## The innovation life cycle – different emphasis over time

We also need to recognize that innovation opportunities change over time. In new industries – like today's biotech, Internet-software or nano-materials – there is huge scope for experimentation around new product and service concepts. But more mature industries tend to focus on process innovation or position innovation, looking for ways of delivering products and services more cheaply or flexibly, or for new market segments into which to sell them. In their pioneering work on this theme Abernathy and Utterback developed a model describing the pattern in terms of three distinct phases (see Figure 1.6).[72]

Initially, under the discontinuous conditions, which arise when completely new technology and/or markets emerge, there is what they term a 'fluid phase' where there is high uncertainty along two dimensions:

- The *target* – what will the new configuration be and who will want it?
- The *technical* – how will we harness new technological knowledge to create and deliver this?

No one knows what the 'right' configuration of technological means and market needs will be and so there is extensive experimentation (accompanied by many failures) and fast learning by a range of players including many new entrepreneurial businesses.

Gradually these experiments begin to converge around what they call a 'dominant design' – something which begins to set up the rules of the game. This represents a convergence around the most popular (importantly not necessarily the most technologically sophisticated or elegant) solution to the emerging configuration. At this point a 'bandwagon' begins to roll and innovation options become increasingly channelled around a core set of possibilities – what Dosi calls a 'technological trajectory'.[64] It becomes increasingly difficult to explore outside this space because entrepreneurial interest and the resources which that brings increasingly focus on possibilities within the dominant design corridor.

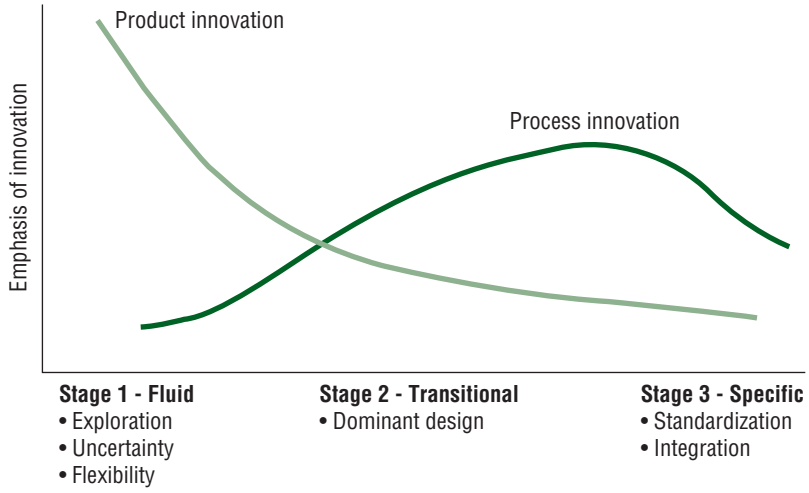


**FIGURE 1.6:** **Abernathy and Utterback's model of innovation life cycle**

This can apply to products or processes: in both cases the key characteristics become stabilized and experimentation moves to getting the bugs out and refining the dominant design. For example, the nineteenth-century chemical industry moved from making soda ash (an essential ingredient in making soap, glass and a host of other products) from the earliest days where it was produced by burning vegetable matter, through to a sophisticated chemical reaction which was carried out in a batch process (the Leblanc process), which was one of the drivers of the Industrial Revolution. This process dominated for nearly a century but was in turn replaced by a new generation of continuous processes using electrolytic techniques, which originated in Belgium where they were developed by the Solvay brothers. Moving to the Leblanc process or the Solvay process did not happen overnight; it took decades of work to refine and improve each process, and to fully understand the chemistry and engineering required to get consistent high quality and output.

The same pattern can be seen in products. For example, the original design for a camera is something that goes back to the early nineteenth century and – as a visit to any science museum will show – involved all sorts of ingenious solutions. The dominant design gradually emerged with an architecture which we would recognize – shutter and lens arrangement, focusing principles, back plate for film or plates, etc. But this design was then modified still further, for example, with different lenses, motorized drives, flash technology – and, in the case of George Eastman's work – to creating a simple and relatively 'idiot-proof' model camera (the Box Brownie) which opened up photography to a mass market. More recent development has seen a similar fluid phase around digital imaging devices. See web for product lifecycle analysis.

The period in which the dominant design emerges and emphasis shifts to imitation and development is termed the 'transitional phase' in the Abernathy and Utterback model. Activities move from radical concept development to more focused efforts geared around product differentiation and to delivering it reliably, cheaply, with higher quality and extended functionality.

As the concept matures still further so incremental innovation becomes more significant and emphasis shifts to factors such as cost – which means efforts within the industries that grow up around these product areas tend to focus increasingly on rationalization, on scale economies and on process innovation to drive out cost and improve productivity. Product innovation is increasingly about differentiation through customization to meet the particular needs of specific users. Abernathy and Utterback term this the 'specific phase'.

Finally the stage is set for change – the scope for innovation becomes smaller and smaller whilst outside – for example, in the laboratories and imaginations of research scientists – new possibilities are emerging. Eventually a new technology emerges, which has the potential to challenge all the by now well-established rules – and the game is disrupted. In the camera case, for example, this is happening with the advent of digital photography, which is having an impact on cameras and the overall service package around how we get, keep and share our photographs. In our chemical case this is happening with biotechnology and the emergence of the possibility of no longer needing giant chemical plants but instead moving to small-scale operations using live organisms genetically engineered to produce what we need.

Table 1.5 sets out the main elements of this model.

Although originally developed for manufactured products the model also works for services, for example the early days of Internet banking were characterized by a typically fluid phase with many options and models being offered. This gradually moved to a transitional phase, for example building a dominant design consensus on the package of services offered, the levels and nature of security and privacy support, the interactivity of website. The field has now become mature with much of the competition shifting to marginal issues such as relative interest rates. Similar patterns can be seen in VoIP telephony, online auctions such as eBay and travel and entertainment booking services such as Expedia.

TABLE 1.5 **Stages in the innovation life cycle**

| Innovation characteristic | Fluid pattern | Transitional phase | Specific phase |
|---|---|---|---|
| Competitive emphasis placed on . . . | Functional product performance | Product variation | Cost reduction |
| Innovation stimulated by . . . | Information on user needs, technical inputs | Opportunities created by expanding internal technical capability | Pressure to reduce cost, improve quality, etc. |
| Predominant type of innovation | Frequent major changes in products | Major process innovations required by rising volume | Incremental product and process innovation |
| Product line | Diverse, often including custom designs | Includes at least one stable or dominant design | Mostly undifferentiated standard products |
| Production processes | Flexible and inefficient – aim is to experiment and make frequent changes | Becoming more rigid and defined | Efficient, often capital intensive and relatively rigid |