TECHNOLOGY SCOUTING & MODULAR ARCHITECTURE

HOW TO CREATE A TECHNOLOGY ROADMAP

Design roadmapping is rooted in technology roadmapping, which technology strategists invented to manage the growing complexity of technologies. In the early days of technology roadmapping, the objective for them was to make strategic choices on long-term technology research in alignment with the strategic decisions on new business development. Nowadays, technology sub-maps still provide the foundation for design roadmaps. Although in the digital age, not every organisation has an in-house technology research program, almost every organisation uses digital technology to aid product and service development. Therefore it remains vital for designers to align the value drivers of the user sub-map with smart choices about emerging technologies. Scouting for new technologies is one of the key activities to do this.

In the first chapter we introduced roadmaps that depict new design innovations along four layers of: user value, market, product and technology. The technology layer assists organisations to forecast and plan for new technology components and modules. Its structure is based on the partitioning of the system architecture.

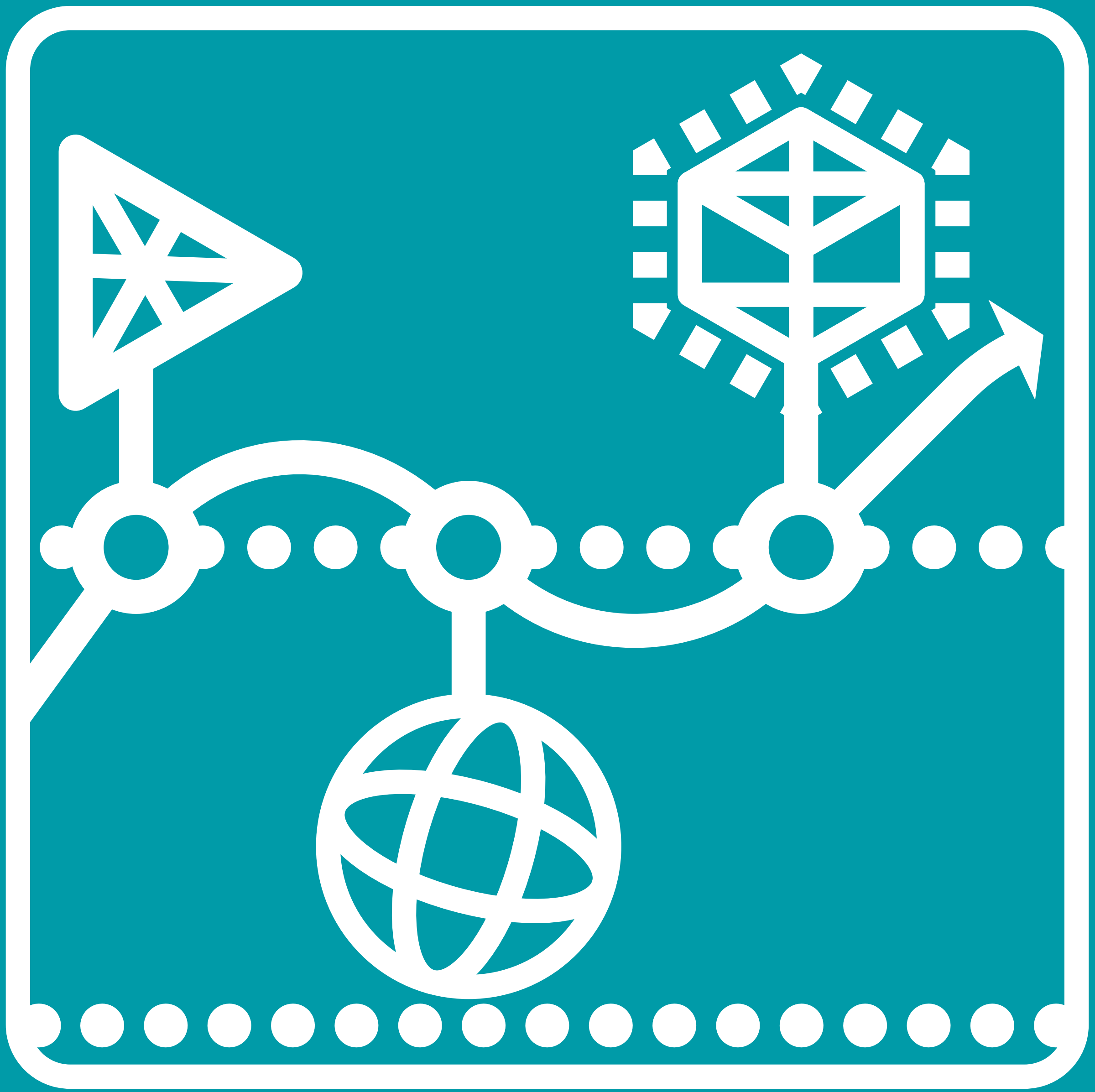
This chapter takes a closer look at this strategic partitioning and delves deeper into ways companies uncover new sources of technology and can make technology evolution projections. The design of the technology roadmap is guided by (1) the mapping of technology evolution (2) the use of a modular system architecture and (3) source-based scouting. Paul Hilkens, the vice president at Océ-Technologies BV, provides us with a case study that highlights the integration of modular system architectures in technology roadmaps.

Mapping Technology Evolution

The evolution of new technologies – the progress from invention, to proof-of-principle, to prototype testing – can take years. To make optimal use of emerging technologies, and harness new user value opportunities, you can anticipate on these evolutions by mapping them. For instance, we mapped the evolution of LED (Light-Emitting-Diode) technology for Philips' wake-up light on the technology sub-roadmap. We placed special emphasis on the 2009 moment mapped at the future timeline when the proof of technology for "white LED-light" was to be expected – see figure 4.1 – because at that time when the roadmap was created, in 2005, there was only proof of technology for coloured LED lights. Before applying the white light LED technology into the wake-up light that (was introduced with incandescent light technology) we mapped the application of subsequently, energy-efficient halogen light technology, mapped on the year 2006, and durable compact fluorescent light technology, mapped on the year 2007.

The mapping of technology evolution has three main activities:

(A) Out-of the box scouting to discover new and promising technology applications that support the visionary direction;



MAPPING TECHNOLOGY EVOLUTION by building logical chains of scouted technologies.

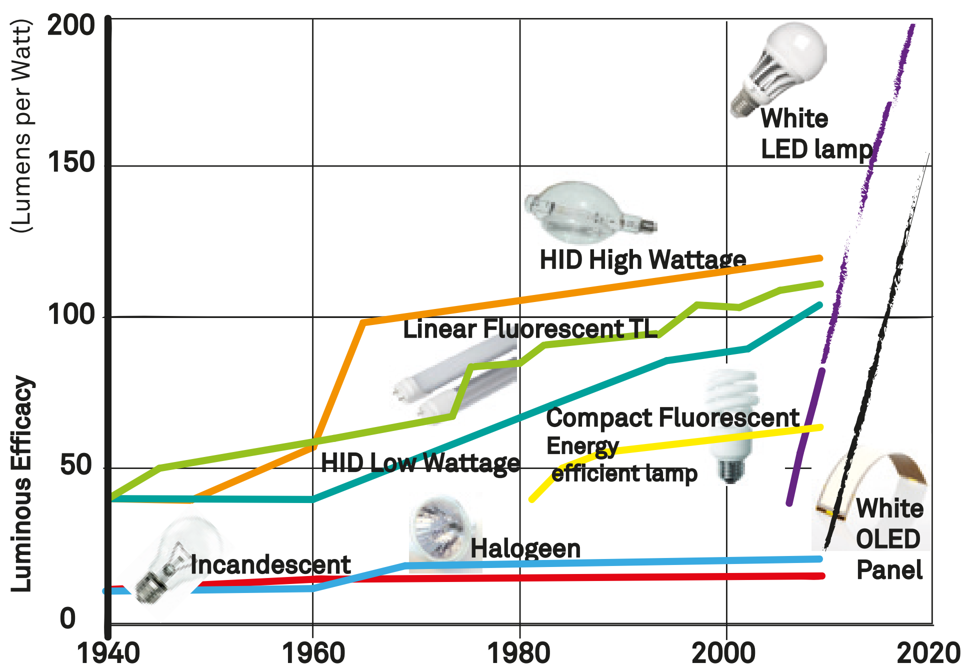
(B) In-depth scouting for plausible and highly promising application ideas and technology options that extent current product lines and also provide for new value propositions;

(C) Mapping the evolution of strategically interesting technologies for further internal development or partnership collaborations in design innovation.

Figure 4.2. shows the evolution of display size technology mapped on a timeline. Such evolutions are commonly mapped on the future timeline of a technology roadmap[1]. Yet, it is also important to bear in mind, that a chain of anticipated technology innovations is not always a straight line or extrapolation - it might involve a jump towards a new emerging technology innovation.

↘ Out-of the box scouting

The out-of-the box scouting results in a status overview of emerging and upcoming technologies. Along the collected evidence of patents, demonstrators with proof of technology, or samples of new 'state-of-the art' technologies, new components from supplier companies are listed. Discoveries from technology research in progress can lead to promising applications in design innovations that the future vision may require. Be aware, that although it is important to detect technologies – in their



↙
Figure 4.1.
Lighting technology evolution.

cc Martin Klaasen, Lighting Design.

↘
Figure 4.2.
Display size evolution.

cc Matti Matila.

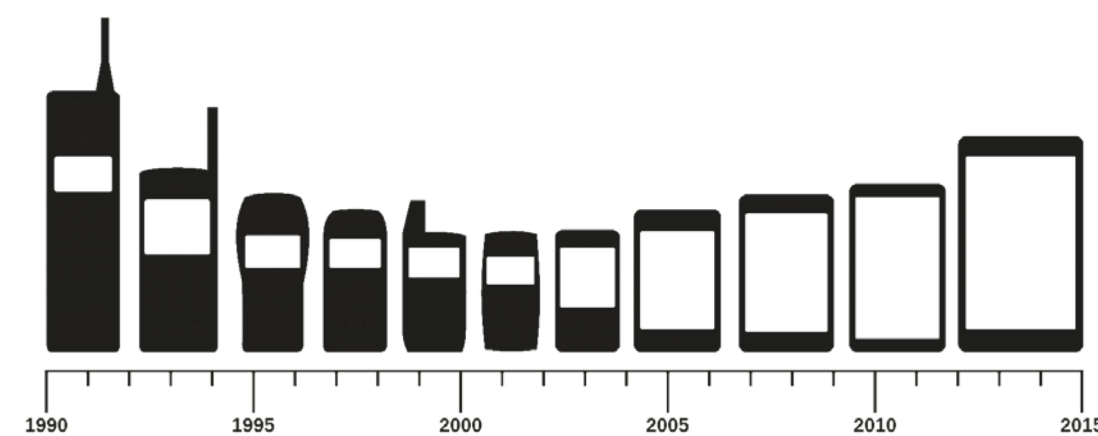
broadest definition, too generic technologies as for instance artificial intelligence - AI - or 3D printing trends, are not the preferred outcome of technology scouting. Beyond identifying an upcoming technology, scouting also includes ideas of application of the technology. Take for instance the application idea of self-producing drone parts with 3D printing such as in the Drone parts by Fusion Imaging. Their application idea was to support the Phantom Drone consumers by offering them the digital files of unique parts they can 3D print at home for the do it yourself customisation and repair of their drones[5]. Another example is the Nest's application idea of AI in their smart thermostat concerns a particular sensor and a control software platform[6].

↘ In-depth scouting

For the in-depth scouting, the current product is deconstructed into its modules and system architecture[1]. Then the supply market of each module can be investigated[2]. Besides this downstream scouting of technologies, the upstream scouting can gauge new inventions that might be patented. A third, in-between stream of technology scouting includes fringe markets and industries – technology applications in other industries that can serve as inspirational examples of ways to re-engineer, restyle, upgrade, downgrade and isolate new technologies.

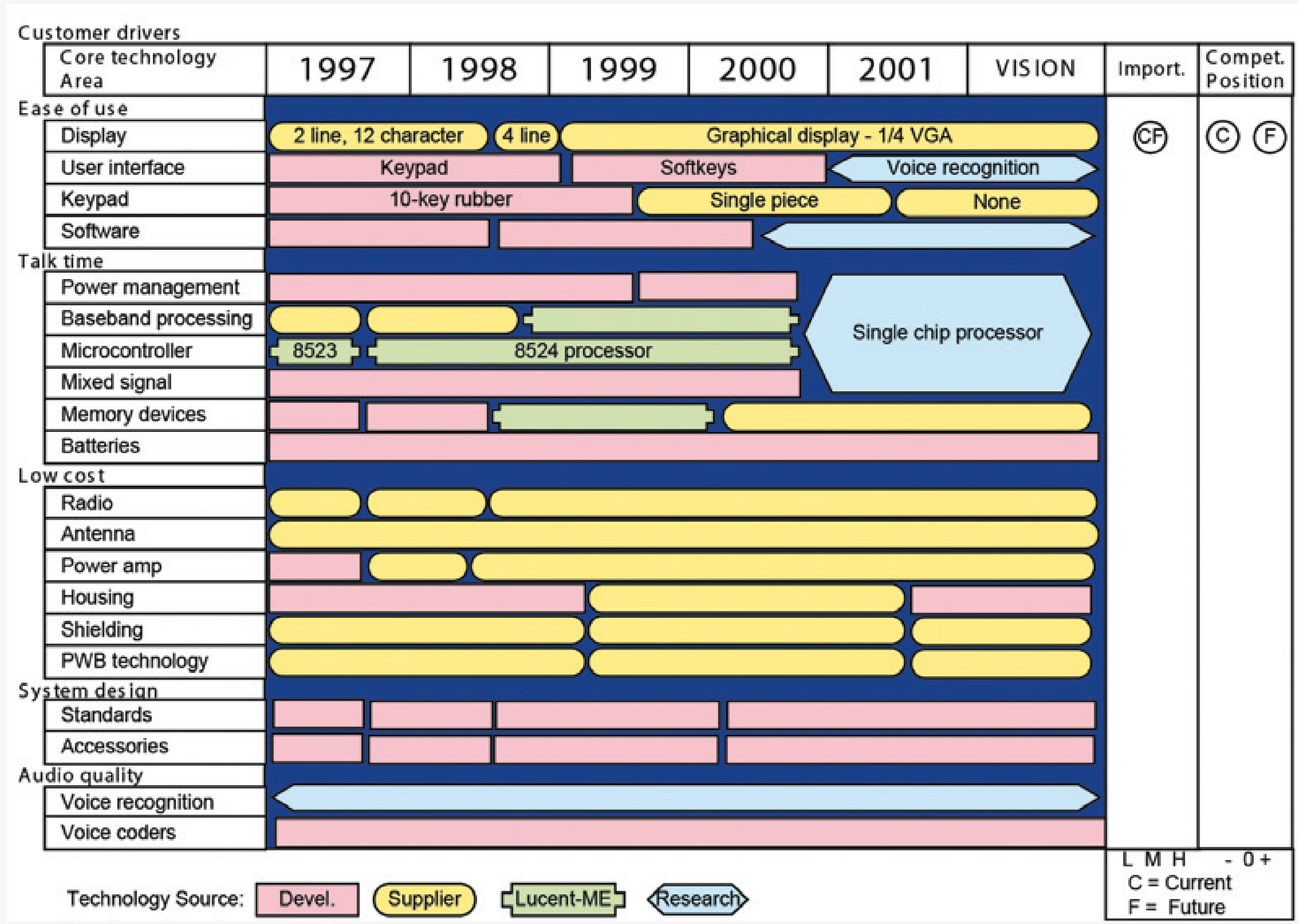
↘ Mapping the evolution of strategic technologies

After the scouting activities have generated substantial input, the activity of mapping the evolution firstly requires decisions regarding the strategic importance and urgency. Not all scouted technologies are mapped, only those that have user relevance and strategic fit for a new product or service



TECHNOLOGY ROADMAP

Lucent Technologies



→Figure 4.3

Technology Roadmap example.

cc Richard E. Albright, 2003. Bell Laboratories, Technologies Office, Lucent Technologies[4].

The technology roadmap, shows sequences of scouted technologies mapped on the modules of a particular cell phone business. See for instance the evolutions mapped for the microprocessor with two successive models, 8523 and 8524, followed up by a single chip processor in its research phase. Or the user interface module that shows the evolution of keypads, softkeys towards the application of voice recognition technology.

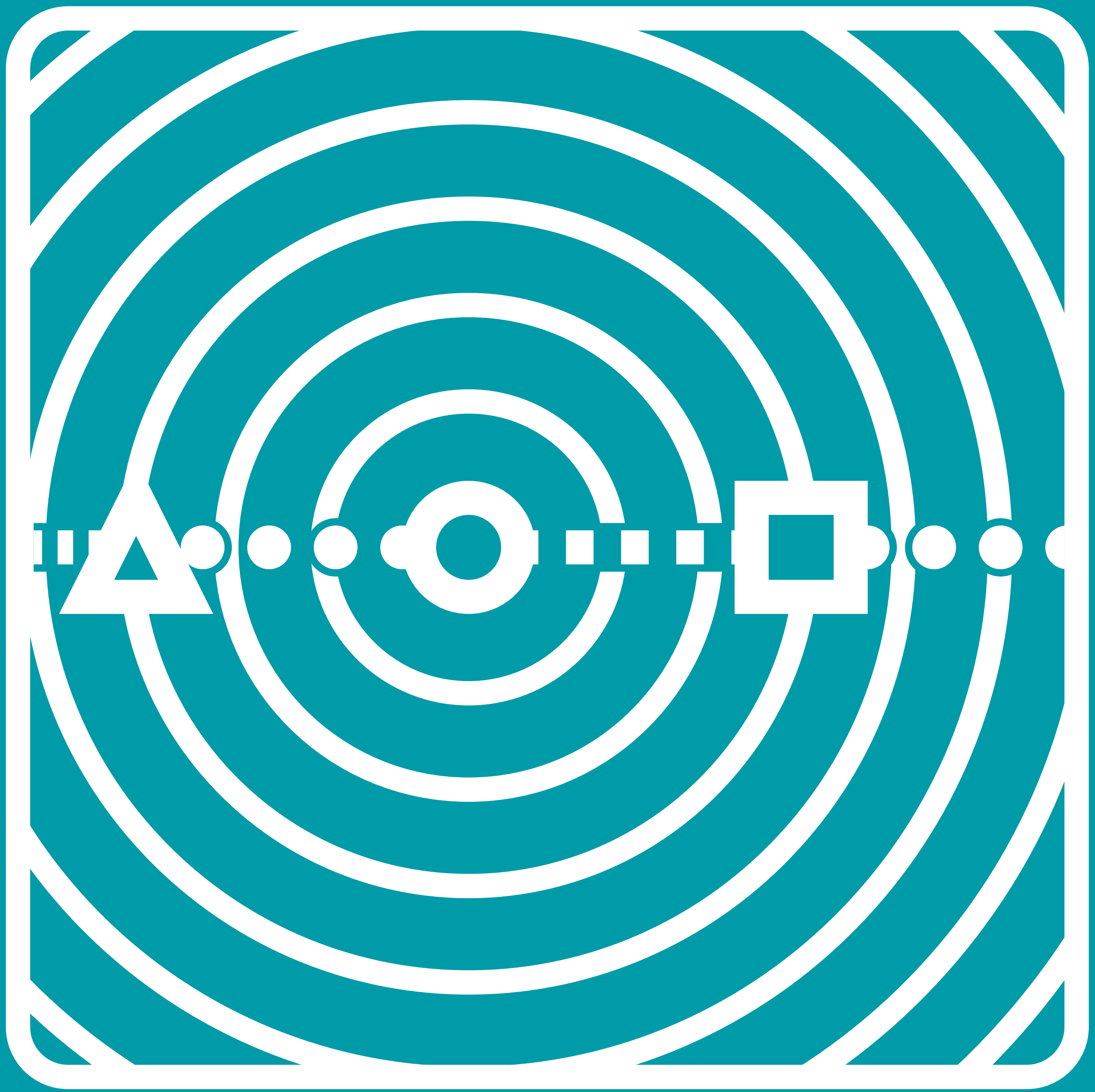
innovations. A decision grid can guide the strategic choice (see figure 6.5). For choosing the technology application options with the highest potential two criteria are used. 'Is the impact on user value real?' and 'Can we do it?'. Only high user impact and high strategic fit options are selected for mapping on the technology roadmap. For the others, the decision is either to drop it, or park it on a list for periodic review.

Second, the evolutions of only the strategic interesting technologies are mapped: those pertaining to distinctive components that – with further development– can contribute to future innovations and provide competitive advantage by creating new user value[3]. Such as for example, the user interface (UI-)module in the Lucent roadmap, shown in figure 4.3, maps the evolution of 'keypad' into 'softkeys' and after that the application of 'voice recognition'[4]. Depending on the decisions of the roadmapping team, an evolution is sometimes an extrapolation, sometimes a jump to a new breakthrough or disruptive technology and sometimes an evolution in technology performance. Roadmapping such technology evolutions thrives on gathering substantial input by out-of-the box and in-depth scouting.

Modular System Architecture – the radar

To effectively identify new technology options, you will find it advantageous to gain some preliminary technical know-how regarding the modular system architecture . Mapping technology evolutions of, for instance, personal computers (PCs) involves scouting for upcoming updates to modular components, such as the microprocessor chip, hard disks, memory chips, display, graphics card, speakers and so on. The modular system architecture makes it possible for roadmappers to map out innovations to a product line or a family of products and services with successive versions of upgraded products[2].

Technology scouts consider their system architecture as a kind of radar that provides a scope to detect and track changes in relevant technological areas, including at the fringe areas. In essence, the architecture defines the essential technical structure of the system; it specifies the partitioning of the overall functionalities of a system into specific functional components[3] . Modular architectures, characterised by a 'one-to-one' coupling of function and module, allow for agile design of a single module independently of the other modules[7]. The next versions of the new product replaces a module with the latest innovations in technologies . Modular architectures enable long-term flexibility of upgrading products with distinctive and desirable modules without the need to completely redesign the whole system[3,7]. The design of a modular architecture commonly requires a project effort of a system architects[2].



a MODULAR SYSTEM ARCHITECTURE specifies the partitioning of the functionalities of a system into specific modules, and their interfaces.

↘ Teardown the system

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Figure 4.4
FAIRPHONE 2 Teardown,

cc iFixit.
Published: November 18, 2015 on https://wwwifixitcom/Teardown/Fairphone+2+Teardown/52523.
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The disassembled FAIRPHONE2 is used for the partitioning into a basic system architecture with:

(A) Strategic modules that generate user value: the repairable click-screen (5" 1080p LCD display (446 ppi) with Gorilla Glass 3 protection), the cameras (front and 8 MP rear) and the rear case (low CO2 emission); and

(B) Commonly used modules, including the midframe with connectors, the antenna module, the lithium-ion battery, the motherboard with its processor chip (Qualcomm Snapdragon 801), the memory (2 GB LPDDR3 RAM) and internal storage (32 GB), the headphone jack, earpiece speaker, and microphone module.

The user-generated repair guide community iFixit gave the FAIRPHONE 2 its first ever perfect score (10 out of 10) for repairability.

For design roadmapping, a quick and enjoyable way to get some basic know-how about a system's architecture is to perform a 'teardown', which means literally disassembling the product. With a deconstructed overview of hardware parts such as of the Fairphone 2 in figure 4.4, you can generate a basic system architecture design. Although a teardown can delve into the tiniest component of a single screw, going into such detail is not necessary for the scouting that aims to provide strategic technologies input for the roadmap. For scouting purposes, the level of aggregation you are looking for is a cluster of components that make up a module adressing a distinctive user value when you renew the module.

One such a strategic module is the screen of the award-winning FAIRPHONE[8]. The screen determines the parameters of its user interface and is also known to be the most commonly damaged component of a mobile phone. Fairphone turned this user insight into the repairability value, leading to a new one-minute screen replacement solution without any tools. Furthermore, the company's future innovation efforts are focused on two other strategic modules that each generate distinctive user value – a camera module, for which the company has plans to launch as an upgrade, and an Near Field Communication (NFC)-embedded rear case that enables quick and easy payments in addition to being made from fair materials with low CO2 emission properties[8].

During your disassembly activity, try not to let the hardware components distract you too much from the software package modules. Increasingly organisations attach strategic importance to software innovations. In the tear down of the FAIRPHONE 2, the main software module, apart from the embedded software programmed in the chips – is its operating system software (Android 5.1 Lollipop).

As stated before, the supply chain markets of components and modules constitute one of the major areas of technology scouting. The others are the areas of technology research and the area of fringe markets and industries that can inspire innovative applications and modules.

↘ Strategic partitioning

When scouting for potential technology options, the strategic partitioning of the system architecture is critical[2]. Strategic partitioning requires that the technical deconstruction of the system allows each module to be coupled to a unique function or feature and also to particular groups of targeted customers[3]. Once that strategic coupling to a module can be arranged, module upgrades of targeted product enhancements within one product line can be realized. When user values can be 'contained' within a single module in the system

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Figure 4.5.
Strategic partitioning of the PHILIPS Sonicare dental system. After the example by Ron Sanchez, 2004[3].

cc Joana Portnoy, Anne Brus, Ruben Verbaan & Marco Bonari. Lecture for the Design Roadmapping Master Course, Faculty Industrial Design Engineering, Delft University of Technology.

architecture, time-to-market can be accelerated[3].

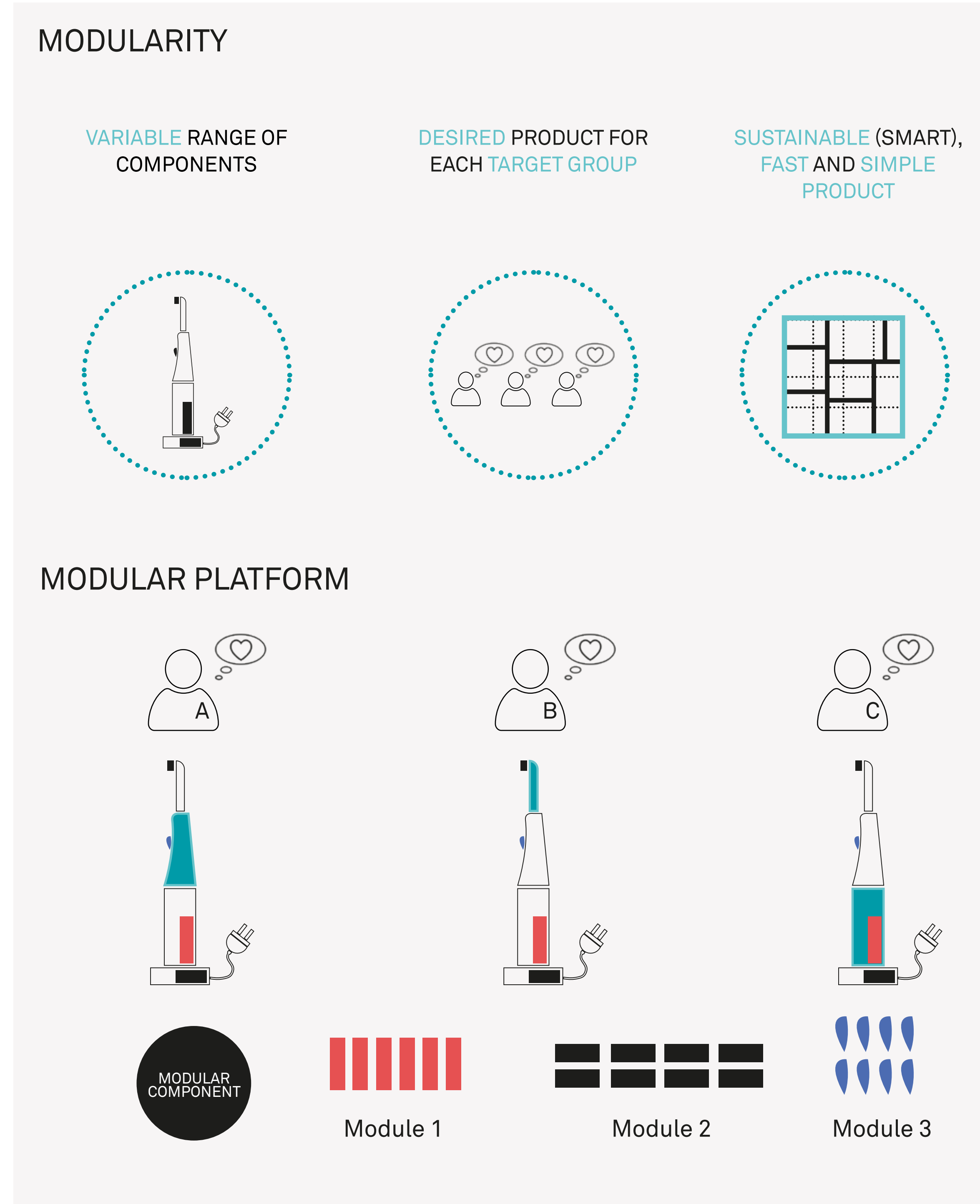
The technical principle behind the system architecture therefore best follows a one-to-one coupling of function to module[7]. According to this principle, each product function is designed within one module. For instance, the technology roadmap of the PHILIPS Sonicare dental system was based on the strategic partitioning of the Sonicare system and supply architecture as illustrated in figure 4.5[3]. Professor Ron Sanchez showcased this strategic system architecture. He highlighted that Sonicare's roadmapping team followed certain key steps :

- → Deconstructing the toothbrush into functional components, and identifying the seven functional module variations;
- → Determing the strategically needed diversity of the productline range by analysing the consumer new values and newly desired modules first and then comparing this to the competitors provision of key function modules;
- → Partitioning the product architecture into physical components, and identifying the in-house or external supply capabilities required to produce the physical module variations required to provide the desired range of product diversity;
- → Specifying module interfaces in the system architecture to support the product configurability into the strategic range of future product lines[3].

By following these steps, the roadmapping team at Sonicare invented a strategic system architecture composed of six modules - sketched in Figure 4.5 -: (1) bristle unit, (2) housing unit, (3) power unit with integrated drive and battery, (4) printed circuit board unit, (5) charger unit and (6) stand unit. Their technology roadmap plotted the technological evolution of each module. Each technology module was linked to one of seven new product types to be offered in specific design variations covering major retail price points from €15 to €79 over a three-year time pacing horizon, from 2001 to 2003. According to Professor Sanchez, "In essence, the flexibility of a modular architecture to configure a range of strategically desired product and service variations and upgrades happens by system architecture design – as a matter of strategic intent – not by luck[3]."

↘ Team decisions on strategic modules

One baseline decision for designers in mapping the scouted technologies is to decide: which parts, components and modules are of strategic interest to in-house innovation efforts, and which parts are more common and thus easily purchased from a supplier. Effective mapping of the technology system architecture requires designers to work closely with strategic managers. Doing so, they ensure that they can sharpen the definition of their specific goals and ambitions for new business growth, and they also



might challenge product (line) managers to adequately formulate their new value strategies for new products in the future marketplace[1].

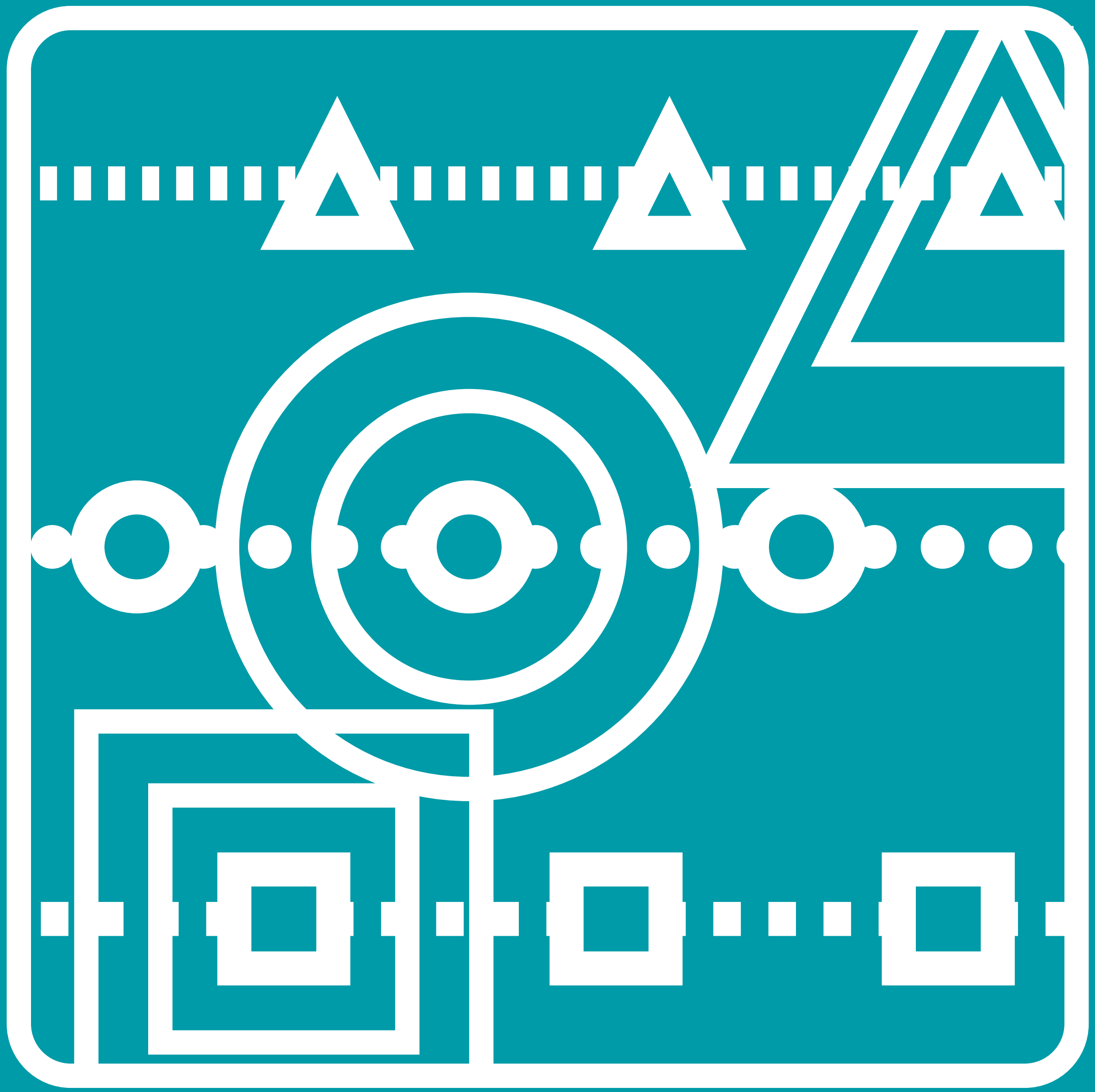
In roadmapping, the technology scouting is not just concerned merely with the designs for the first generation product or service, but also with the mapping of future generations of products and services. In fact, in technology scouting, extensive collaboration with supply chain managers can have a powerful influence on the future time performance of new products. Close connections in the supply chain enable effective sourcing for complete new module engineering and design[9]. Designers who fully grasp the opportunities and future implications of alternative product and service designs can better support the choice to pursue in-house designs, off-the-shelf designs or strategic partnership designs[9]. Therefore regular interactions with supply chain professionals help designers develop the insight into the most advantageous ways of strategically partitioning the technology roadmap by means of a system architecture and improve aspects of supply chain performance that are strategically important.

Source-based Scouting

Technology scouting relies on formal and informal information sources including the scout's personal network, internet databases and any personal observations made during trade events, supplier visits or shopping trips. Instead of simply executing a randomly generic Google search, setting the scope of the search in advance will help your scouting results benefit[1]. For effective in-depth scouting, it is very useful to think about a list of trusted sources of technology development, drawn from the network relations of the organisation you are roadmapping for. Among the most used sources in technology scouting are (a) supplier sources, (b) patent sources and (c) technology labs.

↘ Suppliers sources

An initial listing of preferred suppliers for your strategically-important modules provides a good starting place for downstream scouting[2]. Besides consulting the websites of the suppliers there are several interesting purchase databases that can lead to valuable search results regarding new components and modules. Most renown is ALIBABA.com. It is also worthwhile discussing state-of-the-art technologies and future options with the managers and technology experts at supplier firms. Tradeshows are another source of valuable information – visiting a tradeshow almost always yields an interesting overview of the markets your suppliers deal with and important observations about upcoming innovations in technology modules and beyond. Make sure to document your observations with photos and notes.



SCOUTING TECHNOLOGIES on formal and informal information SOURCES.

↑
Nintendo Switch Teardown

cc iFixit.
Published: March 3, 2017
on https://www.ifixit.com/Teardown/Nintendo+Switch+Teardown/78263. Licensed under the open source Creative Commons.

↘ Patent sources

Patent Listings on the Internet:

→ Espace Patent Database
https://worldwide.espacenet.com/
→ World Intellectual Property Organisation
https://patentscope.wipo.int/search/en/search.jsf
→ US Patent and Trademark Office
http://appft.uspto.gov/netahtml/PTO/search-bool.html

For upstream scouting close to the work of inventors, patent sources are useful[2]. Technology scouts typically use three patent source databases.

Their url addresses are provided above. Besides searches by module and component keywords, we recommend you also to use keywords that include the names of research labs, firms and individual experts.

↘ Technology labs Expert sources

For out of the box scouting of emerging technologies, you will find valuable sources when you turn to experts at technology labs[10]. Well-known labs include the MIT Media Lab, LUCENT Bell Labs, PHILIPS Research and the FRAUNHOFER Institute. Many firms have established research relationships with dedicated labs[10]. For a quick and in-depth evaluation of future opportunities, it is worthwhile to interview several experts working at labs or research institutes. They present an immediate entry point for scouting state-of-the-art technologies. Also, we recommend that you visit a conference in the field of technology pertinent to the strategic modules of your concern.

↘ Scouting reporting with 'One-pagers'

An essential part for pitching the scouting results is the image and description of the technology that explains its application in the business context. The scouts summarize their findings in a one-pager with enough space reserved for an image. Commonly the following types of images are used to explain the application idea of the scouted technology.:

→ Sketches or drawings of patented technology;
→ Pictures of technology demonstrators that showcase the proof of technology;
→ Concept design images, artist's impressions, mock-ups of proof of principles, etc.;
→ Computer-generated images (CAD, rapid prototyping) of a supplier's module;
→ Inspirational images of existing technology applications in fringe areas as an example of modules that might be reengineered, restyled, upgraded, downgraded or isolated.

In addition, typically, the description attributes on the one pagers are:
→ Level of maturity regarding technology performance;
→ User value and business relevance;
→ Estimated costs to either buy or invest in the technology, including technology development defined in terms of man-years.

Figure 4.7 features an example of a one-pagers derived from technology scouting at the printing systems company Océ-Technologies B.V.

OCÉ CASE

System roadmapping

PAUL HILKENS

Founded in 1877, Océ-Technologies B.V. is a global leader in digital imaging, industrial printing and collaborative business services. The company's mission is to accelerate new digital print technologies and transform them into local printing products and services for blue-chip multinationals around the globe and creative studios around the corner. A Canon Group Company since 2009, Océ now operates a vast global network of R&D centres, to connect emerging digital print technologies to future markets. Océ is headquartered in the Netherlands, in the heart of Europe's hi-tech corridor

As Vice President Materials & Device Technology Development at Océ-Technologies B.V., Paul Hilkens is committed to realising innovative system architecture as part of a coordinated technology strategy. This interest began during his Master's degree studies in mechanical engineering at Eindhoven University of Technology, and continues to play a key role in his current position, where he focusses on connecting emerging digital print technologies to future markets

One of his signature projects has been the roadmapping of the platform for the product family launched as the Océ VarioPrint DP line (figure 4.6). According to Hilkens this project is not only evidence of the value of system architecture for organising R&D activities, but equally importantly of the role good roadmapping can play in the presentation and communication of the business proposition throughout the rest of the organisation.

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Figure 4.6
Océ VarioPrint DP line
Digital printing system for production printing facilities, found in company print rooms and print shops.

Hilkens explains how he and his team introduced roadmapping at Océ, and the impact this had: "As a closely-knit team, we worked together for one and a half years. We started by introducing technology scouting alongside system architecture design." Following pilot projects mapping the research and development for two core technology modules, Hilkens and his colleagues created the first platform roadmap focused on a complete product line . He reflects on these early stages of the project: "From the pilots, we knew that roadmapping is a process with an outcome that you don't know when you set off. But at the end of this process there's an outcome that everyone sticks to."

> "When implementing your vision, you put your trust in the fact that having the right people on board will give you the best possible outcome for the future."

↘ Mapping technology evolution

When it comes to mapping technology evolutions, Hilkens is clear about the benefits of combining roadmapping with strategic architecture: "The fact that we are currently seeing new products being launched every year, could lead us to believe that the evolution of technologies and life cycle changes are moving at a faster pace compared with say 10 years ago. But I know from experience that most of these developments have taken much longer than one year; often 2 or 3 years, and sometimes even longer."

> "In order to be able to anticipate change as part of a longer-term strategy, roadmapping offers the perfect way to manage the fit of core technology development with market requirements."

The introduction of the concept of roadmapping at Océ started with a round of stakeholder interviews with senior managers in the organisation. They felt that roadmapping would be strategically important in three ways. Firstly, by involving business strategists, service and business managers earlier on in the development process, roadmaps would ensure new technology innovation efforts were better aligned with the customers' business drivers. Secondly, new system architecture designs create transparency when defining technology development across new printing system development projects. And thirdly, the long-term resourcing of technology evolutions can sustain the in-house development of unique technology capabilities for the future.

When Hilkens first introduced roadmapping to his colleagues, R&D efforts were focused on the physics and chemistry of printing technology – the 'heart' of the printing system – and paid less attention to the functions, features and modules around the core modules. Hilkens explains how this focus shifted: "For the development of this new complete printing system, with unique functions for paper and media handling, we assigned a roadmapping team. Their first job was to carry out full-scale technology scouting research which would provide substantiated input for the roadmap for both the new platform and a new system architecture design."

↘ Time pacing strategy

Previously, when it came to developing new printing systems, Océ had been used to applying an invention-driven approach and project-focused system designs, with minimum relation to module developments in other projects.

Hilkens: "To create the roadmap for the new platform, we felt it was important to map the model year changes, as this rhythm of version upgrades was new to our organisation. We carried out a time-pacing research and investigated innovation cycle times for our own system and those of our competitors. In their roadmap for the new platform, the team set the update rhythm for a new platform generation to seven years, for a significant change to 3 years, and for model updates one year.

↘ Building the system architecture

As the team were working on a completely new platform, the design research for the system architecture included deconstruction of systems used by strategic partners and competitors, as well as those of manufacturing partners responsible for assembling the subsystems. An initial system architecture design was built by a subteam of five system architects (see figure 4.8).

Hilkens outlines the process in more detail: "We held a one-day roadmapping session with the various stakeholders about the setup of the system architecture. We put diagrams on the wall, depicting the function tree of the system and the physical building blocks. The new architecture visualisations generated not only considerable insight about the technologies, but also about the market landscape and the future dilemmas facing our customers in print rooms and print shops."

At the end of just one day, the roadmapping team of engineers, business and service representatives achieved an initial consensus with respect to the building blocks of the system architecture and the creation of a baseline for the modular system, including a view on configurations and upgradeable options. The teams then went on to use this high-level architecture to map out the technology options they had scouted.

↘ Mapping the technology application ideas

The roadmapping team included experts in technology research, competence managers, system architects, a purchasing manager and a manufacturing specialist. All of the team members took on the challenge of carrying out technology scouting. This included desk research as well as carrying out interviews in their own network. The result was a series of long draft lists of potential technology options. These lists provided the input for one of the early roadmapping team meetings.

The team filtered out the overlapping ideas and solutions that had been tested previously, to produce a shortlist of promising technology options. Each team member was asked to prepare a 'one-pager' pitch on one of these ideas and present their findings during the next roadmapping session. The template for these pitches included space for a visual, a short description, a list of the potential customer benefits, estimates regarding the maturity of the technology, the technology application status and availability, cost indications and the source of the information (see figure 4.7).

During a day-long roadmapping session, team members went in rounds to present the shortlisted technology options. The whole team reviewed each one based on its strategic relevance and urgency in relation to future product upgrades. The highest-rated options were mapped on the system architecture block representation. At the end of the workshop, the team had established a raw overview of potential technology applications per module. They had discussed white spots and, where applicable, formulated outlines for new or additional research. -

> "We had never worked like this before. Everyone on the team was enthusi-astic about how the discussions had broadened their view beyond their own projects, ideas and expertise. -

The members from R&D particularly valued the feedback from the strategic, service and business disciplines."

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Figure 4.7
Technology Scouting, 'One-pager' example.

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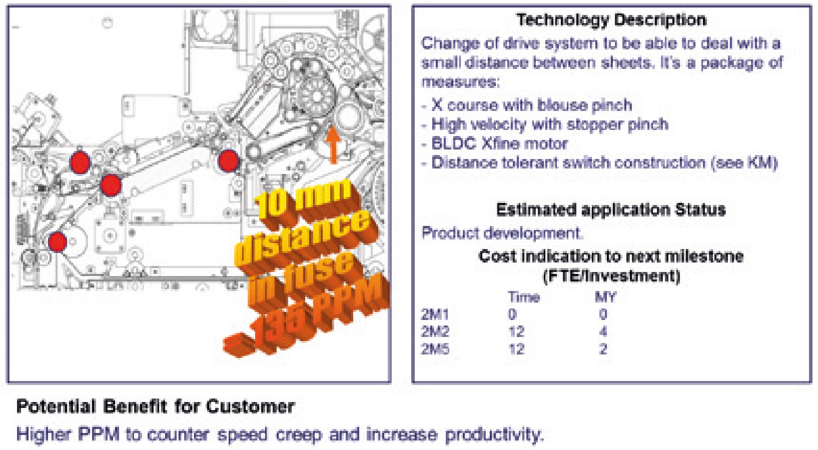
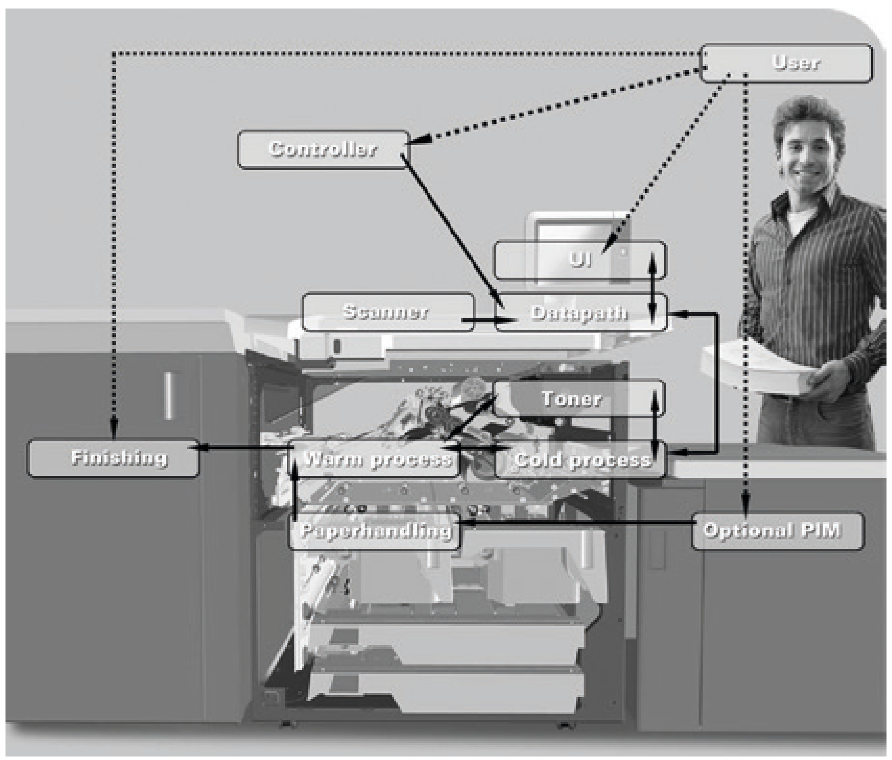
Figure 4.8
System architecture for the platform roadmap of the Océ VarioPrint DP line.





↘ The platform roadmap

The specific strategic challenge of the platform roadmap (see figure 4.9) was to overcome a situation that a product line has as many different

configurations as it has customers. The scouting research carried out for the system architecture was used as a basis for addressing this challenge. A subteam of five multidisciplinary architects built an initial system architecture design. The vision of the roadmap was to provide a range of customers with an upgradable series of configurable printing systems. For customers with a lower budget, one system unit was designed. And for the high-end segment, the team came up with a modular product configuration of 10 - 12 configurations.

The upgradable configuration propositions became the leading theme for the innovations mapped for the first 1-3 years. For 5-7 years and beyond, the theme was 'Inkjet is the future for our new colour technology'. Discussions in the roadmapping team focused on the years in between (3-5 years). The strategic guideline for these decisions was to map only those new modules for the black and white system that could also be used, or reused, to build a potential colour platform. "The complex nature of printing system technologies is such that you have to adopt a broadminded approach, and cannot simply base your innovation strategy on the opinions of a single local hero. In order to create a complete image of the future, you need the contributions of the best experts in the organisation. The ones who have the combined knowledge and experience

> - making sense of this complexity by mapping the evolution of the system in a coherent and complete way."

Hilkens can now look back on a successful platform roadmap. Since the resulting system, the Océ VarioPrint DP line, was launched in 2010, thousands of units have already been sold and continue to be sold to professional printing customers. In a highly competitive market segment, the team managed to achieve a unique value positioning, thanks to the technology asset of upgradable system configurations, smart service anticipation and reliable control of productivity. Hilkens can be justifiably proud of the strong position the first Océ roadmapped platform now occupies within the global Canon portfolio.

PAUL HILKENS MSc, is Vice President Materials & Device Technology Development at Océ-Technologies B.V. He began his career with the company as a young mechanical engineering graduate in 1996. Over the years, he has held positions as a multidisciplinary researcher, function designer and system architect, before becoming Head of System Development in 2007. In this position, Hilkens was responsible for introducing roadmapping for system architecture development. In 2009, he was promoted to Vice President R&D. In that role, he was subsequently responsible for the technology areas of electronics and embedded software, hardware and industrial design, and is currently responsible for materials and printing technologies development. Within the Canon network of R&D centres, Hilkens operates globally, to advise colleagues and realise leading-edge technologies for professional printing customers around the world.

LAB ↗

Tear down the system you are roadmapping to establish a system architecture

MATERIALS NEEDED:

- → screwdriver
- → camera
- → big sheet of paper
- → note book, pen
- → laptop

1 To begin, get a hold of the current version of the device or system you are making a roadmap for and prepare to take it apart at your workplace.

2 Take a screwdriver, or whatever tool is appropriate and dismantle the device part by part. Exercise caution during disassembly. Inspect all the parts.

3 Keep track of each step of the disassembly and take pictures and notes as you work. Most importantly, take a photo featuring the complete teardown, with all the components neatly organised.

4 Use the teardown shot to add images or drawings of software packages that have been programmed in-house or that have been bought off the shelf.

5 Use the teardown overview for establishing the system architecture. Decide which parts are strategically interesting for users and consumers and which ones are common and hence easily purchased from a supplier.

6 Cluster the user value parts of both hardware and software into modules that can be developed as incremental upgrades.

7 Cluster the common parts into modules for suppliers. Tag each cluster with a module name, and generate keywords for the module to inform and direct technology scouting efforts.

PM Concerning strategy and creating 'decision space', the goal is to overcome fixation and this question raises the issue: Which sources will help roadmapping teams overcome it? There are so many knowledge sources available in today's world of data and open innovation – Designers should learn to make use of data science and data intelligence to fuel surveys, networking, open innovation, contests and a wider involvement in scientific and design communities. But that still isn't enough! As we know from design theory, new knowledge also comes from new concepts: Having a creative imagination, and a capacity to formulate 'crazy concepts' is important, because these are the kinds of ideas that lead to 'crazy' questions about who can provide the appropriate knowledge, data or solutions. Designers should get to know about the 'crazy' ideas in their fields by visiting design schools, design studios and any other place where imagination is at work! Designers can also use 'smart browser' enhancements that suggest the key terms they need – but may not be familiar with – to investigate a certain topic[14]. Even a smart web browser can support absorptive capacity! Designers would do well to keep these kinds of tools in mind .

LS My last question is: what is your advice to design roadmappers who are mapping new technology applications to product service systems?

PM Be rigorously creative. Design roadmapping is the capacity to systematically formulate every imaginable future. Thanks to contemporary design theory we know that this work can be carried out rigorously, and thanks to advances in cognition we know that without rigour, we tend to become fixed. This is why we need processes, techniques and guidelines for organisations, like the ones described in this book!

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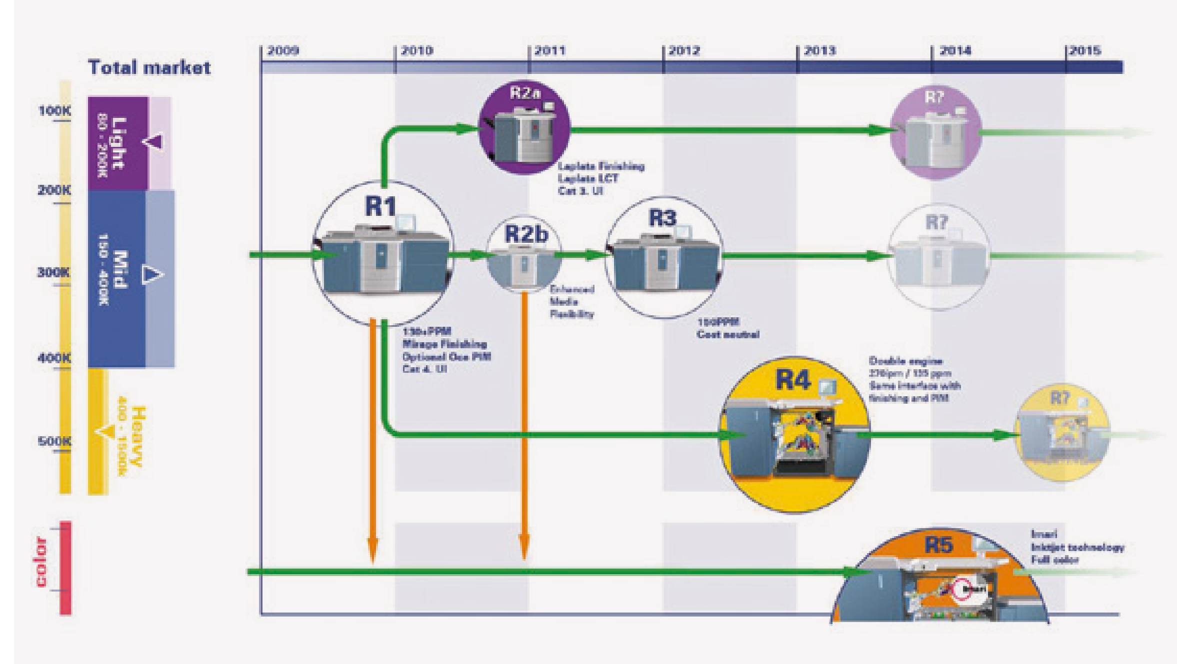
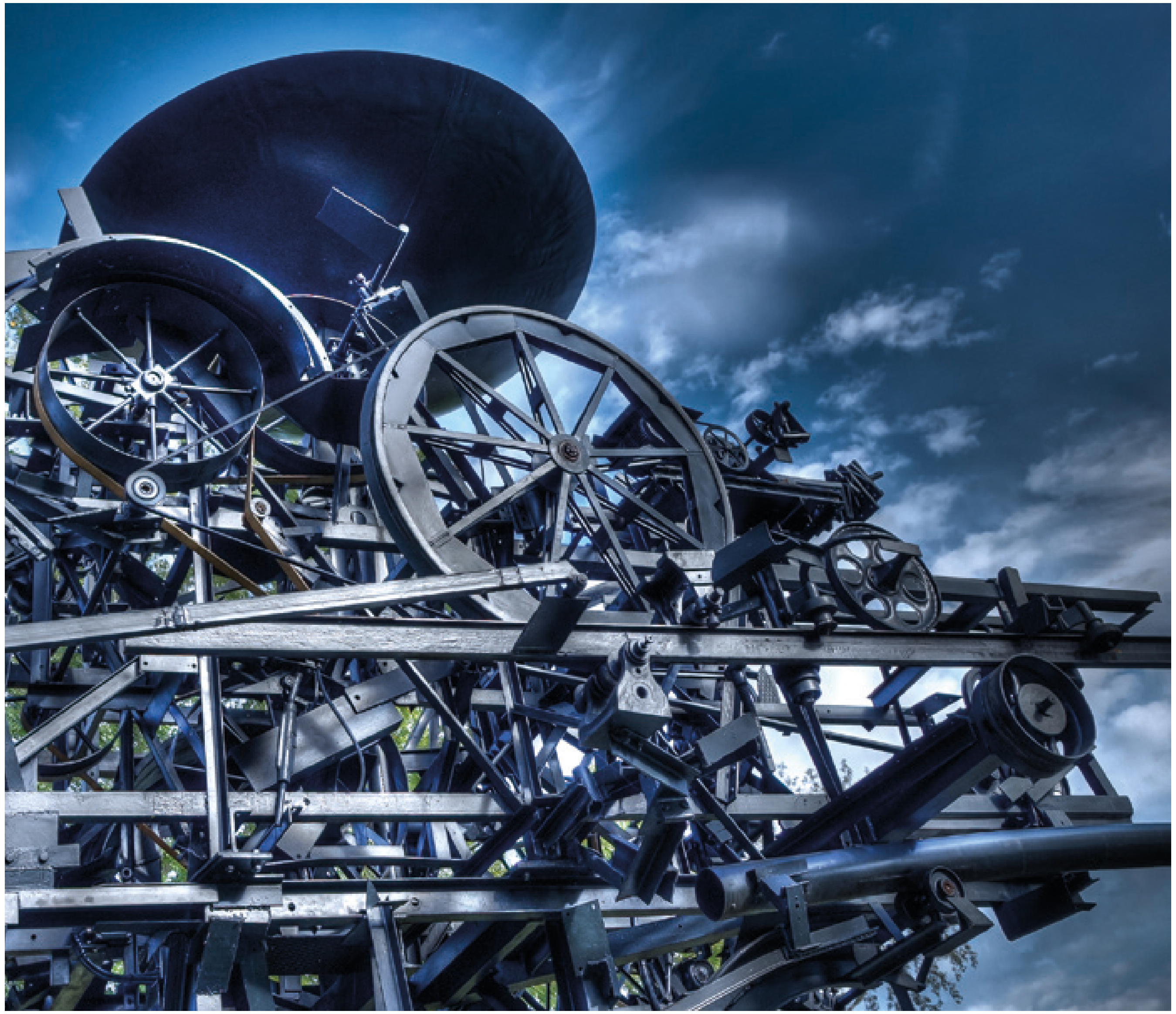
PLATFORM ROADMAP



↑
Figure 4.9
Platform Roadmap
Océ VarioPrint DPLine
- Paul Hilkens.



↗
Kinetic Plastic Heureka,
Jean Tinguely, 1967 Zürichhorn.
Detail shot.

cc Ogre Bot, photography.

IN SUM

Technology Scouting includes a higher level of detail than simply tracking technological trends. In this chapter, the focus was concentrated on the usefulness of system architecture. Modular architecture provides the structure needed to map technology evolutions and also serves as the radar for the technology scouting activity.
We gained knowledge on:

→ The mapping of technology evolutions such as in lighting and display technology;
→ The difference between out of the box scouting and in-depth scouting;
→ The usefulness of a tear down to generate a basic system architecture;and
→ The different types of sources to include in a technology scouting research.

As guidelines, we have provided you several examples, a lab, a case story by and a science interview with Pascal Le Masson on the practice of mapping technology evolution, generating a modular architecture and source-based scouting.

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