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Samenvatting IMAS

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VICTORIA TADEVOSIAN

Lecture 1 and 2

Chapter 1,3 and 5

Chapter 1: Introduction

The importance of technological innovation

Technological innovation: the act of introducing a new device, method or material for application to commercial or practical objectives

Two important drivers:

- Foreign competition → Globalization
    - Pressure on firms to innovate in order to produce different products and services
    - New products to protect the margin
    - New processes to lower the costs
- Advances in IT
    - Computer-aided design and manufacturing make it easier and faster to design and produce new products
    - Flexible manufacturing technologies make shorter production runs economical and reduce the importance of economies of scale

Companies can use broad portfolios of product models to help ensure they can penetrate almost every conceivable market niche by differentiating in their products. For example Samsung had 52 unique smartphones in 2014.
While producing multiple product variations used to be expensive and time-consuming, flexible manufacturing technologies now enable firm to seamlessly transition from producing one product model to the next, adjusting production schedules with real-time information on demand.
Shortened development cycles and rapid product innovations result in greater market segmentation and rapid product obsolescence.

The impact of technological innovation on society

Innovation enables a wider range of goods and services to be delivered to people worldwide.
The aggregate impact of technological innovation can be observed by looking at the GDP → GDP = the total annual output of an economy as measured by its final purchase price, **gross domestic product**.
Solow: growth in GDP can be accounted by growth in labour, capital inputs and technological change.

- Y = F(L,C) . A(T)
- with A(T) = evolution in R&D expenses or patent output; = a technological progress parameter

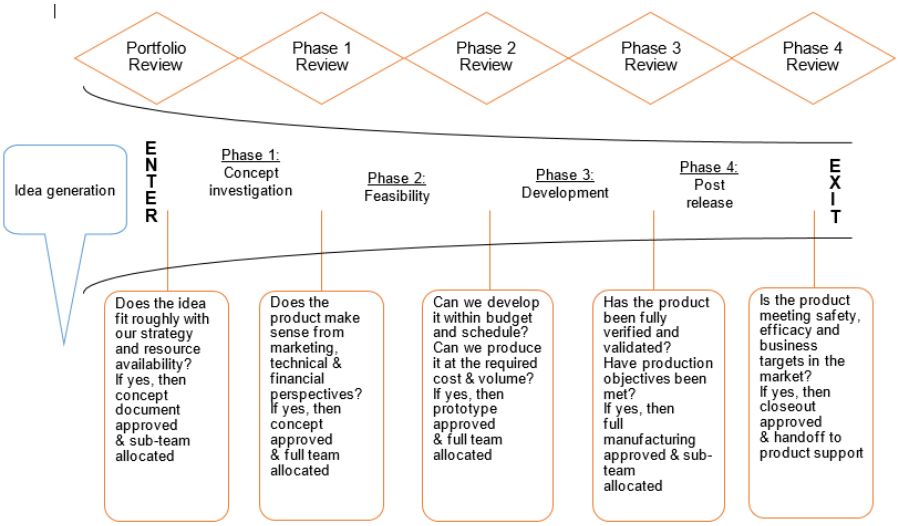
Technological innovation can result in **negative externalities** → negative externalities = costs (or benefits) that are borne (or reaped) by individuals other than those responsible for creating them. If a business emits pollutants, it imposes a negative externality on the community members. If a business creates a park in community, it creates positive externalities for community members.

Technological innovation is the creation of new knowledge that is applied to practical problems hastily, without full consideration of the consequences and alternatives, but overall it will probably serve us better to have more knowledge than less.

Innovation by industry: the importance of strategy

Most innovative ideas do not become successful new products. Innovation is not a freewheeling process that is unconstrained by rules and plans. Study after study has revealed that successful innovators haven clearly defined innovation strategies and management processes.

Innovation funnel → the innovation process is often conceived of as a funnel: many potential new product ideas going in the wide end, but very few making it through the development process.



Strategic management of technological innovation: a firm's innovation projects should align with its resources and objectives, leveraging its core competencies and helping it achieve its strategic intent.

→ for projects to be technically as commercially successful, a firm needs:

1. An in-depth understanding of the dynamics of innovation
    - How and why innovation occurs in an industry, and why some innovations rise to dominate others
2. A well-crafted innovation strategy
    - Formulate a technological innovation strategy
3. Well-designed processes for implementing the innovation strategy l
    - How the organization's size and structure influence its overall rate of innovativeness

While government plays a significant role in innovation, industry provides the majority of R&D funds that are ultimately applied to technological innovation.

Who is responsible for innovation and new economical activities?
Schumpeter postulated two types of agents

- Exceptional individuals (entrepreneurs): not able to foresee the future, but still willing to face all the hazards and difficulties of innovation as an 'act of will'.
- Numerous group of imitators: routine managers follow the wake of the heroic pioneers in the first group

Schumpeter 1: Theory of heroic entrepreneurship and creative destruction
Entrepreneurs are destabilizing agents because they change the existing relations and techniques of production. They lead the economy toward a better use of capital and knowledge, which is vital for macroeconomic growth and rising productivity.
Innovating ≠ inventing, therefore exogenity of science and technology. It's no part of his function to find or create new possibilities. There are always present, abundantly accumulated by all sorts of people. Schumpeter was in favor of technology push.

Schumpeter 2: **Organized and specialized R&D departments play an important role in the innovation process.**
A development engineer in the R&D department of a large electrical firm could be an entrepreneur in his sense of the word.
Endogenous science & technology (mainly inhouse R&D)

If both contribute, is the nature of the contribution similar?
Under which circumstances is it better to be an entrepreneur or a large routinized firm?
Baumol: Schumpeter was wrong in terms of 'replacement': both type of actors remains present albeit 'focusing' on different contributions. Entrepreneurs seem to do better when it comes down to creating breakthroughs. Large routinized firms seem to be more effective in creating aggregated incremental improvements, which can have revolutionary consequences.

Chapter 3: Types and patterns of innovation

Overview

Technology trajectory: The path a technology takes through its lifetime. This path may refer to its rate of performance improvement, its rate of diffusion, or other change of interest.

Types of innovation

Different types of innovation require different kinds of underlying knowledge and have different impacts on the industry's competitors and customers.

Product innovation versus process innovation

Product innovations: embodied in the outputs of an organization, its goods or services.
Process innovations: innovations in the way an organization conducts its business, such as in the techniques of producing or marketing goods or services. Oriented toward improving effectiveness, or efficiency of production. E.g. reducing defect rates or increasing quantity that may be produced in a given time.

Often occur in tandem. New processes may enable the production of new products (bicycles) and new products may enable the development of new processes (advanced workstations).

Radical innovation versus incremental innovation

Radical innovation: An innovation that is very new and different from prior solutions. Combination of newness and the degree of differentness.
Incremental innovation: An innovation that makes a relatively minor change from (or adjustment to) existing practices. E.g.: Cellphone; from exposed keyboard to flip cover

An innovation that was once considered radical, may eventually be considered incremental as the knowledge base underlying the innovation becomes more common. An innovation that is radical to one firm may seem incremental to another.

Competence-Enhancing innovation versus Competence-Destroying innovation

Competence-Enhancing (-destroying) innovation: An innovation that builds on (renders obsolete) existing knowledge and skills. Whether an innovation is competence enhancing or competence destroying depends on whose perspective is being taken. An innovation can be competence enhancing to one firm, while competence destroying for another.
Competence enhancing: it builds on the firm's existing knowledge base. E.g. Intel processors
Competence destroying: technology does not build on the firm's existing competencies or renders them obsolete. E.g. calculator

Architectural Innovation versus Component innovation

Component (or modular) innovation: An innovation to one or more components that does not significantly affect the overall configuration of the system. Innovation entails changes to one or more components, but does not significantly affect the overall configuration of the system.
Architectural innovation: An innovation that changes the overall design of a system or the way its components interact with each other. Innovation entails changing the overall design of the system, without changing the components themselves. Often have far-reaching and complex influences on industry competitors and technology users. For a firm to initiate or adopt an architectural innovation typically requires that he firm have architectural knowledge about the way components link and integrate to form the whole system. Firms must be able to understand how the attributes of components interact, and how changes in some system features might trigger the need for changes in many other design features of the overall system or the individual components.

Most products are hierarchically nested systems, meaning that at any unit of analysis, the entity is a system of components, and each of those components is, in turn, a system of finer components until we reach some point at which the components are elementary particles.

Technology S-curves

Both the rate of a technology's performance improvement and the rate at which the technology is adopted in the marketplace repeatedly have been shown to conform to an s-shape curve.

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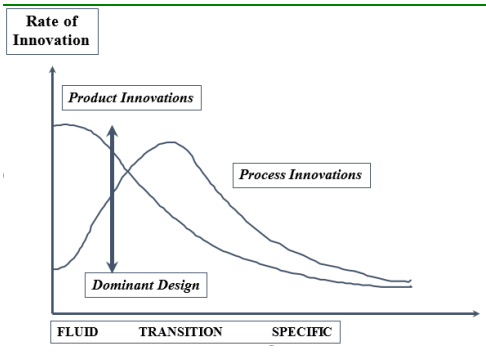
Technology Cycles

Abernathy and Utterback: a technology passed through distinct phases.

- Fluid phase: considerable uncertainty about both the technology and its market. Products or services based on the technology might be crude, unreliable or expensive, but might suit the needs of some market niches.
    - Firms experiment with different form factors or product features to assess the market response.
- Specific phase:
    - Dominant design: a product design that is adopted by the majority of producers, typically creating a stable architecture on which the industry can focus its efforts
    - Innovations in products, materials, and manufacturing processes are all specific to the dominant design.

	Fluid	Specific
Competitive emphasis on	Functional Product Performance	Cost Reduction (Price)
Predominant type of innovation	Frequent major changes in products	Incremental for product and process with cumulative improvements (<> trivial) in productivity and quality
Product Line	Diverse, often including custom designs	Mostly undifferentiated standard products
Production processes	Flexible and inefficient	Efficient, capital-intensive and rigid.
Equipment	General-purpose, requiring highly skilled labor	Special-purpose/committed, automated
Organizational form	Informal and Entrepreneurial	Emphasis on structure, goals and procedures
…		



We are running much faster through a product's lifecycle and the incubation period is becoming much short

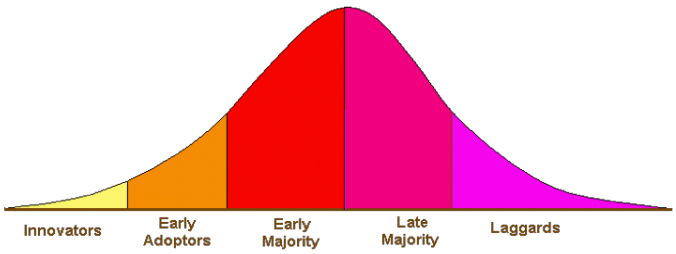
Social Construction of Technology (SCOT):

- **Interpretative flexibility** = each technological artefact has different meanings and interpretations for various groups.
  - Air tire of bicycle meant a more convenient mode of transportation for some people, for others a new sport, whereas it meant technical nuisances, traction problems and ugly aesthetics to another group of people.
  - Alternative interpretations generate different problems to be solved.
- **Relevant social groups**: users, producers and journalists, politicians, civil groups etc.
- **Design flexibility**: there are multiple ways of constructing technologies. A design is only a single point in the large field of technical possibilities, reflecting the interpretations of certain relevant groups.
- **Problems and conflicts**: the different interpretations often give rise to conflicts between the criteria that are hard to resolve (woman in skirt) technologically or between the relevant groups (cyclists – anti-cyclists) + different groups in different societies construct different problems leading to different designs
- **Closure**: over time the interpretative and design flexibility disappears through closure mechanisms:
  - Rhetorical closure = when social groups see the problem as being solved, the need for alternative designs diminishes.
  - Redefinition of the problem by inventive activity = inventing a new design which transcends the current problem → air tire bikes started to win bike races.

  Closure is not permanent → in the 1890s automobiles were seen as the *green* alternative to horse-powered vehicles.

Basics II: Diffusion of innovation - Rogers

Rogers – 5 categories of users:



Moore: argues there is a chasm between the early adopters of the product (the technology enthusiasts and visionaries) and the early majority (the pragmatists). Moore believes visionaries and pragmatists have very different expectations, and he attempts to explore those differences and suggest techniques to successfully cross the "chasm," including choosing a target market, understanding the whole product concept, positioning the product, building a marketing strategy, choosing the most appropriate distribution channel and pricing.

If we have acknowledged the contribution of both types of economical actors, can we account for a complete picture in terms of innovation dynamics?

Baumol: governments and universities play important roles as well:

- Provide legal framework conditions that encourage entrepreneurship and investment in R&D – allow/enable free access to markets
- Create frameworks/rules for property rights and enforceability of contracts
- Support basic research ('Market failures')
- Introduce universities as the engines of novelty

Arrow:

- Uncertainty and risks: investors will force inventors/innovators to participate in risk taking because they will not be able to monitor efforts (information asymmetry), this might lead to a situation in which the inventor/innovator may be forced to hold more shares in the project than he would prefer and therefore be unwilling to undertake the project.
- Invention as the production of information: in the absence of legal protection, the owner of information cannot just sell information on the open market as any purchaser could destroy the market, this might lead to a situation in which the owner of information is the only user, which is not only socially inefficient but also may not be of much use to the owner since he may not be able to exploit it as effectively as possible.

Hence, the market fails due to underinvestment in innovation – two remedies:

- Social/collective financing of innovation: on firm-level via portfolios or on society-level via government intervention.
- Granting patents: will create another problem in terms of welfare dynamics.

Market failures are only present in research and development activities of an uncertain/more basic nature.
Efforts/policies should focus on creating additional rather than substitutive effects.

Chapter 5: Timing of entry

Read in textbook

Technology push vs. market pull?

- Different typologies of innovation exist: systematic, major/minor, breakthrough/derivative, incremental/radical
- In the 60s and 70s: **demand-led** theories of innovation made a considerable impact on policy makers and managers
- Schmookler (1996) provided a more systematic, historical justification: by analyzing patent data over time, he discovered that usually the peaks ofinventive activity lagged behind the peaks of investment activity. From this, he drew the conclusion that the main stimulus to innovate came from the changing pattern of demad as measured by investment in capital goods in various industries.

Innovation & Market failures

- Innovation implies uncertainty: technical and commercial
- Innovation might imply long time frames introducing 'appropriation' concerns:
    - Will a firm be able to reep the beefits of its investment if these manifests themselves only 10/15/20 years later? This latter point implies especially to innovatios of a more radical nature. Notice that the nature of knowledge (information) complicates things even more.
- The presence of uncertainty and the outcome of inventive activity (information) seems to require activities designed to reduce or mitigate its consequences
- Introduce insurance schemes (options) to handle risk? But what about incentive problems? Introduce portfolio of innovations in order to handle risks – requires resources. Moopolists can use/ivest excess profits more easily in such portfolio's hence could (will?) be more innovative. The main actors will be large firms and/or moopolists (Schumpeter)? Introduce arrangemets that allow information dissemination and exploitation (IP regimes)?

Science

- No immediate economical return
- Basic research: valuable but at the same time uncertain
- Outcomes often characterized by extended time frames
- Introduction of public funding to address market failures
- Allocation mechanisms/ criteria required for funding – Allocation of public sources introduces accountability – governance evolves towards 'Entrepreneurial' Universities

Market failures

- The market, as a coordination device to allocate resources, results in a sub-optimal situation.
- Basic scientific work: extended time frames before impact unfolds; results highly uncertain (so often no impact yet): creation of information/knowledge which is difficult to appropriate
- For rational actors, driven by profit maximizing objectives, the rational choice with respect to this type of activities: do not invest
- If all market actors arrive at the same conclusion, investment levels wil be low/moderate
- Society as a whole might be better off if we would allocate more resources leading to investing taxpayer's money.

Lecture 3 and 4

Chapter 2

Chapter 2: Sources of innovation

Universities and Government-funded research

Universities

Basic research = research targeted at increasing scientific knowledge for its own sake. It may or may not have any long-term commercial application.
Applied research = research targeted at increasing knowledge for a specific application or need.
Universities:

- Number one performer of basic research in the US.
- To increase the degree to which university research leads to commercial innovation, many universities have established

Technology transfer offices (TTO) = offices designed to facilitate the transfer of technology developed in a research environment to an environment where it can be commercially applied.

Government-funded research

Governments of many countries actively invest in research through:

- Their own laboratories;
- The formation of **science parks and incubators**
    1. Science parks = regional districts, typically set up by government, to foster R&D collaboration between government, universities and private firms. Often include institutions, called incubators.
    2. Incubators = institutions designed to nurture the development of new businesses that might otherwise lack access to adequate funding or advice; Help overcome market failure that can result when a new technology has the potential for important societal benefits, but its potential for direct returns is highly uncertain.
- Grants for other public or private research entities.

Innovation systems

Differences in organizing innovation systems do translate into performance differences
National innovation system → **National innovative capacity** = the ability of a country to produce and commercialize a flow of innovative technology over the long term. The capacity depends on:

- The strength of nation's common innovation infrastructure;
- The environment for innovation in a nation's industrial clusters;
- The strength of linkages between both.

Innovation intensity of countries as measured by patents, vary as a result of differences in

- Innovation input (R&D manpower and spending)
- R&D policy choices such as the extent of IP protection and openness to international trade, the share of research performed by the academic sector and funded by the private sector, the degree of technological specialization, and each individual country's knowledge stock

European paradox = European countries are good in science but they have an entrepreneurial deficit: they lack the ability to translate the new scientific knowledge into economic activity. European countries perform good in mature industries, fee. the agriculture industry.

Bayh Dole legislation = legislation that allows universities to take patents on publicly funded research.

Entrepreneurial universities = add patenting activities, spin off activities and contract research to their traditional missions of teaching and research.

- Why?
  1. Extra university research funding opportunities
  2. Improving relevance of academic curricula
  3. Faster/better exploitation of new inventions
  4. Rejuvenating the economical texture of a region
- Example: Stanford University → in the 1930s, Frederick Term an (dean), encouraged Bill Hewlett and David Packard, to start their own electronics company, in 1951, Stanford University opened the Stanford Industrial Park (234 ha of university land), the first company was Varian Industries, the second Hewlett Packard, today, 150 firms are active in the areas of electronics, software, biotechnology.

<u>Concerns related to this second academic revolution</u>:

- **Secrecy problem:** firms may ask universities to keep information (temporarily) confidential, this might reduce the incentive to publish and run counter to the academic norm of public exposure of scientific knowledge.
- **Skewing problem:** corporations may interfere with the normal pursuit of science and seek to control university research for their own ends, the changes in the university research agenda are most often related to an alleged shift towards the more applied research end.

Publication and patent behaviour of academic researchers: conflicting, reinforcing or merely co-existing?

Research questions:

(1) *Do faculty members who are engaged in patenting activity publish less than their colleague non-inventors?*
→ Inventors publish more than non-inventors, two possible explanations:

- Companies prefer working with the better scientists (selection effect)
- The inventor can increase his scientific footprint using the benefits related to his patents (treatment effect)

(2*) Do inventors differ from colleague non-inventors in terms of the nature of their publications (basic/applied)?*
→ Inventors publish less than expected in technology-oriented journals and more than expected in science-oriented journals (↔ skewing problem!)

(3) *To what extent does involvement in contract research with industry influence the co-existence of patent and scientific activities?*
→ Involvement in contract research further adds to the differential publication outputs.

Myths versus Realities (Van Looy/Piccaluga/Debackere)	
Entrepreneurial activities hamper science.	Scientific capabilities (eminence) are the engine of entrepreneurial performance.
TTO's are crucial to arrive at scale/scope of technology transfer activities (TTO's are the 'engine' behind the third mission).	Distributed entrepreneurial efforts (within the university) benefit from the presence of specialized support staff and a strategic vision/commitment at the level of the top (of universities) (our 'internal triple helix').
Entrepreneurial activities generate a substantial share of funding for universities (allowing to decrease over time more traditional types of university funding).	Universities will always require funding for research (market failures) and education (as long as we organize it as a 'public good'). Entrepreneurial activities of universities could/should not be organized for monetary purposes only.
A more entrepreneurial orientation of universities will be beneficial for all kind of industries and all kind of R&D/Innovation challenges.	The specific role of universities within innovation systems is situated in the vicinity of 'market failures'
'Bayh Dole' type of legislations are not relevant (or even harmful).	To the extent IP rights are essential to operate they are best situated at the level of the principal (University/Faculty/Department) while agents (academic staff) should be considered as entrepreneurial (and hence incentivized as such)

Lecture 5

Chapter 6, 7 and reading

Chapter 6: Defining the organization's strategic direction

Assessing the firm's current position

External analysis

- **Porter's five-force model**
  Attractiveness of an industry and a firm's opportunities and threats are identified by analyzing five forces. Originally developed to assess industry atractiveness, model is often used to a assess a specific firm's external environment.
    - The degree of existing rivalry (midden):
      → is influenced by: the number and relative size of competitors, the degree to which competitors are differentiated, demand conditions (more demand means more revenues so less competitive pressure), exit barriers
        - The more firms competing that are of comparable size, the more competitive the industry will be
        - Exception: **oligopolistic industries** = higly consolidated industries with a few large competitors
    - Threat of potential entrants:
      → is influenced by: the degree to which the industry is likely to attract new entrants, **entry barriers**
    - Bargaining power of suppliers
      → is influenced by: the number of suppliers, the degree to which suppliers are differentiated, the amount a firm purchases from a supplier, switching costs, vertical integration
      The degree to which the firm relies on one or a few suppliers will influence the ability to negotiate good terms.
      Switching costs: Factor that make it diffuclt or expensive to change suppliers or buyers, such as investments in specialized assets to work with a particular supplier
    - Bargaining power of buyers
      → is influenced by: the number of customers, the degree of product differentiation, switching costs, vertical integration
      The degree to which the firm is reliant on a few customers will increase the customer's bargaining power, and vice versa.
    - Threat of substitutes
      → is influenced by: the number of substitutes, the degree of substitution and the relative price
      Note: distinguishing between a competitor and a substitute depends on how the industry is defined – fee. transportation industry versus airline industry
- **Stakeholder analysis**: involves identifying any entity with an interest in the firm, what it wants from the company and what claims it can make on the company.
  - Strategic stakeholder analysis: emphasizes the stakeholder management issues that are likely to impact the firm's financial performance.
  - Normative stakeholder analysis: emphasizes the stakeholder management issues the firm ought to attend to due to their ethical or moral implications.

Internal analysis

- **Porter's value chain**: activities are divided into primary activities and support activities. Each activity can then be considered from the point of view of how it contributes to the overall value produced by the firm and what the firm's strengths and weaknesses are in that activity. Once the key strengths and weaknesses are identified, the firm can assess which strengths have the potential to be a source of sustainable competitive advantage → a sustainable competitive advantage is rare, valuable, durable and inimitable.

Identifying core competencies and dynamic capabilities

Core competencies

= integrated combinations of abilitites that distinguish the firm in the marketplace; arises from a firm's ability to combine and harmonize multiple primary abilities in which the firm excels into a few key building blocks of specialized expertise.
Several core competencies may underlie an individual business unit, and several business units may draw upon the same core competency.

Identifying the firm's core competencies – Prahalad and Hamel:

- Is it a significant source of competitive differentiation? Does it provide a unique signature to the organization? Does it make a significant contribution to the value a customer perceives in the end product?
- Does it transcend a single business? Does it cover a range of businesses?
- Is it hard for competitors to imitate?

Few firms are likely to be leaders in more than fice or six core competencies.

Dynamic capabilities

= a set of abilities that make a firm more agile and responsive to change.
A firm can also develop core competencies that are not specific core products, it is also possible for a firm to develop core competencies that are nor specific to any set of technologies or products, but rather to a set of abilities that enable it quickly to reconfigure its organizational structure and routines in response to new opportunities.

Strategic intent

Strategic intent = a long-term goal that is ambitious, builds upon and stretches the firm's existing core competencies and draws from all levels of the organization, f.e. Apple's mission of ensuring that every individual has a personal computer. Once the firm articulates its strategic intent, managers should identify the resources and capabilities the firm must develop or acquire to achieve its strategic intent. Many companies are now pairing the articulation of their strategic intent with a multidimensional performance measurement system such as the balance scorecard.

The balance scorecard – Kaplan and Norton
= measurement system that encourages the firm to consider its goals from multiple perspectives and establish measures that correspond to each of those perspectives.

- Financial perspective
  goal: meet shareholder's expectations
  measure: net cashflow
- Customer perspective
  goal: improve customer loyalty
  measure: % of repeat purchases
- Internal perspective
  goal: improve inventory management
  measure: inventory costs
- Innovation and learning perspective
  goal: improve employee skills
  measure: employee training targets

RedOcean strategy	BlueOcean strategy
compete in existing market-space	create uncontested market space
beat the competition	make the competition irrelevant
exploit existing demand	create and capture new demand
make the value-cost trade-off	break the value-cost trade-off
align the firm's activities with its strategic choice (differentiation / low cost)	align the firm's activities in pursuit of differentiation and low cost

Strategy canvas – Mauborgne and Chan
Firms can identify BlueOcean strategies by using a visualization tool (the horizontal axis lists the factors that the industry competes on, the vertical axis indicates high/low), managers can plot value curves for different product offerings and can then challenge the industry's strategic logic by asking the following questions:

- Which of the factors that the industry takes for granted should be eliminated?
- Which factors should be reduced well below the industry's standard?
- Which factors should be raised well above the industry's standard?
- Which factors should be created that the industry has never offered?

Chapter 7: Choosing innovation projects

Capital rationing = the firm sets a fixed R&D budget and then uses a rank ordering of possible projects to determine which will be funded.

Quantitative methods for choosing projects

Discounted cash flow methods

= methods for assessing whether the anticipated future benefits are large enough to justify expenditure, given the risks.

- **Net present value (NPV):** what is the project worth today?

$$NPV = C * \frac{1 - \frac{1}{(1+r)^t}}{r} \text{ or in case of perpetuity } NPV = C * \frac{1}{r}$$

Actual NPV: includes risk and uncertainties.

$$A - NPV = NPV * P_t * P_o * P_m$$

P_t = technical risk

P_o / P_m = are you able to scale it?

- **Internal rate of return (IRR):** what rate of return does this project yield?

→ to better incorporate strategic implications in the new product development investment decision, some managers and scholars have recently begun promoting the idea of treating new product development decisions as real options.

Real options

An investor who makes an initial investment in basic R&D or in breakthrough technologies is buying a real call option to implement that technology later should it prove to be valuable. The investor is an active driver of the value of the investment!

Disadvantages of quantitative methods

- Discounted cash flow estimates are only as accurate as the original estimates of the profits form the technology.
- Discounted cash flow methods discriminate heavily against projects that are long term or risky.
- Discounted cash flow methods fail to capture the strategic importance of the investment decision.

Qualitative methods for choosing projects

- **Screening questions**: can be used to structure debate about a project or they can create a scoring mechanism.
- **Aggregate project planning framework**: four types of development projects commonly appear on the map:
    - R&D and advanced development projects: precursor to commercial development projects, necessary to develop cutting-edge strategic technologies;
    - Breakthrough: development of products that incorporate revolutionary new product and process technologies;

    - Platform: offer fundamental improvements in cost, quality and performance over preceding generations, they introduce improvements across a range of performance dimensions – speed, functionality, size, weight – and are designed to serve a core group of customers;
    - Derivative projects: introduce changes along only one or two dimensions and are designed to appeal to different niches within the core group.
      → companies can use a project map to assess what their balance of projects is and allocate resources accordingly.
- **Q-Sort** = a simple method for ranking objects or ideas on a number of different dimension. Individuals are each given a stack of cards with a project on each card. Then a series of project selection criteria are presented and for each criterion, the individuals sort their cards in rank order or in categories. Individuals then compare their rank orderings and use these to structure a debate about the projects.

Combining quantitative and qualitative information → there are also valuation techniques that attempt to translate qualitative assessments into quantitative measures:

- **Conjoint analysis** = a method of converting qualitative assessments of a choice into quantitative weights of the different criteria underlying the choice. It is most often used for assessing how customers value different product attributes.
- **Data envelopment analysis (DEA)** = a method that enables projects that have multiple criteria in different measurements units to be ranked by comparing them to a hypothetical efficiency frontier.

Reading: Creating project plans to focus product development

Most organizations we are familiar with spend their time putting out fires and pursuing projects aimed at catching up to their competitors. They have far too many projects going at once and all too often seriously overcommit their development resources. They spend too much time dealing with short-term pressures and not enough time on the strategic mission of product development. → Companies need to devote more attention to managing the set and mix of projects! The aggregate project plan addresses all of these issues.

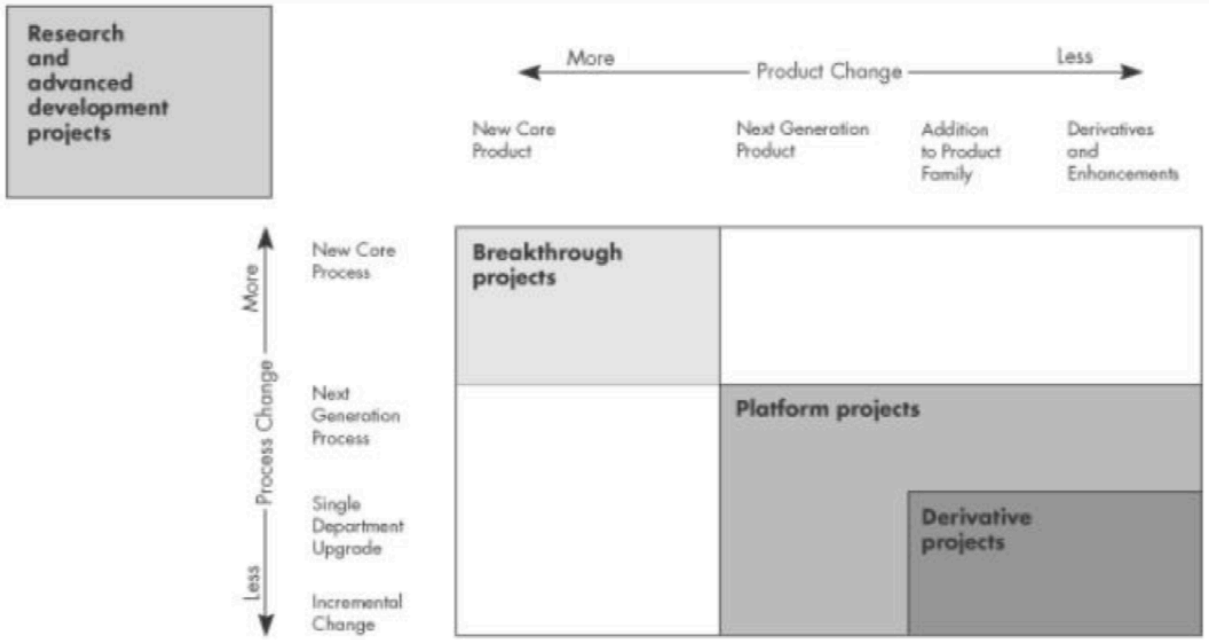
To create a plan, management categorizes projects based on the amount of resources they consume and how they will contribute to the company's product line. Then, by mapping the project types, management can see where gaps exist in the development strategy and make more informed decisions about what types of projects to add and when to add them. Sequencing projects carefully, gives management greater control of resource allocation and utilization. Periodically evaluating the product mix keeps development activities on the right track.

- **Steady stream sequencing**: management schedules projects at evenly spaced intervals to ensure a steady stream of projects.
- **Secondary wave planning**: a development team begins work on a next-generation platform – the completed platform is introduced on the market with few derivatives – once the platform begins to age and competitor's newer platforms challenge it, the company refocuses resources on a set of derivatives – this wave of derivatives extends the platform's life, provides experience and feedback and prepares the team for the next-generation platform development – the cycle begins again

The greatest value of an aggregate project plan over the long-term is its ability to shape and build development capabilities, both individual and organizational. It provides a vehicle for training development engineers, marketers and manufacturing people in the different skills sets needed by the company. Some less experienced engineers initially may be better suited to work on derivative projects, while others might have technical skills more suited for break-through projects. The aggregated project plan lets companies play to employees 'strengths and broaden their careers and abilities over time.

<u>Eight steps of an aggregate project plan:</u>

1. Define project types as either breakthrough, platform, derivative, R&D or partnered projects
2. Identify existing projects and classify by project type
3. Estimate the average time and resources needed for each project type based on past experience
4. Identify existing resource capacity
5. Determine the desired mix of projects
6. Estimate the number of projects that existing resources can support
7. Decide which projects to pursue
8. Work to improve development capabilities



A balanced portfolio will tend to be distributed along the diagonal top left-bottom right.

Innovation at the firm level:

- **Innovation** = creating something and making money with it. It is a managerial and entrepreneurial activity, involving a variety of activities along the corporate value chain (R&D, Engineering & Manufacturing, Logistics, Marketing & Sales)
    - **R&D** = a 'service' function as well as a 'business' creation function
- **Innovation** = ideas + exploitation of ideas
- **Innovation strategy**:
    - Embedding the innovation strategy
      Consider the corporate strategy, the competitive strategy, the R&D intensity in the industry, industry dynamics
    - Defining the objectives of the innovation strategy
      Support/extend existing products and/or processes, create new products and/or processes, support/rejuvenate the competence base of the firm
    - Implementing the innovation strategy
      Consider portfolio's/funnels/roadmaps/alliances and networks

Roadmap = instrument to integrate business unit strategies and corporate technology strategies. Roadmaps have a dual function:

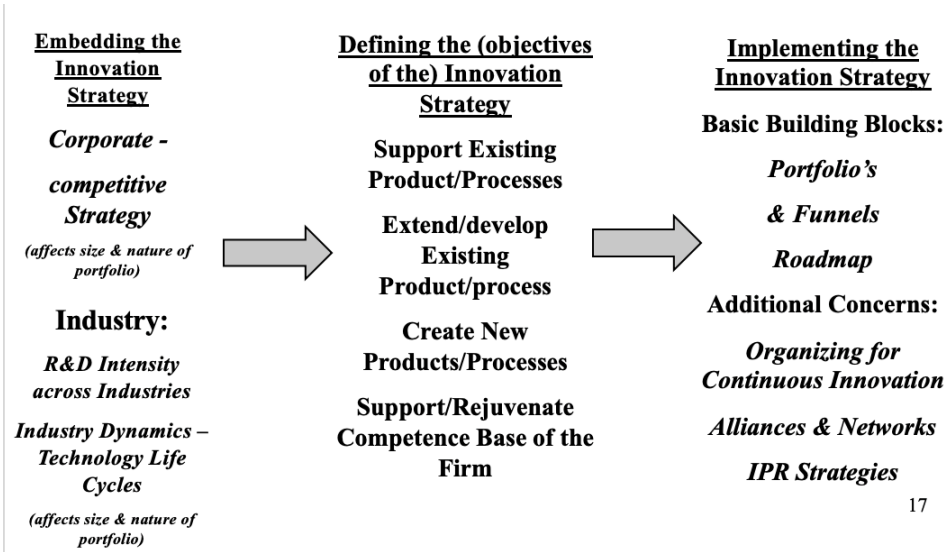
- Linking technology to the business unit by improving/diversifying product/process platforms;
- Stimulating the creation of new businesses.

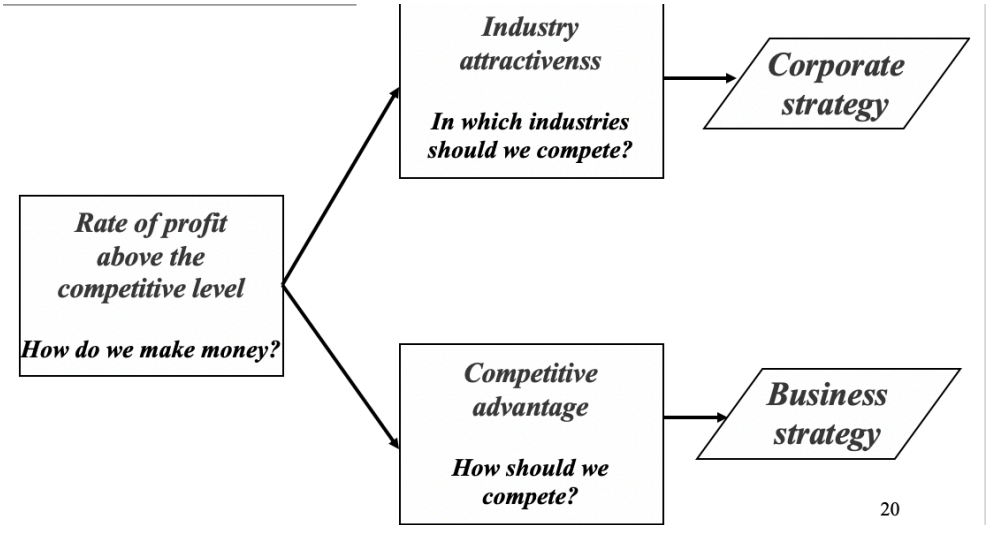
Developing roadmaps is not a top-down exercise 'only' but requires active bottom-up participation and cross-functional processes.

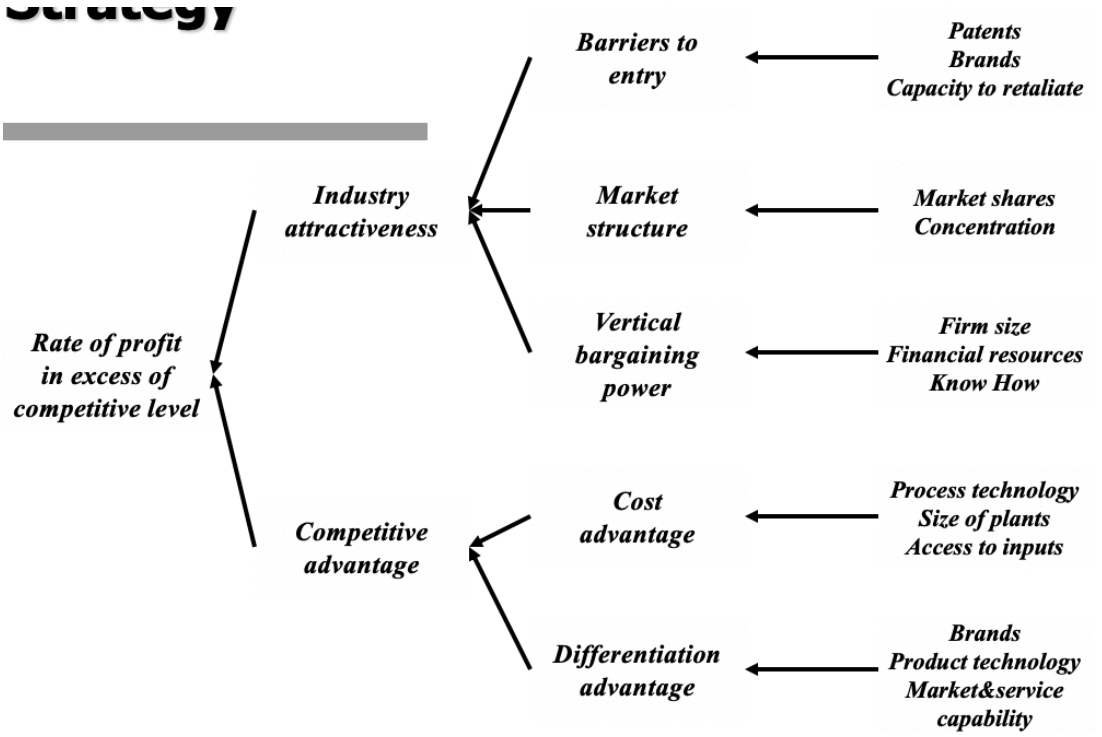
Third generation R&D and innovation:

- Some companies are still managing R&D in what we define as the **first-generation** mode → They hire good people, provide them with the best facilities money can buy, have them work in a creative – possibly remote – setting, leave them alone, and hope they produce commercially viable results.
- Many companies have adopted **second-generation** R&D management practices → Practices that are distinctly more systematic and more specifically attuned to business needs. Second-generation R&D management seeks to quantify the cost and benefits of individual projects and to monitor progress against project objectives. But even in the second-generation mode, operations tend to manage R&D on a project-by-project basis, rather than managing the aggregate of all projects. Although each individual project may have merit, the collection, or portfolio, of projects may or may not be strategically adequate. Managers working in this mode find it difficult to establish priorities among projects within each business, across businesses, and for the corporation as a whole.
- Some companies are now moving to a **third-generation** mode of R&D management that is both purposeful and strategic → General managers and R&D managers work as partners to pool their insights in deciding what to do and why and when to do it, given the needs of each business and of the corporation. They realistically assess costs, benefits, and risk/reward, and they balance these variables within a portfolio of R&D activity that best fulfils the purposes of the corporation as a whole.

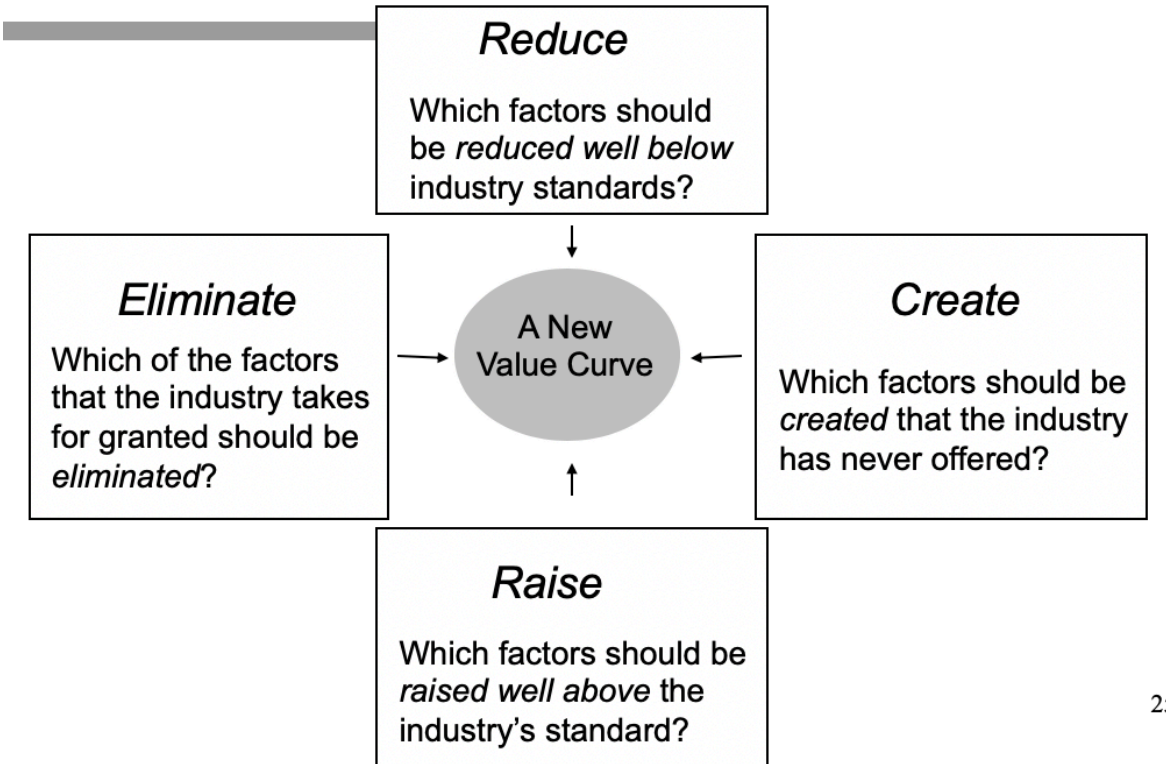
First Generation	***Second Generation***	***Third Generation***
No long-term strategic framework	Partial strategic framework	Holistic strategic framework
No explicit link with the value chain	Some customer-supplier relationships	R&D contributes along the value chain
Cost center approach	Project-based approach	Value creation approach
Professional control of resource allocation	Customer/supplier involvement in resource allocation	Partnership approach to resource allocation
No clear performance indicators	Project performance indicators	Regular performance reviews
No targeting of expected results	Consistency between business / R&D objectives	Combining business & technological objectives

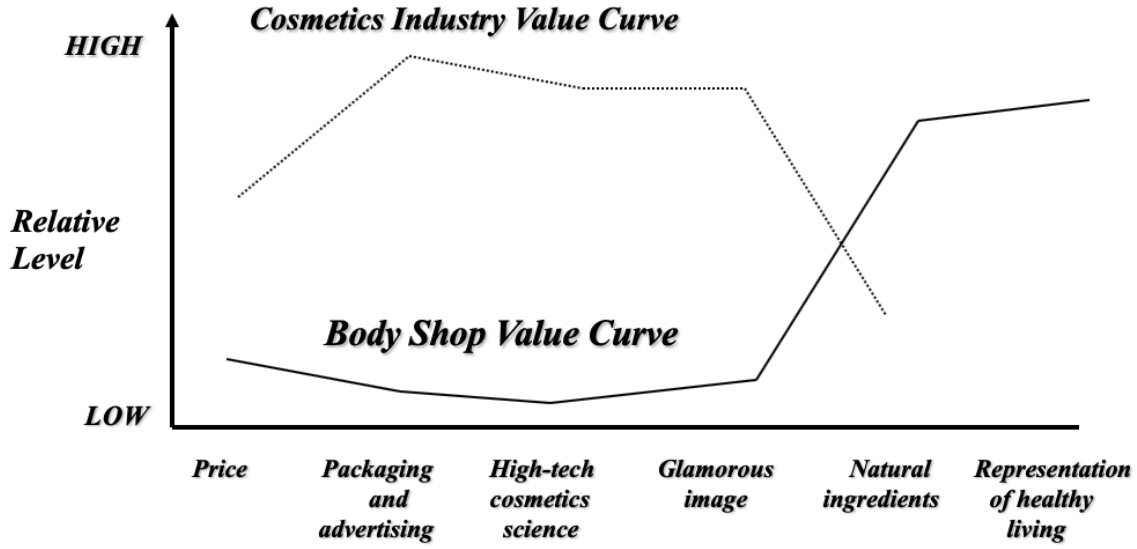




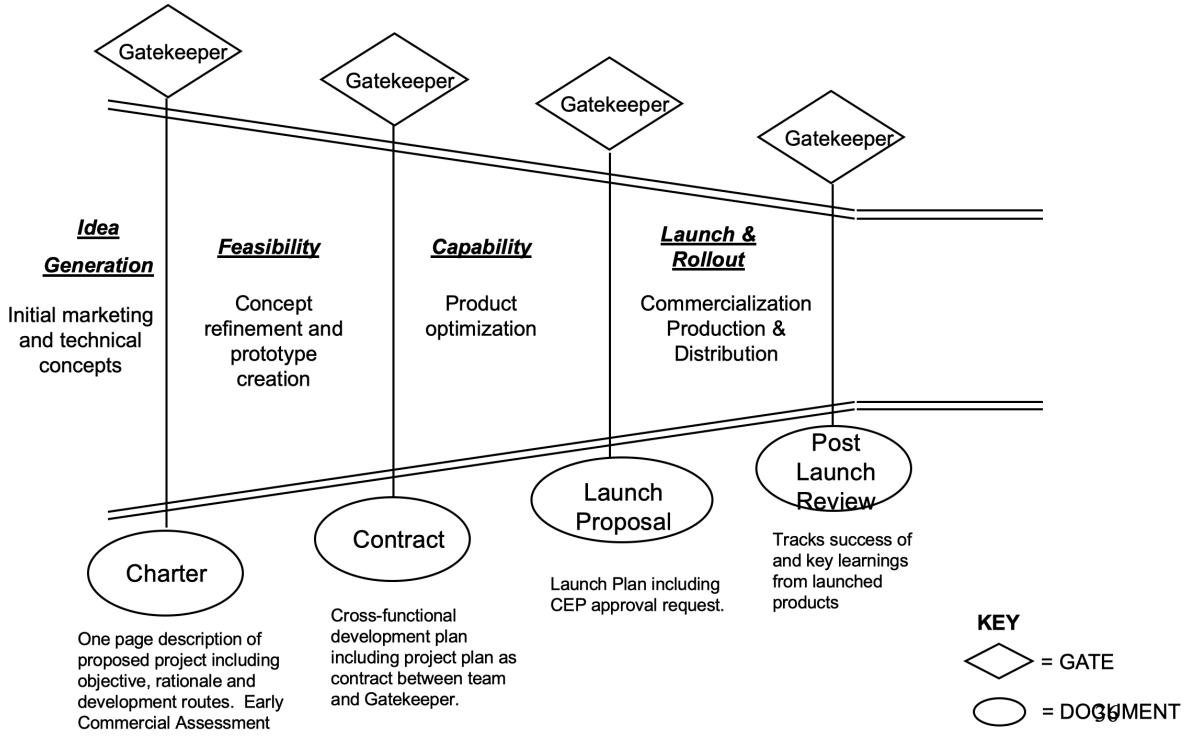


The value curve



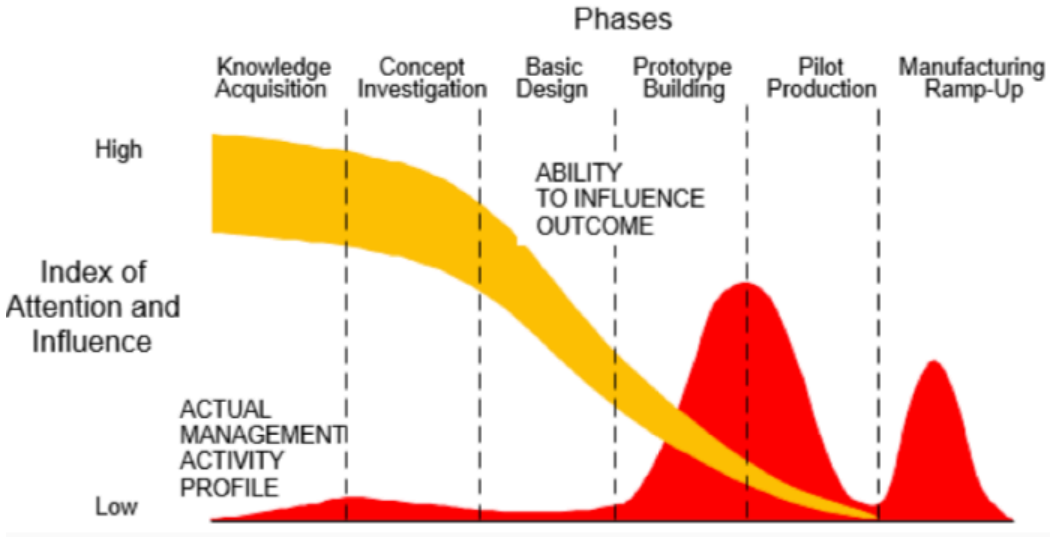


Key elements of product, service and delivery 26



Gates are major milestones; intendent to allow passage of the projects *more likely to succeed* by sacrificing projects *more likely to fail* as early as possible. At a gate, a decision is therefore made to either continue working on the project, moving it along to the next stage in the funnel; OR Stop working on the project, shelving it or canceling it; OR Get additional information and reconsider the project for passage through the same gate once that information becomes available.

The timing and impact of **management attention and influence** → the activity management profile is very low in the early face of the program; this is a huge mistake: in the beginning they have more space to adjust the product!



Slides!!!

Lecture 6 and 7

Chapter 3 (see lecture 1 and 2), 10 and reading + slides!!

Chapter 10: Organizing for innovation

Flat technocracy: resources and control are allocated based on the quality of people's ideas rather than seniority or hierarchical status.

Size and structural dimensions of the firm

Size: is bigger better?

- The impact of size on innovation has been debated for more than 50 years. Size is thought to confer advantages such as economies of scale in R&D, greater access to complementary resources and learning benefits. However, size may also be associated with disadvantages such as inertia and governance problems.
- Many firms attempt to make big companies feel small by breaking them into networks of more specialized divisions. These divisions can behave like smaller, more entrepreneurial firms.
- **Icarus paradox** = a firm's prior success in the market can hinder its ability to respond to new technological generations.

Structural dimensions of the firm

- **Centralization** = the degree to which decision-making authority is kept at top levels of the firm.
  Contra decentralization:
  - Enables divisions to develop new products or processes that closely meet their particular division's needs;
  - Enables the firm to take advantage of the diversity of knowledge and market contacts
  - The firm ends up taking on both a greater quantity and variety of projects and makes fewer errors of omission;
  - Enables the firm to respond better to technological or environmental change.

  Contra decentralization:
  - Much risk of reinventing the wheel;
  - Redundant R&D activities;
  - Forgone economies of scale and learning-curve effects;
  - Struggle to cooperate.

  The use of a centralized versus decentralized development process varies by type of firm and industry:
  - Consumer product companies → decentralized (tailoring projects to local markets)
  - Electronics industries → centralized

- **Formalization** = the degree to which the firm utilized rules, procedures and written documentation to structure the behaviour of individuals or groups within the organisation.
  Pro formalization: formalization can substitute for some degree of managerial oversight.
  Contra formalization: high degrees of formalization can make a firm rigid.
- **Standardization** = the degree to which activities in a firm are performed in a uniform manner.
  Pro standardization: standardization can ensure that activities within the firm run smoothly and yield predictable outcomes.
  Contra standardization: standardization can stifle innovation.

- **Mechanic versus organic structures**:
  - Mechanic structure = organization structure characterized by a high degree of formalization and standardization, causing operations to be almost automatic or mechanical.
  - Organic structure = organization structure characterized by a low degree of formalization and standardization. Employees may not have well-defined job responsibilities and operation may be characterized by a high degree of variation.

  → Because much innovation arises from experimentation and improvisation, organic structures are often thought to be better for innovation despite their possible detriment to efficiency.
- **Ambidextrous organisation**: the best of both worlds? → Ambidextrous organisation = an organisation that behaves almost as two different kinds of companies at once. Different divisions of the firm may have different structures and control systems, enabling them to have different cultures and patterns of operation.
  - Skunk works = new product development teams that operate nearly autonomously form the parent organization with considerable decentralization of authority and little bureaucracy.
    Pros of isolation:
    - No risk of converging on the same ideas;
    - No demand of the rest of the organization;
    - A separate division can have its own unique culture.
  - Quasiformal structures (Schoonhoven and Jelinek) = relationships that were not formally indicated on the organizational chart. These quasiformal structures were more problem-focused and could change faster than the rest of the company and provided a form for interaction across divisions. They fostered interactions based on interests rather than on hierarchy.

Modularity and loosely coupled organisations → another method firms use to strike a balance between efficiency and flexibility is to adopt standardized manufacturing platforms or components that can be mixed and matched in a modular production system.

- Modular products – modularity = the degree to which a system's components may be separated and recombined.

- Loosely coupled organizational structures = organizational structures where development and production activities are not tightly integrated but rather achieve coordination trough their adherence to shared objectives and common standards.
  Pro:
    - Less need for integration frees firms to pursue more flexible R&D and production configurations;

  Contra:
    - If ongoing intensive coordination is required, the development activities might be better carried out through close integration of all parties;
    - If the development groups are in separate companies, developing a new product in a collaboration agreement, neither firm may possess the authority to resolve the dispute and enforce a particular outcome.

Managing innovation across borders – four strategies (Barlett and Ghoshal):

- Center-for-global strategy = when all innovation activities are conducted at a central hub and innovations are then diffused throughout the company.
- Local-for-local strategy = when each subsidiary conducts its own R&D activities tailored for the needs of the local market.
- Locally leveraged strategy = when each division or subsidiary of the firm conducts its own R&D activities, but the firm attempts to take the most creative resources and innovative developments from divisions and deploy them across the company.
- Globally linked strategy = innovation activities are decentralized, but also centrally coordinated for the global needs of the corporation, each division might be charged with a different innovation task that serves the global company's needs, in which the division can exploit some local market resource advantage.

→ Barlet and Ghoshal propose that firms should take a transnational approach (= firms are trying to simultaneously achieve cost reductions and local responsiveness).

Reading: Disruptive technologies (Bower & Christensen)

Why is it that leading companies invest aggressively and successfully in the technologies necessary to retain their current customers but fail to make certain other technological investments that customers of the future will demand? → Leading companies succumb to one of the most popular and valuable management dogmas: they stay close to their customers.

The technological changes that damage established companies have two important characteristics:

- They typically present a different package of performance attributes, ones that are not valued by existing customers;
- The performance attributes that existing customers do value improve at such a rapid rate that the new technology can later invade those established markets.

To explain the differences in the impact of certain kinds of technological innovations on a given industry, the concept of performance trajectories can be helpful → performance trajectories = the rate at which the performance of a product has improved and is expected to improve over time. Different types of technological innovations affect performance trajectories in different ways:

- Sustaining technologies tend to maintain a rate of improvement; that is, they give customers something more or better in the attributes they already value;
- Disruptive technologies introduce a very different package of attributes and perform far worse along one or two dimensions that are particularly important to customers; at first, mainstream customers are unwilling to use a disruptive product in applications they know and understand, then, disruptive technologies tend to be used and value only in new markets or new applications.

Innovator's dilemma: established firms lose their market leadership over technological changes.

How could technologies that were initially inferior and useful only to new markets eventually threaten leading companies in established markets? Once the disruptive architectures became established in their new markets, sustaining innovations raised each architecture's performance along steep trajectories, so steep that the performance available from each architecture soon satisfied the needs of customers in established markets.

Identify and track potentially disruptive technologies:

- Identify: who supports the project and who does not?
  → marketing and financial managers will rarely support a disruptive technology, while technical personnel with outstanding track records will often persist in arguing that a new market for the technology will emerge.
- Define the strategic significance of the disruptive technology: a simple graph plotting product performance and time can help!
  → draw a line depicting the level of performance and the trajectory of performance improvement that customers have enjoyed and are likely to expect in the future, then locate the estimated initial performance level of the new technology; the technology is disruptive if the point lies far below the performance demanded by current customers. If knowledgeable technologists believe the new technology might progress faster than the market's demand for performance improvement, then that technology, which does not meet customers 'needs today, may very well address them tomorrow.
- Locate the initial market for the disruptive technology: because disruptive technologies frequently signal the emergence of new markets, managers must create information about such markets by experimenting rapidly, iteratively and inexpensively with both the product and the market.
- Place responsibility for building a disruptive technology business in an independent organization – example: CDC successfully created a remote organization to commercialize tis 5.25-inch drive.
- Keep the disruptive organization independent: what should CDC do when the emerging market becomes large and established? Wit disruptive technologies, folding the spin-off into the mainstream organization can be disastrous.

Reading: The ambidextrous organization (O'Reilly & Tushman)

Most successful enterprises are adept at refining their current offerings, but they falter when it comes to pioneering radically new products and services. Some companies have been quite successful at both exploiting the present and exploring the future: they separate their exploratory units from their exploitative ones, allowing for different processes, structures and cultures and manage this organizational separation through a tightly integrated senior team. = ambidextrous organizations

Companies have to make:

- Incremental innovations = small improvements in their existing products and operations that let them operate more efficiently and deliver even greater value to customers.
- Architectural innovations = technological or process advances to fundamentally change some component or element of their business – example: a bank can perhaps shift its call center to a low-labour cost country.
- Discontinuous innovations = radical advances like digital photography that profoundly alter the basis for competition in an industry, often rendering old products or ways of working obsolete.

Companies tend to structure their breakthrough projects in one of four basic ways:

- Existing functional designs = integrated into the regular organizational and management structure.
- Cross-functional teams = groups operating within the established organization but outside the existing management hierarchy.
- Unsupported teams = independent units set up outside the established organization and management hierarchy.
- Ambidextrous organizations = structurally independent units, each having its own processes, structures and cultures but integrated into the existing senior management hierarchy. = most successful

Why ambidextrous organizations outperform other organizational types?

- The structure allows cross-fertilization among units while preventing cross-contamination;
- The tight coordination at the managerial level enables sharing important resources but the organizational separation ensures that the new units 'distinctive processes, structures and cultures are not overwhelmed by the forces of business as usual;
- The established units are shielded from the distractions of launching new businesses; they can continue to focus all their attention and energy on refining their operations, improving their products and serving their customers.

Ambidexterity as a dynamic capability: resolving the innovator's dilemma – 5 ingredients:

- The presence of a compelling strategic intent;
- The articulation of a common vision;
- The consensus among senior management, relentless communication and a common fate incentive system;
- Separate exploitation and exploration activities;
- Senior leadership to handle tensions and contradictions.

(**Paper**) Is the concept of ambidextrous organizations really sustainable? → Under the following conditions, diversified firms can indeed take on sustainable forms, resulting in overall value creation equal or superior to focused mature firms:

- Adopting longer time frames: they are able to compensate over time the inferior performance of the first phases;
- Being able to shift resources across different parts of the portfolio: beneficial effects resulting from flexibility in terms of resource allocation should come as no surprise; as an organization is able to shift resources from declining parts of the business portfolio to growing parts, financial returns tend to increase rather than decrease;
- Actively pursuing or enacting synergies:
    - The more one is able to affect the growth rates, both of emerging and declining activities, the more beneficial effects in terms of financial returns become outspoken within our models → example Tesla boosting the growth;
    - Combining resources deployed within two different activities might result in the development of new products and/or market applications, affecting the overall size of the attainable market for ambidextrous firms.

Lecture 8 and 9

Chapter 8 and AMJ paper + slides!!

Chapter 8: Collaboration strategies

Collaboration:

- Can enable firms to achieve more, at a faster rate and with less cost or risk than they can achieve alone;
- Often entails relinquishing some degree of control over development and some share of the expected rewards of innovation, plus it can expose the firm to risk of malfeasance by its partner(s).

Reasons for going solo

- No need to collaborate because they possess all the necessary capabilities and resources in-house or there is no available partner;
- Protecting proprietary technologies;
- Controlling development processes and the use of any resulting new technologies;
- Development efforts are key to building and renewing capabilities.

Advantages of collaborating

- Enables a firm to obtain the necessary skills or resources more quickly than developing them in-house;
- Enables a firm to reduce its asset commitment and enhance its flexibility → when technology is progressing rapidly, firms may seek to avoid committing themselves to fixed assets that may rapidly become obsolete;
- Collaboration can be an important source of learning;
- Sharing costs and risks of the project;
- Collaboration may facilitate the creation of a shared standard → cooperation at the development stage can be an important way of ensuring cooperation in the commercialization stage.

Types of collaborative arrangements

Strategic alliances

- Joint ventures;
- Licensing;
- Outsourcing;
- Collective research organizations.

Alliance = any type of formal or informal relationship between two or more firms.
Joint venture = a partnership between two or more firms involving a significant equity stake by the partners and often resulting in the creation of a new business entity.
Licensing = a contractual arrangement whereby one organization (the licensee) obtains the rights to use the proprietary technology of another organization (the licensor).
Contract manufacturing (common form of outsourcing) = when a firm hires another firm to manufacture its products.

Collective research organizations (CRV) – examples: trade associations, university-based centers, private research corporations ...

Doz & Hamel – it is useful to categorize a firm's alliance strategy along two dimensions:

- The degree to which alliances practice capability complementation versus capability transfer;
- Whether the firm manages each alliance individually or manages a collective network of alliances.

In building an alliance portfolio, managers should think carefully about:

- Competitive effects: if multiple alliances are serving the same strategic needs, there is a risk of redundant resources investment or competitive conflict between partners;
- Complementing effects: a pharma firm might be using an alliance to develop a drug with one partner and another alliance to develop a delivery method; in this situation, the benefits of each alliance are accentuated by the benefits of the other;
- Network structure effects: managers should consider how their portfolio of alliances positions them in the web of relationships that connect their firm, partners and partners 'partners.

Choosing a mode of collaboration

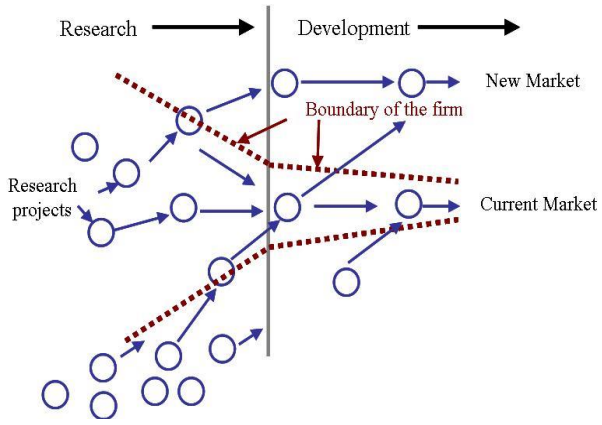
	Speed	Cost	Control	Potential for leveraging existing competencies	Potential for developing new competencies	Potential for accessing other firm's competencies
Solo	Low	High	High	Yes	Yes	No
Strategic alliance	Varies	Varies	Low	Yes	Yes	Sometimes
JV	Low	Shared	Shared	Yes	Yes	Yes
Licensing in	High	Medium	Low	Sometimes	Sometimes	Sometimes
Licensing out	High	Low	Medium	Yes	No	Sometimes
Outsourcing	Medium	Medium	Medium	Sometimes	No	Yes
CRV	Low	Varies	Varies	Yes	Yes	Yes

Choosing and monitoring partners

- Partner selection:
  - Resource fit = the degree to which potential partners have resources that can be effectively integrated into a strategy that creates value.
  - Strategic fit = the degree to which partners have compatible objectives and styles.
- Partner monitoring and governance:
  - Alliance contracts = legally binding contractual arrangements to ensure that partners (1) are fully aware of their rights and obligations in the collaboration and (2) have legal remedies available if a partner should violate the agreement.
  - Equity ownership = each partner contributes capital and owns a share of the equity in the alliance. This helps to align the incentives of the partners and provides a sense of ownership and commitment to the project that can facilitate supervision and monitoring of the alliance.
  - Relational governance = self-enforcing norms based on goodwill, trust and reputation of the partners. These typically emerge over time through repeated experiences working together.

Mode of cooperation	**Interdependece**
Joint ventures Research cooperations	Large
Joint R&D Research pacts & joint development agreements	
Minority investment	Medium
Customer-supplier relations R&D contract Co-production	
Mutual technology exchange agreements Mutual technology sharing Cross licensing	
One directional technology sharing Licensing	Small

Open innovation



Open innovation: you have a bidirectional flow of knowledge (outside – in and inside – out) throughout the whole funnel.

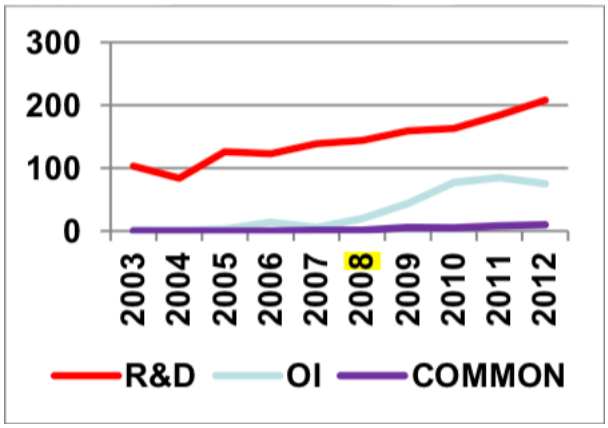
Open innovation = the use of purposive inflows and outflows of knowledge to accelerate internal innovation and expand the markets for external use of innovation.

Advantages:

- Higher development speed;
- Access to external technology sources;
- Higher flexibility: you acquire the technology earlier on or later on;
- The value of technologies can be determined by linking them to your business model: you insource technologies that strengthen your business and sell the others.

(**Paper**) Exploring the scope of open innovation:

- What are the main theoretical foundations of open innovation research?
  → Open innovation is primarily rooted in technology and innovation management (strategic partnering and external sourcing / user-centric innovation / technology and innovation management), but also builds on frameworks and concepts from the strategic management literature (resource -and knowledge -based view of the firm)
- What are the main thematic areas that structure open innovation research and how do they relate to each other?
  → Publications focusing on the themes of idea generation, idea competitions and external technology commercialization, these are related by the core cluster (the core of open innovation) which interconnects the remaining clusters
- How did these thematic areas develop over time?
  → The identified themes have been pursued consistently over the last decade



→ It can be observed that WOS-publications on the topic of R&D alliances show a steady increase over time whilst the open innovation literature resembles a double boom pattern.

Open innovation and R&D alliances – not so novel after all: growing awareness began in the 70's, boomed in the 80's!

Organizing alliances is a complex process – **50% of alliances fail**!

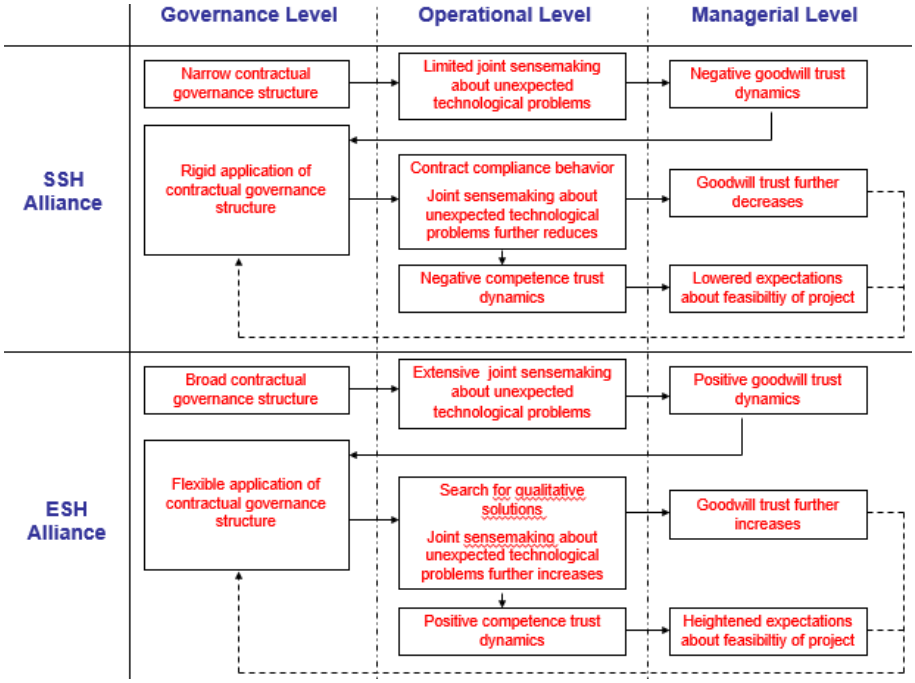
- What makes it complex?
  - Unintended knowledge spillovers
  - Learning races between the partners
  - Diverging opinions on intended benefits
  - Lack of flexibility and adaptability
  - Lack of managerial skills/expertise/experience
  - Strategic/cultural differences between partners
  - Lack of overlapping capabilities
  - Additional complexity on the level of portfolios

- How to address the complexities entailed?
  - Importance of combining formal (contracts) and relational governance mechanisms (trust)
  - Alliances differ in terms of objectives and interdependencies; hence a portfolio approach seems to be as relevant

(**Paper**) Toward an integrative perspective on alliance governance: connecting contract design, trust dynamics and contract application:

- Structural and relational perspectives on alliance governance:
  - Structural perspective = perspective that rests on the assumption that alliance partners ten to act opportunistically. It identifies complex contracts as safeguarding devices that mitigated the perceived risk of opportunistic behaviour.
  - Relational perspective = perspective that focuses on interfirm relationships as they evolve over time and over transactions. It promotes a more relational governance strategy in which partners rely on trust to address issues of safeguarding and coordination.
  - Trust = a multidimensional concept, encompassing positive expectations about a partner's ability to perform according to an agreement (competence trust) as well as the party's intentions to do so (goodwill trust).
- How does the content of contracts influence trust dynamics at both operational and managerial levels in alliances?
  → A broad contractual government structure facilitates joint sense making on unanticipated technological problems at the operational level, which in turn positively influences goodwill trust dynamics at the managerial level!
- How does the application of contracts coevolve with trust dynamics at both operational and managerial levels in alliances?
  → Positive goodwill trust dynamics at the managerial level increase the probability of flexible contract application and flexible contract application is likely to trigger positive trust dynamics at both the operational and the managerial level, which in turn leads to increasing flexibility regarding contract application.

- Implications:
  → Complex contracts can both encourage and discourage trust building depending on the nature of the contract.
  → The process of contracting is an incremental learning process that is sensitive to bargaining power dynamics and not goodwill trust, but rather mutual interdependence and competence trust function as necessary conditions to continue interfirm relationships.



Lecture 10

Chapter 11 and 12

Chapter 11: Managing the new product development process

Objectives of new the new product development process

- Maximizing fit with customer requirements → many fail to achieve this:
  - The firm may not have a clear sense of which features customer value most;
  - The firm may overestimate the customer's willingness to pay for particular features;
  - The firm may have difficulty resolving heterogeneity in customer demands.
- Minimizing cycle time → a firm that brings a new product to market late:
  - May find that customers are already committed to other products;
  - Will have higher costs because many development costs are directly related to time and is unlikely to be able to fully amortize the fixed costs before the generation becomes obsolete;
  - May not be able to quickly revise or update its offering as design flaws are revealed or technology advances and may miss out on first-mover and second-mover advantages.
- Controlling development costs → development efforts must not only be effective, but also be efficient!

Methods of achieving these objectives

- To shorten the development process and avoid time-consuming and costly iterations, firms may adopt a partly parallel development processes → partly parallel development process = a development process in which some (or all) of the development activities at least partially overlap.
  - Concurrent engineering (type of parallel development process) = a design method in which stages of product development and planning for later stages of the product lifecycle occur simultaneously.
- Firms may use project champions → project champion = senior executive that has the power and authority to support and fight for a project, note: a manager's role as champion may cloud judgment about the true value of the project.
- Firms can involve customers and suppliers:
  - Beta testing = an early working prototype of a product is released to users for testing and feedback.
  - Lead users = customers who face the same general needs of the marketplace but are likely to experience them months or years earlier than the rest of the market and stand to benefit disproportionally form solutions to those needs.
  - Crowdsourcing = a distributed problem-solving model whereby a design problem or production task is presented to a group of people who voluntarily contribute their ideas and effort in exchange for compensation, intrinsic rewards or a combination thereof.

Tools for improving the new product development process

- **Stage-Gate processes** = model that provides a blueprint for moving projects through different stages of development.
    - Go/kill decision points = gates established in the development process where managers must evaluate whether or not to kill the project or allow it to proceed.

  → figure funnel page 1!
- **Quality function deployment (QFD)** = process for improving the communication and coordination among engineering, marketing and manufacturing personnel by taking managers through a problem-solving process in a very structured fashion.
    - House of quality = a matrix that maps customer requirements against product attributes – 9 steps:
        1. Identify customer requirements
        2. Weight the customer requirements in terms of relative customer importance
        3. Identify the engineering attributes that drive the performance of the product
        4. Enter the correlations between the engineering attributes to assess the degree to which one characteristic may positively or negatively affect another
        5. Fill in the body of the central matrix: the number represents the strength of the relationship between a customer requirement and engineering attribute
        6. Multiply the customer importance rating of a feature by its relationship to an engineering attribute and sum these numbers for each column
        7. Evaluate the competing products on each of the customer requirements
        8. Use the relative importance ratings for each engineering attribute and the scores for the competing products to determine target values for each of the design requirements
        9. Create a product design based on the design targets

- **Design manufacturing methods (DFM)** =simple way of structuring the new product development process, often this involves articulating a series of design rules.
- **Failure modes and effects analysis (FMEA)** = a method by which firms identify potential failures in a system, classify them according to their severity and put a plan into place to prevent the failures from happening – several steps:
        1. Identify potential failure modes
        2. Evaluate the failure modes based on severity, likelihood of occurrence and the inability of controls to detect it (one for the lowest risk, five for the highest risk)
        3. Create a composite risk priority number for each failure mode by multiplying the scores
        4. Prioritize the development efforts to target potential failures modes that pose the most composite risk

- **CAD (computer aided design)** = the use of computers to build and test product designs.
  CAM (computer aided manufacturing) = the implementation of machine-controlled processes in manufacturing.
    - Three-dimensional printing = a method whereby a design developed in a CAD program is printed in three dimensions.

Tools for measuring new product development performance

Firms should use a variety of measures of their new product development effectiveness and overall innovation performance to identify opportunities for improving the new product development process and improving the allocation of resources.

Chapter 12: Managing new product development teams

Constructing new product development teams

- **Team size – bigger is not always better**:
    - Large teams can create more administrative costs and communication problems, leading to costly delays;
    - The larger the team, the harder it can be to foster a shared sense of identity;
    - As the size of the team increases, the potential for social loafing also increases → social loafing = when an individual does not exert the expected amount of effort and relies instead on the work of other team members.
- **Team composition:**
    - Cross-functional teams = teams whose members are drawn from multiple functional areas in the firm – advantage: broader knowledge base and cross-fertilization of ideas;
    - Homophily = the tendency for individuals to like other people whom they perceive as being similar to themselves – advantages of heterogeneous teams: they possess more information and can increase the creativity and variance in decision making, leading to more innovative outcomes and higher overall performance; however, to realize these advantages, heterogeneous teams may require long-term contact and incentives to foster communication and cooperation.

The structure of new product development teams

- **Functional teams**: members remain their functional departments and report to their regular functional manager; however, they may meet periodically to discuss the project. Functional teams are usually temporary and no not have a project manager or dedicated liaison personnel. The structure provides little opportunity for cross-functional coordination and team members may have little commitment to the project since they are still evaluated and rewarded on their functional performance.
- **Lightweight teams**: members remain their functional departments and report to their regular functional manager; however, they have a (junior) project manager and dedicated liaison personnel who facilitate communication and coordination among functions.

- **Heavyweight teams**: members are removed from their functional departments and report to a (senior) project manager. The core group of team members is often dedicated full-time to the project. This combination of factors helps ensure that the team has strong cross-functional coordination and communication and team members are significantly committed to the project. Heavyweight teams are still often temporary.
- **Autonomous teams**: members are removed from their functional departments and dedicated full-time to the team. The project manager is given full control over resources contributed from different functional departments and has exclusive authority over the evaluation and reward of team members. Autonomous teams are permitted to create their own policies, procedures and reward systems and are held fully accountable for the success of the project.

The management of new product development teams

For a new product development team to be effective, its leadership and administrative policies should be matched to the team's structure and needs:

- **Team leadership**: attributes of the team leader must match the team type for teams to be most effective;
- **Team administration**: many firms have teams develop and sign a project charter and contract book to ensure that all team members have a common understanding of the project's goals and possess a sense of ownership and commitment to the project's success;
- **Managing virtual teams**: when a company wishes to form a team with individuals who have unique skills but live great distances from each other, it might opt to form a virtual team; the team uses IT to achieve communication and coordination and faces a distinct set of challenges in promoting participation, cooperation and trust, management must make sure they select personnel who are both comfortable with the technologies used and who have strong interpersonal skills.

<u>Gassman and von Zedtwitz – typology of international virtual teams:</u>

- Decentralized self-coordinating teams: all R&D is conducted by decentralized divisions that coordinate loosely with each other.
- System integrator as coordinator: most R&D is conducted by decentralized divisions, but one single individual or office takes responsibility for the coordination.
- Core team as system architect: the core team takes a lead role in R&D, while also coordinating the decentralized divisions.
- Centralized venture team: all R&D resources are transferred to a centralized venture team, which then conducts all R&D.

<u>Communication:</u>

- Within project communication will not matter: high performers spend less time on within project communication.
- Boundary-spanning communication will matter: high performers spend more time on boundary-spanning communication.
- Diversity of communication will matter!

The **not-invented-here (NIH) syndrome** = internal resistance in a company against externally developed knowledge.

Allen: table team membership reduces communication within groups, across groups and with external parties. Individuals working in teams with stable membership tend to isolate themselves from sources providing critical evaluations, information and feedback which does not coincide with group ideas; this leading to resistance against externally developed knowledge.

- **Reasons**:
  - 'We know it'
  - Potential threat from newness

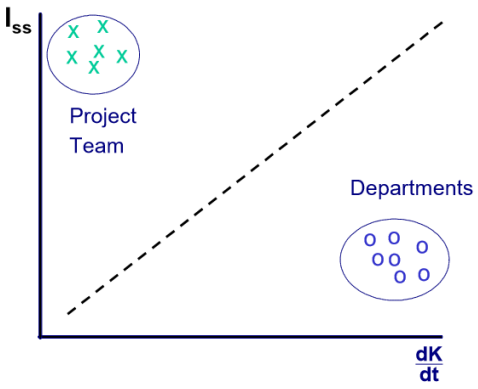
  → selection / conversion select & success trap
- **Remedies:**
  - Rejuvenating the team
  - Opening team boundaries

Innovation - **departmental or project team organization**?

- **Departmental organization**: provides a better connection to supporting technologies and better ongoing technical support; however, this is accomplished at the cost of much greater difficulty in coordination and less responsiveness to market change.
- **Project team organization**: provides better coordination of the project tasks and increased sensitivity to market dynamics; however, this is accomplished at the cost of a separation from disciplinary knowledge underlying the project effort.
- Bit of both?

There are four variables that are important in determining the organizational structure for product development:

- Dynamics of the market → project in case of different market dynamics
- Rate of change of knowledge → departmental in case of major knowledge changes
- Subsystem interdependence → project in case of major interdependence
- Duration of the project assignment → departmental in case of long durations



Standard industrial practice: focuses only on project duration, this will probably lead to the wrong decision!

ADSL

Begin 90s De Prycker (the manager of central research) proposed to senior management to start a small research program on the possibilities of ADSL. The foreseen killer application was Video On Demand but this idea collapsed when researchers discovered the technology was not mature enough. Another application also gained attention: The Internet. To further develop ADSL technology for internet usage, Alcatel set up a semi-autonomous unit, which they named a virtual company (VC). The VC was an organizational unit within the boundaries of Alcatel, had an autonomous position and was allowed, for instance, to determine its own purchase and HR policies. De Prycker also pushed through the idea to set aside the development of ADSL from Alcatel's central product, which did not have an installed base in the American market. To pursue the ADSL goals, de Prycker and colleagues received support from members of the senior management team. A crucial moment in the emergence of ADSL -based internet technology for Alcatel was the granting of the JPC contract. In hindsight, a combination of factors can be identified that contributed to the success of Alcatel in winning the JPC contract:

- Technological choices: line coding technique DMT
- Organizational factors: the combination of bottom-up, entrepreneurial action and top down support

The VC structure proved to be an effective design to facilitate and make use of entrepreneurial dynamics and top management support. One the one hand, the VC provided flexibility in terms of ADSL development options and enabled fast decision making. On the other hand, it made the use of corporate resources possible, in terms of financial buffers and technological expertise.

Implications:

- The effectiveness of a hybrid structure characterized by semi permeability which allows the simultaneous presence of entrepreneurial autonomy and the enactment of complementarities;
- The presence of complementarities as well as the adoption of this semi permeable structure does not provide a complete account; entrepreneurial behaviour present itself as a third ingredient.

→ The management could have killed the project but people in the lower hierarchy did not want to give up. Intrapreneurship is very important in this story: the project was developed bottom-up!

Needed roles in a company:

- Idea generation
- Entrepreneurship and championing
- Project leading
- Gatekeeping
- Sponsoring or coaching → you need senior management support!

Idea Generating	Expert in a limited number of fields – Creative – Strong in problem solving
Entrepreneurship or Championing	Wide range of interests – Energetic and determined – Able to sell ideas and obtain resources - Takes risks
Project Leading	Planning, organizing and coaching – ensures that administrative and organizational requirements are met – takes care of project progress and team members
Gatekeeping	High level of technical competence – can communicate – keeps informed and likes to inform
Sponsoring or Coaching	Support development of people's talents – experience in what is feasible and needed - provides access to a power base within the organization – Buffers when needed

Lecture 11

IP & Innovation beyond R&D: Business model; Innovation/Design Driven Innovation

Slides

Intellectual property

Patent = a limited property right that the government offers to inventors in exchange for their agreement to share the details of their inventions with the public. → In order to obtain a patent, an applicant must provide a written description of his or her invention in sufficient detail for a person skilled in the art to make and use the invention. In addition, at the end of the specification, the applicant must provide the patent office with one or more claims that distinctly point out what the applicant regards as his or her invention.

Certain areas are excluded:

- European patents shall be granted for any inventions which are susceptible of industrial application, which are new and which involve an inventive step.
- The following in particular shall not be regarded as inventions:
    - Discoveries, scientific theories and mathematical methods
    - Aesthetic creations
    - Schemes, rules and methods for performing mental acts, playing games or doing business, and programs for computers
    - Presentations of information

View on patents:

- Locke (1690): a person who labours upon resources that are either unowned or held in common has a natural property right to the fruits of his labour (natural right approach).
- Utilitarian perspective: patents are viewed as incentives for further innovation → social institutions should be designed so as to maximize social welfare; the core of the utilitarian argument for patents is that free competition will generate an under-optimal rate of inventions, due to the public good characteristic of knowledge, hence it is in the interest of society to supplement free competition with special institutions in that field, patents being one of them.
  → the utilitarian view has at its core a tradeoff between benefits (incentives to invent) and costs (loss of consumer surplus)!

Advantages of patents:

- Technology protection (resulting in an increase of the economic returns of R&D investments)
- Retaliatory (=vergelding) power
- Licensing out/Cross-Licensing/Cooperative R&D

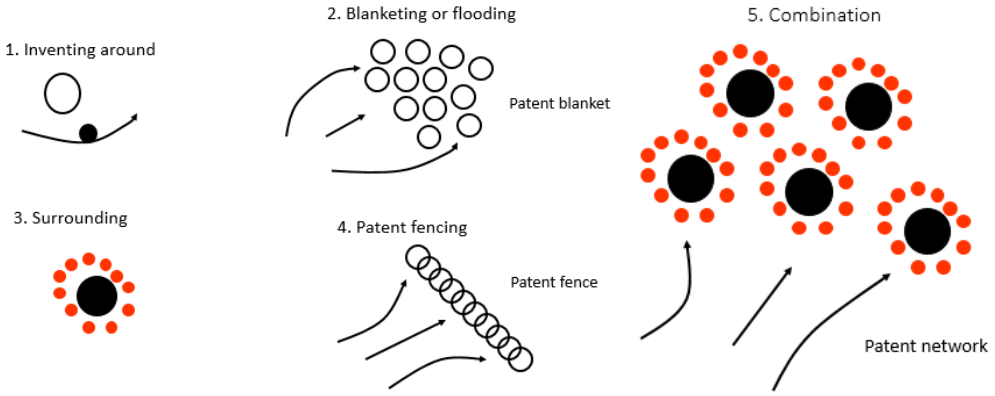
Economic value of a patent:

- $Patent\ value = p * 1/r * (1 - e^{-r*L}) - discounted\ investment$
  Example:
  - 15% sales margin due to enhanced product performance or cost savings
  - 10-year lifetime of patent
  - Discount rate of 7%

  → $value = 0{,}15 * 1/0{,}07 * (1 - e^{-0{,}07*10})$
- Other indicators:
  - Payment of renewal fees
  - Times the patent is being cited
  - Requested geographic coverage
  - Cross-citations to and in the scientific literature

Patent strategies:

- **Inventing around** = one or a few patents are used in this case to protect an innovation in a special application.
- **Blanketing or flooding** = efforts are made to turn an area into a minefield of patents.
- **Surrounding** = this is the case when an important central patent of some kind, especially a strategic patent, can be fenced in or surrounded by other patents, which are individually less important but collectively block the effective commercial use of the central patent, even after its expiration.
- **Patent fencing** = the situation where a series of patents, ordered in some way, block certain lines or directions of R&D.
- **Patent network** = a patent portfolio in which patents of various kinds and configurations are consciously used to strengthen overall protection and bargaining power.



Lecture 12

Melexis Report

Read!