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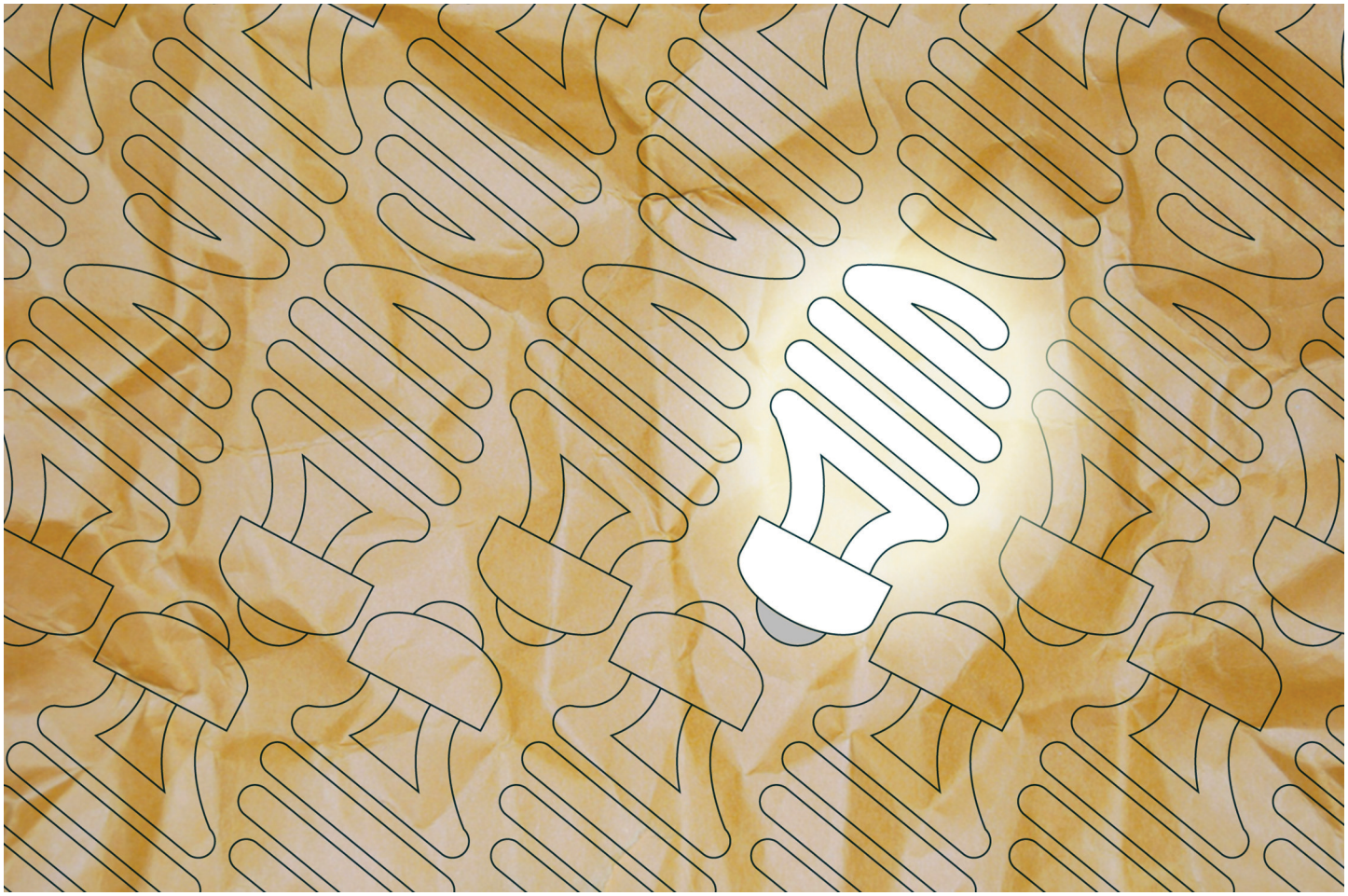
Innovation through representation



About this free course

This free course is an adapted extract from the Open University course T317 *Innovation: designing for change* http://www.open.ac.uk/courses/modules/t317.

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Introduction

Innovations are realised through design, and some of the most useful tools in the designer's toolbox are the representations that are used to move from a vague idea to a concept, and then to a realised product, service or system. In this course we are going to explore in some detail what these representations are and how they are used not only to develop, but also to communicate visions of innovation.

In this free course, we will start in Section 1 by considering how innovation is defined, what the sources of innovation are, and what the outcomes of innovation look like. In Section 2 we will take this further by considering how representations are used to develop and discuss innovations; how they are used by designers to communicate their ideas, concepts or visions, and why they are used to support communication and dialogue. In Section 3, we will explore how representations are created and used as tools during innovation processes; we will consider the different types of representations and the different roles that these play in innovation processes. In Section 4 we will explore the role of representations in ensuring that innovation takes place, by persuading others of the value of an innovation. Finally, in Section 5, we will summarise the key learning outcomes of the course, and introduce the *Innovation Frame*, a useful model that supports thinking about the innovation process.

Table 1 What you have to do

Section	Study time
1. What is innovation?	4 hours
2. Talking about representations	3 hours
3. What are representations for?	4 hours
4. Persuading representations	3 hour
5. Supporting innovation	1 hour

This OpenLearn course is an adapted extract from the Open University course T317 *Innovation: designing for change*.

Learning Outcomes

After studying this course, you should be able to:

- understand innovation as an interactive process that draws on several sources to attain various outputs – products, services and systems
- appreciate the role of representations in design and innovation processes
- think critically about different aspects of design and innovation.

1 What is innovation?

1.1 Defining Innovation

This course is an exploration of the nature of innovation and the role that representations play in enabling an innovation to be shared, explored and developed. We'll start by exploring what we mean by the word *innovation*.

Activity 1 Describing innovation

What does the word innovation mean to you? Use the text box to record your initial impressions when you think of innovation.

Provide your answer...

Discussion

Perhaps you thought of an innovative product, such as a smartphone or an electric car, or perhaps you thought of a famous innovator, such as James Dyson or Mark Zuckerberg. Maybe you thought of a 'light-bulb moment' – a moment of creative discovery, like in Figure 1. These are all good answers and, as they indicate, the word innovation covers a broad spectrum of meanings. In this course we have a specific idea of what innovation means which we will explore in the remainder of this section.

Figure 1 An image of innovation

In its broadest sense *innovation* comes from the Latin verb *innovare*, which means to make something new. This definition may seem too simple and straightforward, indeed there are many modern definitions of innovation, which suggest that the concept is quite complex and is difficult to capture in a few words. Some definitions include:

> Innovation is the successful exploitation of new ideas.
>
> (Innovation Unit, 2004)
>
> A specific tool of entrepreneurs, the means by which they exploit change as an opportunity for a different business or service. It is capable of being presented as a discipline, capable of being learned, capable of being practiced.
>
> (Drucker, 1985)

> A process of matching technical possibilities to market opportunities, through activities including experimental development and design, trial production and marketing.
>
> (Freeman and Soete, 1997)
>
> A process of turning opportunity into new ideas and of putting these into widely used practice.
>
> (Tidd and Bessant, 2009)

While definitions of innovation may vary in their wording, the common theme is that innovation involves coming up with ideas and putting these to practical use, and it is this meaning that we use in this course. It is important to realise the distinction here between *invention* and *innovation*. Invention is the process of *creating* and *developing* ideas, concepts or designs. On the other hand, innovation is the process of developing a new or improved product, service or system for *adoption into use*, and possibly widespread diffusion. The key difference is that innovation results in something that can be used, either a product service or system; these are the outputs of innovation, and are discussed in more detail in Section 1.2.

An innovation is not just an idea; it is also the process of putting the idea into practice. This involves an underlying pattern of activities which form the basis of innovation, and include developing a vision, thinking about how the vision can be realised through design, and specifying details so that the vision can be realised. A necessary and important part of almost all these activities are the representations that are used. In the early stages of the innovation process, representations are used to develop and share ideas, often through sketches, diagrams or concept maps. But, these ideas do not constitute an innovation until they have been transformed into something that has a potential for practical application. This transformation is where design occurs and a range of representations including drawings, models and diagrams are used to support the development of a vague, but potentially innovative, idea into something real and specific that has potential for practical application. Representations have an equally vital role to play as ideas are grown for adoption and diffusion, including drawings and instructions that contain all the information necessary for the realisation of a product, service or system, as well as posters and models that describe the innovation and encourage users to engage with it.

This description may suggest that innovation follows a nice neat sequence of activity. This is rarely true; instead it is typically a messy iterative process in which context, people and the various materials they engage with all need to be taken into consideration. These various factors add to the complexity of the innovation process, but they are also the source of innovation as described in Section 1.3. At every stage, innovation is an interactive process in which the various sources of innovation are engaged and linked in some way, providing both requirements and constraints which inform decisions and make the output of innovation realistic and useful.

1.2 Outputs of innovation

Innovations work their way into reality in a variety of forms. In the preceding section, we mentioned three types of outputs of innovation: products, services and systems. Let us start by thinking about how products, services and systems differ and how they are similar. We put these questions to Tim McAloone, Professor of Product/Service-Systems at the Technical University of Denmark.

Activity 2 Describing the outputs of innovation

In the following video, Tim McAloone defines products, services and systems. Watch the video, and using Tim's definitions identify three examples of products, of services and of systems. Use the textbox to record your answer.

Video content is not available in this format.
Video 1 Interview with Tim McAloone of the Technical University of Denmark

Provide your answer...

Answer

These are examples that I thought of, but yours are likely to be different:

Table 2

Product	Service	System
A pair of scissors	A haircut	A beauty salon
A bicycle	Public bicycle hire scheme	A city-wide bicycle system
A movie	On-demand internet streaming	A cinema

Discussion

My answers follow Tim's definitions for products, services and systems, which are:

A *product* is the result of a development process. It is something that is designed and ownership is transferred. The example Tim mentions is buying a lawnmower.

A *service* is an activity that is provided on your behalf. So in Tim's example the activity would be a grass cutting service. A product is involved (the lawnmower) but this is part of the activity that is undertaken.

A *system* is where there is a collection of infrastructure, people with roles, which call on products and services. So grass cutting may be part of a service system that is provided to a neighbourhood or town.

Tim picked up the point that businesses often call services 'products'. That may be just business speak, but not all products are necessarily tangible. If I buy a financial product (say an investment package), this does involve the design of the mix of investments concerned and a change of ownership.

Overall these three categories are useful, but we should not get too hung up on the boundaries between them. Indeed some really important innovations are those that take place on the boundaries of meaning between product, service and system.

Now that we have defined products, services and systems, we can move on to explore some examples of product, service and system innovation.

Product Innovation

When we think of innovation we often alight upon product innovations – objects. The vacuum cleaner and electric light bulbs are examples of such product innovations, and in general we can define the product innovation process as

> the introduction of a new good or a new quality of a good.

(Schumpeter, 1939)

Notice that the idea for the product does not have to be new. For example, when pocket calculators were introduced in the 1970s, the idea of using a machine to carry out arithmetic operations was not new. Mechanical calculating machines have been around since the invention of the abacus, around 2000 BC, and automated calculating machines were available in the 17th century. But, pocket calculators, such as the example in Figure 2a, were an innovation because they used the invention of the microprocessor to introduce new functionality, to make the design more user friendly, and to make them easier to manufacture and, eventually, cheaper to buy.

Figure 2 Innovative products: (a) early digital calculator (b) digital camera

Similarly, the digital camera, as illustrated in Figure 2b, took a while to become established as it initially offered little advantage over film cameras. But over time people realised they offered different functionality from a traditional camera, allowing many more pictures to be taken without the need for film. Also, improvements in computing technology allowed for reduction in size, increase in functionality and decrease in cost, which further encouraged diffusion. The inclusion of a digital camera on mobile phones accelerated this effect further, and today digital cameras are ubiquitous.

Service Innovation

Our society and economy is increasingly built on services, and so innovations in service and in service design are extremely important. Hairdressing and gardening are examples of quite traditional service offerings, but newer, more exciting examples are emerging every day, with examples such as business services, internet grocery delivery services, energy services and new transport ticketing services such as the Oyster smart card in London. In general, the service innovation process can be defined as *the introduction of new or improved service offerings*.

As with product innovation, a service innovation can be a new type of service but is often an improved delivery or performance of an existing service. Broadly speaking, service innovation involves (re)configuring the elements necessary to provide services and/or integrating new ones. For example, a new information system may be integrated in a service to manage bookings.

Unsurprisingly, much service innovation is undertaken in what is classified as the traditional service sector, including finance, insurance, real estate, transport, and communications. However, it is important to realise that service innovation is not confined to the traditional service sector. There is also a growing trend for manufacturers to use their products as platforms for various service innovations, such as extended warranties for household appliances and servicing (Howells, 2002). In such instances, manufactured goods are not offered to consumers in their own right but rather as part of a package that includes service components. These often focus on satisfying customer demand for outcomes and results (e.g. reliable central heating). Also, the ubiquity of the internet and mobile devices is introducing opportunities for service innovation, for example music and video internet streaming, holiday planning and booking, navigation, and information retrieval, such as Wikipedia, the free, online community-created, instantly updated encyclopaedia.

Figure 3 Wikipedia

System Innovation

In reality, few innovations stand alone. Most only work when they are embedded within systems. For example, cars and trains do not make much sense in the absence of roads and rails and the fuelling systems for them. That is why there are widespread problems in introducing hydrogen fuel cell cars due to the lack of a nationwide fuelling system. Systems are collections of various elements including people, products, services and infrastructures, e.g. railways, roads, IT networks. Systems include services and differ from them as they are typically based on a larger collection of elements and satisfy societal needs for functionality.

Activity 3 Identifying systems

Think about making a trip to a nearby town. What systems are involved in making this trip? The following photos may provide some clues – but work it through for yourself, and use the text box provided to record your ideas.

Figure 4 Systems involved in making a trip

Provide your answer...

Answer

Your answer might involve a number of systems. If you travel by road (either by car, bus or cycling) it involves the road system and its controls (traffic lights, enforcement, emergency services, etc.). There is a parallel for the rail system, e.g. tracks, signals, railway staff and the scheduling of services as shown in a timetable. For public transport there may be information and ticketing systems; for a car you may use a GPS system to guide you – and even a printed road atlas has a system behind the mapping involved.

Systems do not simply exist. Instead they were designed, introduced and developed over time. For example, to make electric lighting work, Edison set about developing an urban electricity generation and distribution system (McPherson, 2013). Generally, the system innovation process can be defined as

> *the introduction of new or improved socio-technical systems that fulfil societal functions, e.g. for transport, communication, housing.*
>
> (Adapted from Geels (2002) after Hughes (1983))

Systems are often quite complex. While systems include elements such as infrastructures, they also embody ways of doing things. For example, the Highway Code sets out the formal rules of the road and is needed to enable vehicles to travel safely. This helps explain why such systems are often termed socio-technical systems. Systems involve various technical elements such as products and infrastructures as well as human operators who follow social rules. Those rules may be laws, or they may just be accepted practices and behaviours. System innovation therefore often involves deep structural change, not only in things but in our everyday practices.

1.3 Sources of innovation

There are many sources of innovation. New ideas often arise as a result of the introduction of new technologies. For example, the introduction of the microchip made the pocket calculator possible, as well as countless other innovations. New technologies are the harder, often physical, sources of innovations which, in this course, are referred to as ‘material things’. While these are important sources of innovation, so too are people and their needs. Also important are contextual factors such as new regulations and changes in markets and society in general. Innovation is a process in which these three sources interact.

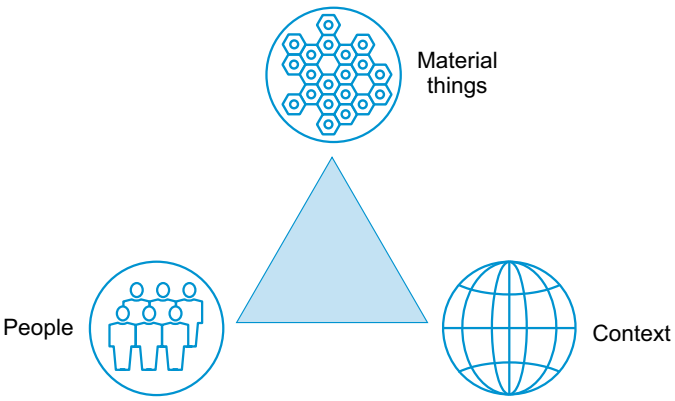

Figure 5 Sources of innovation

Material Things

Material things provide a source of innovation that can take many forms and are developed in a variety of settings. Consider, for example, nylon. The discovery of nylon was a major accomplishment of organic chemistry in private industry-sponsored basic research. It was discovered in a laboratory, set up in 1927 by E. I. DuPont de Nemours which aimed to fill gaps in knowledge of chemical processes which might be of commercial value. DuPont was already in the textile business and the development of nylon involved determining whether commercial production was feasible and identifying practical commercial possibilities, which led to the company's focus on hosiery (Ruttan, 2001). In contrast to this, consider the development of the 'cat's eyes' by Percy Shaw. Percy was not a member of a big research team in a major laboratory. He was a road mender who was aware of the dangers of driving along unlit, and often fogbound, roads. One night in 1933 he was driving his car near his home in Yorkshire when his headlights were reflected in the eyes of a cat. This inspired him to develop the cat's eye reflector, that when embedded at intervals in the centre of the road, reflected a vehicle's headlights and made it easier to identify the course of the road, as illustrated in Figure 6. Shaw spent several years developing the concept and his eventual design consisted of pairs of glass beads embedded within a flexible rubber moulding fixed into the road surface. When vehicles drove over this, the rubber contracted, clearing away any dirt, making cat's eyes self-cleaning.

Figure 6 Cat's eyes reflectors on a road

People

Sometimes consideration of material things alone can lead to successful innovation. But this is rare, and developing products, services or systems based on new technologies is usually insufficient. There is a danger that focus on technology means that the requirements of the user are neglected. While new material things may create

opportunities for innovation, these will only be successful if they meet or even create user needs. In other words, people are also an important source of innovation. For example, in the 1990s Trevor Baylis developed the wind-up radio after watching a television programme about the spread of AIDS in Africa (Baylis, 1999). It was predicted that the spread of the disease could be halted if people could be educated, but few of the African poor had access to televisions or radio, so public broadcasting was ineffectual. Part of the problem was power supply; few towns had electrical infrastructure in place, and batteries were prohibitively expensive. Instead Baylis adapted and improved existing clockwork technology to produce a radio that could be charged by hand, and was designed for the intended users. As this example shows, it is perfectly possible to have innovation without the development of new material things being the primary motivating factor. Something can be innovative if it originates from the needs of the people that use it. Considering the users in design and innovation is an important part of the process.

Figure 7 Trevor Baylis and the wind-up radio

Whether innovation is driven by technological discovery or user needs is the subject of considerable debate. In some instances, such as the nylon example, innovation is clearly driven by new materials. In others, such as the wind-up radio, innovation is driven by user needs. However, in almost all instances, materials and people interact as sources of innovation. Even in the case of nylon, the choice of the market for launching nylon, hosiery, was because there was a demand and nylon offered an attractive alternative to expensive silk stockings.

Context

So far we have identified two major sources of innovation: material things and people. However, innovations are produced, consumed and used somewhere, i.e. in contexts, and this is the third and final source of innovation we consider in this course.

Contexts for innovation can take many forms. For example, there is the context of how and where products are used. In the example of the wind-up radio, the context of the AIDS epidemic in Africa was a big motivating factor in Baylis' decision to develop the radio. Regional regulations can also have a huge impact on design and innovation. For example, regulations to cut pollutants from cars led to the development of catalytic converters and filters on vehicle exhaust systems; regulations on carbon dioxide emissions have led to major changes in car design and the development of technologies such as petrol–electric hybrid cars.

Changes in regulation are a two-edged sword – regulation both restricts certain activities, and can close avenues along which innovation may have been following, but it also opens new avenues along which change is mandated. Conversely, deregulation (the slackening of controls) may provide opportunities for innovation – for example the deregulation of telecommunications in the UK in the 1980s led to the development of a whole range of new products and services that had not been permitted by the old state-owned monopoly.

Context includes other important factors such as increasing global wealth, globalisation, improved communication enabled by information and communications technologies, and increasing availability of simulation and prototyping tools. Engaging with the world to

create opportunities for innovation may mean that far more territory needs to be covered than before (Tidd and Bessant, 2009). This is further complicated by the internet-enabled reduction in separation between users and producers. Consequently consumers expect to be more involved in how innovations emerge, and community-based schemes such as crowdsourcing and crowdfunding are becoming commonplace.

2 Talking about representations

The innovation process often starts with a vision, inspired by some combination of material things, people and context. But product, service or system innovation cannot proceed without design. Design thinking is used to explore and develop a vision, while design details are specified to make the vision realisable as a new or improved product, service or system. Broadly speaking, creating a vision, design thinking and design detail are the primary activities in an innovation process and as discussed in the introduction to the course, in each of these, representations play an important role.

2.1 Visions of innovation

Visions set the direction of innovation and help enrol key actors in the process. For example, visions of an innovative new housing development may give financiers a sufficient basis to begin to invest and other actors, such as local planners, an interest and reason to be involved. In the context of innovation processes, visions can be defined as

> collectively held and communicable schemata that represent future objectives and express the means by which objectives will be realized
>
> (Eames et al., 2006)

Representations are used to develop and communicate visions to others, to initiate the design and innovation process, set direction, enrol key stakeholders and help to create tangible outputs to assess and modify the scope of the vision.

Activity 4 Communicating visions for innovation

The following video is an excerpt from an episode *of Design for Life*, a TV show which followed UK design students competing for a place at Philippe Starck's School of Design. In this episode the students have been asked to develop an innovative project. Watch Starck's presentation of the design brief, and the students presentations of their projects, and consider the way that the students communicate their vision to Starck. Answer the following questions:

- What representations do the students use?
- Which of these are effective in communicating the vision or concept?
- What does Starck say about the projects?

Use the textbox to record your impressions.

Video content is not available in this format.
Video 2 Design for life

Provide your answer...