

There is a perception that product-centric tools and techniques are the 'right' tools and techniques. Organisations commonly mistake *efficiency* for *effectiveness*. Product-centric STEM-based tools often help to increase efficiency (within clear boundaries), but leave very little room for managers to question if such tools are *effective* in service-oriented environments. By taking product-centric tools as a given, the potential to be more effective (and hence the potential to innovate) is often lost.

For example, conventional STEM techniques have been inadequate in the work on the pricing and revenue models of services, understanding the separation of purchase and consumption (which is unique to services) and the pricing of through-life services. This is not surprising as even within industry, there have been heated debates on how to 'monetise' innovative services such as social networking sites and peer-to-peer technologies (e.g. Skype) that have immense value to society.

Often, there are organisations that feel compelled to 'fit' product-centric STEM tools just because they are available (e.g. the use of 'lean' concepts in service organisations) and because manufacturing and engineering has a large body of knowledge. Using product-centric STEM-based tools means that context and human behaviour are often relegated to the margins, resulting in organisations focusing on the tangible aspects of a service because it's just easier.

**10. *Co-creation of value with customers results in service innovation that is dynamic and not captured***

One manager remarked, "There is a lot of innovation going on - mostly with the customer, but very little of it is documented, and most of it is embedded in our people."

Service organisations have claimed that the results of innovative practices have not been well-extracted or abstracted. They lie embedded in human capability and are not easily shared: "We just have to make sure that we choose the right people for a new project, coz they bring with them all the knowledge of how to make the service work better."

There is a need to expand STEM tools and techniques to cover the human side, as well as interactivity in services.

*Some successes:*

The centre is now starting work on abstraction projects i.e. documenting innovative service practices in reports, with the specific intent of future replication and development of meta-concepts. These projects use behavioural science and mathematical tools.

## **Facing the challenges: What industry, academia and government can do**

Obviously, more needs to be done by companies, universities and the government to enhance the impact of STEM on innovation in services.

### ***Industry***

For companies to invest in service innovation involving STEM tools and techniques, there needs to be a mindset change from 'service-is-just-what-the-organisation-does-naturally' or merely viewing the customer-facing parts of the company as 'service', towards a deeper understanding of service as a deliberate, organised and well-designed system that include behaviours.

Researchers have encountered organisations that invest millions in technological product innovation without recognising that service is often what unlocks the value of a product to the customer. The whole organisation is structured towards getting the tangible components designed, organised, manufactured, packed and delivered while the service 'just happens'. Similarly, service companies (such as hotels, transportation etc.) often focus on the tangible aspects (seats, rooms, vehicles) rather than on the value that the entire service system delivers. Such an attitude impedes the organisation's competitive advantage, even if the tangible product is best in class. Companies need to invest in change and transformation programmes, and there is a need to develop leaders that are both able and empowered to communicate across silos to gain a full understanding of service and what service innovation means.

Organisations should recognise the benefit of having academia provide cross-sectoral learning through a more abstract understanding of service, and should collaborate with universities on the use of STEM-based tools and techniques in

services. This again, would require empowerment and leadership from the companies to break through existing mindsets. Current service organisations often do not know how to work with academia, or fail to see how academia is able to help them. Due to a dearth of service-based STEM tools and techniques, academics do not have quick fixes and fast solutions either. Both parties need to come together on research projects that are able to advance knowledge in services and that are exploitable for companies.

### ***Academia***

Working with the service sector requires researchers to have a strong interdisciplinary inclination and to be relevant to practice; both qualities are a rarity amongst management academics. Solutions for STEM-based tools in service organisations are much more challenging academically, because they are not easily found and require bespoke intellectual input. The good news of course, is that there is greater scope for publishing academic papers. The challenge is to build research capacity of people who understand service and STEM techniques, are interdisciplinary and are able to work at an advanced level. Also, many product-centric STEM-based technologies are immensely useful, but academics must be cognisant of the fact that service characteristics do change tools and if there is insufficient research into how and when such tools need modification, there is the risk of the potter being enslaved by his/her own clay.

Universities should recognise that silo-ed, mono-disciplined mentalities therefore inhibit engagement with the service sector. If the objective is to stimulate research into how an organisation can innovate in service, service itself should not be constrained by the political and territorial boundaries of disciplines. To be truly interdisciplinary so as to encourage innovative research, service needs to be free of its disciplinary boundaries, and the paradigmatic research influences of each discipline.

In short, service needs to evolve into a discipline in its own right. Unfortunately, universities often have to manage practical issues such as ‘which school or department should house the new discipline (of service)?’ and the political nature of such a question has led to the service discipline being trapped by institutions’ unwillingness to change. To engage with the service sector fully, service research should be liberated from school and departmental territories and sit autonomously within the university, free to bring in top academics of other disciplines to advance the cause of service innovation.

### ***Government***

Government should proactively fund service research in areas that address the challenges stated above. Specifically, STEM tools and techniques that need modification due to the nature of service (perishability, inseparability, intangibility,

heterogeneity) needs further research. In addition, the interface between academic leaders and business leaders in the service sector would also require investment. Industry has much to offer academia through the service innovation outcomes of entrepreneurialism and empowerment (for example, Google, etc.). Academia has also much to offer industry in providing abstracted language, tools and techniques (STEM or otherwise) so as to facilitate more cross-sector learning.

The government could offer small-scale grants for companies to work with academia. It is astonishing how even large companies have little knowledge of working with academia. Funding to seed the process with small amounts of money would help initiate more joint projects. Knowledge Transfer Partnership (KTP) schemes in the area of services have been found to be very useful in helping companies think of STEM-based tools and techniques in services. Given this, a dedicated tranche of KTP funds for the service sector would be helpful.

## **Conclusion**

With productivity levels reaching their peaks in both the manufacturing and service sector, innovation is the next frontier. The service sector is in need of a paradigmic shift from a product-centric industrial era mindset.

The report sponsored by QinetiQ (“Excellence in Service Innovation: CBI/QinetiQ report on innovation in UK service sector businesses”) provided some excellent examples of service innovation and recommendations to government. In addition, we also fully support the action plan set out by the Department for Business Enterprise and Regulatory Reform (BERR) report on Supporting Innovation in Services.

We feel strongly however, that academic institutions should play a much stronger role in abstracting, transferring and scaling knowledge in services for more productive and efficient innovation in services. Without abstraction, individual service sectors will consistently reinvent wheels. More plans need to be put in place to promote service as an integrative discipline that is capable of transforming traditional disciplines and silo-based ideas.