Technology, Innovation and Strategy: A general management perspective (Burgelman et al.)

- **Manager’s task:** 1) allocation of resources; 2) develop and exploit capacity for innovation

**Key concepts** → see Exhibit 1 (page 3)
- distinguish between activities and outcomes!

**Inventions/Discoveries/Technologies**
- **Innovations** (invested is what did not exist before) / **Discoveries** (discover what existed before) → origin of technological innovation process; creative and difficult to plan
  - **Scientific research:** _basic_ (generating new knowledge); _applied_ (solve particular technical problems)
- **Technology** – theoretical and practical knowledge, skills and artifacts that can be used to develop products and services as well as their production and delivery systems (can be implicit) → **outcome of deliberate planning;** used to put inventions and discoveries into practical use
  → success determined by technical factors, rather than commercial

**Technological innovations**
- **Innovations** = outcome of innovation process – combined activities leading to **new, marketable products and services** / **new production and delivery systems** → combine inventions/discoveries, technology & administration
- **Types:** incremental / radical / architectural innovations

**Technological entrepreneurship**
- **Technological entrepreneurship** = activities that create new resource combinations to make innovation possible → **product, process and market development**

**Integrating technology and strategy**
- **Perspectives on strategy:**
  - **Positive** (actual strategy – formed by top-management beliefs on core competencies, market areas, core values and people) versus **normative** (what it should be) view → often divergence in high-tech firms
  - **Product market** (how firm competes with products, e.g. Porter) versus **resource-based** (how does it secure competitive advantage) views → strategy is function of quantity and quality of firm’s capabilities
- **Connecting technology and strategy** → technology adds dynamic character
  - **Technology and product-market strategy** – strategy is expressed in products brought to the market – technology/product matrix decomposes products into its constituting technologies according to their strength
  - **Technology portfolio:** classify technology on 2 dimensions – 1) **technology importance** and 2) **relative technology position** and accordingly set strategy (bet, cash-in, draw, fold)
  - **Technology portfolio and business portfolio:** add 2 new dimensions to technology portfolio – 1) attractiveness for business; 2) competitive position in the business (can be very different from technical viewpoint)
  - **Technology and value chain** – any of the technologies used in the value chain can affect firm’s competitive position → technology strategy: 1) how to use it to gain a technological advantage; 2) make or buy decision for technology
  - **Technological evolution and forecasting**
    - **Technology life cycle** (emerging technologies, pacing technologies, key technologies, base technologies)
    - **Technology forecasting** – not only forecasting, but also helps seeing relationships between technologically significant events

**Assessing Innovative Capabilities**
- **Innovative capabilities** = comprehensive set of characteristics of an organization that facilitate and support innovation strategies → need to be assessed at business unit and corporate level and answer **3 questions:**
  - how the firm has been innovative
  - how good the fit between business, strategies and innovative capabilities is
o what innovative capabilities are necessary to support long-term competitive advantages

- business unit level audit:
  o innovative strategies can be characterized in terms of: 1) timing of market entry; 2) technological leader-/followership; 3) scope of innovativeness; 4) rate of innovation
  o 5 important categories of variables that influence the innovation strategies (assess the combination of all) (first 3 are inputs to the formulation of strategies, last 2 inputs for the implementation):
    ▪ resources available for innovation activity
    ▪ capacity to understand competitors’ strategies & industry evolution
    ▪ capacity to understand technological developments relevant to business unit
    ▪ structural and cultural context affecting internal entrepreneurial behavior
    ▪ strategic management capacity to deal with internal entrepreneurial initiatives

- corporate level audit → new dimension lies in exploiting synergies
  o innovative strategies can be characterized in terms of:
    1) scope and rate of development of new products from synergetic innovativeness; 2) scope and rate of new business development; 3) timing of entry
  o 5 important categories of variables that influence the innovation strategies (assess the combination of all) (first 3 are inputs to the formulation of strategies, last 2 inputs for the implementation):
    ▪ resources available and allocation
    ▪ capacity to understand multi-industry competitive strategies and evolution
    ▪ capacity to understand technological developments
    ▪ corporate structural and cultural context
    ▪ corporate strategic management capacity

- important is the leadership in the audit

Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy (David J. Teece)

- tries to explain why innovating firms (those which are first to commercialize a new product/process) often fail to obtain significant returns from innovations, while customers, imitators and suppliers do → framework that explains share of profits going to innovator compared to followers and suppliers + interfirm activities such as collaboration, licensing…
  - for examples see exhibit 2, p.233

Profiting from innovation: Basic building blocks

- appropriability regime = environmental factors that govern innovator’s ability to capture profits generated – can be “tight” or “weak” → 2 main points: 1) legal instruments to protect innovation; 2) nature of technology
  o legal instruments: patents, copyrights, trade secrets
  o nature of technology: product, process, tacit, codified → especially process innovations are difficult to protect (imitability / transferability)
- dominant design paradigm (Abernathy-Utterback framework - see exhibit 4) – over the product/industry life cycle of an innovation there are 2 broad phases:
  o preparadigmatic stage → product designs are fluid, manufacturing is loosely and adaptively organized – competition among designs (product innovation)
  o paradigmatic stage → dominant strategy emerges and competition shifts to price terms – scale and learning become more important, as does process innovation in the attempt to lower costs
  o when imitation is possible and occurs before the emergence of a dominant strategy, followers have a good chance of having their modified product anointed as the industry standard
- complementary assets – are almost always needed (e.g. marketing, manufacturing, service…)
  o can be generic (used for general-purpose), specialized (unilateral dependence between innovation and complementary asset – either way) or cospecialized (mutually dependent)

Implications for profitability

Tight appropriability regimes (exception)
- if innovator is secured from imitation – he is shielded and can even afford getting things wrong in the preparadigmatic stage
- if complementary assets needed are generic or claims to the technology can be enforced easily, licensing is a viable option, otherwise integration into these is advisable and also feasible

**Weak appropriability (the rule) → business strategy**
- *preparadigmatic phase* → need to let basic design float – probability of successfully entering the paradigmatic phase possessing the dominant design is rising with ability to have *multiple prototypes and with tight coupling to the market* so that users can fully impact designs – latter is influenced by managerial choice, former can only be influenced in minor ways
- *paradigmatic stage* → complementary assets become critical; the commercial success rests on the terms upon which required complementary assets can be accessed (especially specialized and cospecialized assets)

**Channel strategy issues**
- *appropriate control structure over complementary assets depends largely on appropriability and associated risks* → 2 extremes: 1) full internalization; 2) hollow corporation
- difficult decisions arise when appropriability regime is weak and specialized assets are critical to profitable commercialization
- innovators, imitators and owners of cospecialized assets can potentially benefit, the latter ones especially if they own bottleneck facilities
- incorrect strategies compound problems, however mixed modes are common and necessary in real life, though the often are only transitory states

**Contractual modes**
- *pros*: 1) reduces capital expenditures and risk; 2) added credibility from known partner;
- *cons*: 1) opportunistic abuses, induced by necessary irreversible commitments; 2) difficult to write, execute and enforce complex development/production contracts; 3) possible creation of a competitor
- *best when appropriability regime is tight and there is competitive supply of the complementary asset* (generic assets)

**Integration modes**
- major constraints are *timing and cash*, as well as critical factor and investment (minority position might be a reasonable trade-off)
- think of bottlenecks to secure & spillover effects

**Implications for R&D strategy, industry structure and trade policy**
- *allocating R&D resources* → *resources have to be targeted towards development of innovations that are easy to protect and capitalize on existing capabilities in complementary resources* (investment decision has to be seen together with strategic analysis of markets and industries and the firms position
- possession of cospecialized assets puts *larger firms at an advantage*
- regimes of appropriability and *industry structure* → when legal protection is weak, control of cospecialized assets crucial to long-term survival – thus integration will occur in the maturation phase
- industry maturity, *new entry and history* → increased integration stifles entry, but strategic partnering can lower entry again, however, does historically grown integration not always reflect current needs
- importance of *manufacturing to international competitiveness* → with weak appropriability, participation in manufacturing is necessary to appropriate rents from innovation, thus more towards vertical disintegration and contracting has to viewed with concern
- *trade and investment barriers* can impact innovators’ profits → with weak appropriability, denying innovators ownership of specialized assets can *extract profits*, especially if the complementary assets the country has to offer are critical to the innovator not only for the local market
- *international distribution of benefits* from innovation → to ensure domestic cospecialized assets capture the benefits, the supporting infrastructure must not be allowed to decay

→ Public policy aimed at promoting innovation must focus also on *complementary assets and underlying infrastructure*. **Main success factor for innovations are the firms’ boundaries.**
Dynamic Interaction between Strategy and Technology (Hiroyuki Itami & Tsuyoshi Numagami)

- **technology** = systematic body of knowledge about how natural and artificial things function and interact
- **strategy** = dynamic design of the activities for the entire firm – determines basic framework for activities of the firm and basic principles of its game plan in the marketplace
- 3 types of relationships between strategy and technology:
  - current strategy capitalized on current technology (technology $\Rightarrow$ strategy)
  - current strategy cultivates future technology (strategy $\Rightarrow$ future technology)
  - current technology drives cognition of future strategy (technology $\Rightarrow$ future strategy)

**Strategy capitalizes on technology (short term focus)**
- focus is on the **match** between strategy the firm wants to take and the technology it possesses $\Rightarrow$ technology is a tool which has to be best used
- technology can act as 1) weapon if technology is superior; 2) constraint that has to be adapted to; 3) threat if the current technology is inferior to that of the competition
- matching is done by adjusting both technology and strategy independently $\Rightarrow$ no interactivity, but static

**Strategy cultivates technology (long-term focus)**
- focus on the **investment requirement of contemporaneous matching which leads to accumulation of technology** with much greater future potentials than necessary to meet current needs; either through technological development, or through day-to-day implementation of current strategy
- to foster accumulation of technology, counterintuitive strategy recommendations may prove valuable
- research has provided some insights:
  - daily corporate activities not only consume resources but also create some experience curve $\Rightarrow$ generating more business volume and greater market share leads to greater accumulation of experience; however needs to be managed carefully
  - product portfolio management (PPM) – firm needs to balance dynamic cash flows from various businesses
  - invisible assets (information; often results of learning through daily activities) are extensible and have a dual nature of being both an input to an accumulating output produced from strategy
  - firm should overextend itself beyond current technological limit to generate tension and provide opportunities for learning by doing
  - core competencies – help to adapt quickly $\Rightarrow$ resource based view of the firm
  - economics of evolution = by focusing on multiple projects with different stages of technological evolution, to existing knowledge helps in the creation of the newer technology, while the advances help further the understanding of the older technology and reduce costs and increase speed in production (old technology becomes basis of new technology and new technology stimulates deepening of old technology) $\Rightarrow$ develop new technology even if currently not necessary

**Technology drives cognition of strategy (long-term focus)**
- focus on stimulating effect of current technology on future strategy, as technology drives cognition of particular strategy because it 1) channels and activates idea generation processes and 2) helps integrate fragmentary ideas as it helps employees to communicate (however, technology can also hinder strategy)
- research has seen this role more form a passive viewpoint, as it pointed out that firm can find bottlenecks and lets firms recognize strategies to follow
- authors advocate for a more active role:
  - strong knowledge base provided by commitment to a particular technology will activate idea generation
  - commitment implies a common base of shared knowledge $\Rightarrow$ clustering of ideas, common direction, stimulate each other
  - strong technological base backs acceptance
  - however, appropriate technology needs neither to be too mature and homogeneous, nor too new and heterogeneous

**How the 3 perspectives are different** $\Rightarrow$ **3 dimensions of difference:**
- distinction between content and process of strategy $\Rightarrow$ separated 1, intertwined for 2, unclear for 3
- importance of learning and human cognitive process $\Rightarrow$ not considered for 1, important for 2, very important for 3
- importance of technology $\Rightarrow$ just a tool for 1, needs to be developed in 2
coming from 1 to 3, interaction between strategy and technology becomes more dynamic; we go from economics to organizational behavior; first has been stressed in academic research, because it is the most basic requirement
of importance is actually the content of strategy, but the process influences the content and both are (at least for the last 2 perspectives) intertwined
Exploiting the core competences of your organization (Tampoe, M.)

Concepts

- **core competences** = technical or management subsystem which integrates diverse technologies, processes, resources and know-how to deliver products and services which confer sustainable and unique competitive advantage and added value to an organization; importance rises as structural barriers crumble, strategies converge and human capital becomes key
  - collective learning, ability to co-ordinate diverse production skills and integrate multiple streams of technology
  - most important features: 1) invisible to competitors; 2) difficult to imitate
  - rooted in technical subsystem of the organization
  - needed to identify new opportunities and surprise/out-maneuver competitors
- closely linked to concept of core competences:
  - **core skills** = critical capabilities an organization has that bridge strategy and implementation
  - **technical subsystems** = core technologies that transform inputs into outputs
- distinct from core competences:
  - **distinctive capabilities**: innovation, architecture, reputation, strategic assets are imitable, however, are needed to exploit/lever core competences

Isolating core competences → Figure 1 (p.71)

- start with revenue stream → main products → core products → core components (technologies, skills, processes, strategic assets) determine core competences from the set of identified core components
  - enables to examines new markets based on core competences / to consider new alliances / to identify areas to divest
  → core competences become inputs into portfolio analysis

Using core competences for profit → Figure 3 (p.73)

- need to draw on capabilities to exploit/leverage core competencies → causal relationship between core competence, shared corporate direction, market leverage and motivated organization
  - success needs all 4 variables to be fulfilled

Market survival strategies → Figure 4 (p.74)

- model of survival and future growth identifies 4 different sources of market strength
  - **core competence** – easiest to sustain, highest competitive advantage, highest profitability
  - **patents** – strong competitive advantage and profits, but leaves some room for competitive responses
  - **new product know-how** – limited number of organizations offering, but still enough to ensure market conditions prevail
  - **price place** – products are vulnerable to profit erosion and customer freckles

Conclusion:

- art of successful competitive advantage depends on ability of companies to leverage from their strength → need to understand where strength really lies – core competencies help to identify this (but is only one of many concepts)
  - core competencies are no substitute for product quality, effective marketing, sound financial management or corporate governance

Core Capabilities and core rigidities: A paradox in managing new product development (Leonard-Barton)

- paper explores interaction between core capabilities and the new product/process development projects (strategy)
- core capabilities = knowledge set that distinguishes and provides a competitive advantage → 4 dimensions:
  o employee knowledge and skills
  o technical systems (embedded knowledge and skills)
  o managerial systems (guide processes of knowledge creation)
  o values and norms (associated with types of embodied and embedded knowledge and with the processes of knowledge creation and control) → at the center of previous 3 dimensions
- core capabilities are institutionalized, they reflect accumulated behaviors and beliefs → unique heritage impedes imitation
- interaction of development projects and core capability differs according to alignment of the 4 dimensions necessary for project completion with the prevalent set of them within the corporation
  o unaligned projects = nontraditional for the organization along several dimensions of the selected core capability
  o all new product development efforts depart somewhat from current capabilities → misalignment is matter of degree

The up side: Capabilities enhance development
- although all 4 dimensions of core capabilities are interrelated, it is best to analyze them separately:
  - skills/knowledge:
    o excellence in the dominant discipline → experts can achieve the impossible because of their knowledge
    o pervasive technical literacy → reservoir of complementary skills and interests outside the projects, composed of technically skilled people helps to shape new products with skilled criticism
  - technical systems → artifacts and documentation left behind allows project members to tap into this embedded knowledge – providing for possible timing advantages and higher accuracy in amount of available data
  - management systems dimension → part of a core capability, when they blend skills (e.g. through educational systems) and/or foster beneficial behaviors (e.g. through incentive systems)
  - values dimension (values assigned to knowledge creation – reinforced through leaders and management practices; affect all development processes alike
    o empowerment of project members → individuals can champion new products; create more potential futures for the corporation
    o high status for the dominant discipline → helps attract, hold and motivate talented people

The down side: Core rigidities inhibit development
- recurring shortfalls in the development process are often traceable to a gap between requirements and core capabilities → for some problems, during the cause of time, core capabilities turn into core rigidities - inappropriate sets of knowledge which create problems → especially problematic for projects that aim at creating new, nontraditional capabilities
  - skills/knowledge → less strength in nondominant disciplines - resources in other areas are limited and knowledge is not attracted
  - technical systems dimension → skills and processes captured in soft- or hardware become easily outdated
  - management systems dimension → project leadership needs to be valued, and also a focus on new,unaligned capabilities must be allowed and encouraged
  - values dimension → certain generic types of corporate cultures encourage innovation more than others; however, also the same values, norms and attitudes that support a core capability can constrain developing new ones:
    o empowerment – empowered employees need to know how far they can go and what is valued, otherwise they may become disappointed or unwilling to take risks → management challenge to channel empowered individual energy towards corporate aims without destroying creativity or loosing people
    o lower status for non-dominant disciplines → if historically undervalued skills are necessary, it is difficult to mobilize those; non-dominant roles on the development team are kept in place through a self-reinforcing cycle of norms, attitudes and skill sets
      ▪ dominant-disciplines tend to isolate themselves – inhibits learning
      ▪ expectations about status of people and roles is self-fulfilling
      ▪ higher expectations and greater credibility for dominant function
      ▪ contributions are only accepted in the language of the dominant function
Interaction of product/process development projects with core rigidities

- severity of paradox depends upon 1) number and 2) types of dimensions comprising a core rigidity
- 4 dimensions vary in ease of change (from easiest to hardest): technical, managerial systems, skills and knowledge, values (as they become less visible and less codified)
- managers handle the paradox by: 1) abandonment; 2) recidivism (return to core capabilities); 3) reorientation; 4) isolation
- projects pave the way or organizational change by highlighting core rigidities and introducing new capabilities – for those to become core capabilities, they have to address all 4 dimensions

Designing and Implementing a Technology strategy (Burgelman et al.)

- technology strategy extends beyond R&D in that it is fed by technological capabilities and results in experience which is fed back into both the capabilities and the strategy it is an evolutionary organizational learning process

Technological competence and capability

- core competence = collective learning in the organization, especially how to coordinate diverse production skills and integrate multiple streams of technologies access to wide variety of markets; significant contribution; difficult to imitate
- capability – comprises the entire value chain

Substance of technology strategy → 4 substantive dimensions

1. competitive strategy stance – business defines role technology should play in creating competitive advantage
   - technology choice requires firm to carefully assess technical as well as market factors and identify an array of targets for technology development
   - technology leadership – relative advantage in the command of a body of technological competencies and capabilities arises out of continuous commitment and unique aspects of the technology strategy
   - technology entry timing first-mover advantages / disadvantages need to be considered; think of appropriability regimes, control of specialized assets
   - technology licensing: decide whether to bring technologies to the market yourself, or if others have a better position

2. value chain stance – competencies and capabilities-based view view technology strategy in light of all value chain activities
   - scope of technology strategy those technologies developed internally are core technologies, the more you have the less vulnerable you are, however limited by resource constraints

3. resource commitment stance – intensity of the firm’s resource commitment to technology drives depth of technology strategy – the more resources are spend on R&D, the more technological options and thus flexibility the firm has

4. management stance – choice of a management approach and organization design that are consistent with the stances taken on other substantive dimensions (organizational fit)

Evolutionary forces shaping technology strategy

- the variation-selection-retention structure of evolutionary theory also has some power to identify and elucidate interesting phenomena concerning technological evolution (see framework in exhibit 2, p 39)
- evolutionary forces shape technology along:
  - internal and external generative forces strategy action & technology evolution
  - internal and external integrative (or selective) forces organizational context & industry context
- technology evolution – technology strategy is rooted in the evolution of its technical capability, however, the dynamics of these capabilities are not completely endogenous (e.g. S-shaped pattern in technology introduction)
- industry context – e.g. industry structure, appropriability regime, complementary assets, dominant designs external selection pressures
- **strategic action** – strategy captures experiences, thus strategic action is to a large extent induced by the prevailing conception of strategy in the corporation – see strategic intent
- **organizational context** – organizational context allows firms, to some extent, to substitute internal selection for external selection

**Experience through enactment of technology strategy**

- Experience is viewed in terms of performing the different tasks involved in carrying out the strategy → provides feedback concerning the quantity and quality of the firm’s technical competencies and capabilities and the effectiveness of its strategy
- **technology strategy is realized in practice through the enactment of several key tasks:**
  - **technology sourcing** – both internal and external → are both closely linked, as internal sourcing (R&D capability) determines the firm’s absorptive capacity (ability to recognize value of new, external information, assimilation and successful application)
  - **deploying technology in product and process development** → most firms lack a development strategy framework to consistently integrate technology strategy with product-market strategy
  - **technical support** – interface between firm’s technical function and the users of its products or services

**Enactment reveals the substance of technology strategy**

→ see framework on page 45

→ reread and summarize last paragraph and conclusion
The illegitimacy of successful product innovation in established firms (Dougherty, D., Hellter T.)

- focus on problem that large firms seemingly have problems in innovativeness
- develop a theory integrating the views that 1) old firms are rigid (have too much inertia for innovation) and 2) difficulties are not inherent but reflect a lack of know-how or inappropriate organization → combine bureaucratic inertia with possibility to change (focus is on day-to-day practices)
- use an institutional approach – behavior is constrained by legitimacy

→ necessary activities of products innovation do not fit into institutionalized practices in large, old firms – either activities violate existing system of thought and action or fall into a vacuum where no shared understandings exist to make them meaningful

Conceptual background

- innovation needs 3 sets of linkages (constituent activities):
  - market and technological possibilities need to be linked (creative process)
  - expertise of different functions within the firm needs to be linked
  - product needs to be linked with firm’s strategy, (structure) and resources

Institutional concepts and product innovation in large firms

- organizations with long history of stability depend on institutionalized practices – supports high volume production of standard products → taken-for-granted
- innovation does not fit into institutionalized thoughts and actions → violate practice or new ways of thinking → are illegitimate
- institutions, however, do adapt over time – but this is not simply done through adding skills or altering structure, but the linkage activities need to be woven into the established practices – they need to be legitimated → 3 modes:
  - usual: new activities are made to conform with existing institutionalized practices (are adopted readily if they seem familiar) → innovation through incremental expansion of legitimate practices
  - ceremonially: associate an innovation with a legitimate practice, but continue to behave in the old way (provides external legitimation, but does not alter innovators’ day-to-day practices) → simple display of legitimacy is enough for innovation
  - reframe: use legitimate practices to reframe new activities – make people change their viewpoint by linking innovation to practices in metaphorical ways

Research

- collected qualitative data on 2 dimensions: 1) degree of innovativeness (unfamiliarity in 5 areas: applications, market segments, distribution, product technology, manufacturing); 2) status of the project (success – failure)

Research – How are the 3 linkage activities illegitimate → found 8 dimensions for the 3 linkages:

- market-technology linking (question of who should develop): institutionalized practices in the firms keep innovators from engaging in …
  - a creative design process (1)
  - evaluating their product effectively (2)
- interdepartmental linking (question of how to develop – human resources is always a problem): institutionalized practices in the firms keep innovators from engaging in …
  - overcoming departmental barriers (breach functional barriers) (3)
  - understanding different perspectives (4)
  - maintaining team commitment (people need to be assigned in timely fashion) (5)
- product-to-firm linking: institutionalized practices in the firms keep innovators from fitting the product …
  - into the structure (authority, decision making, communication flows → problem to tap into resources) (6)
  - into the strategy (does the product fit into the company) (7)
  - into the climate (e.g. risk-averse climate) (8)
number of illegitimacy problems is not dependent on the status of the product; however, number of illegitimacies is dependent on degree of innovativeness for at least 4 (1,2,6,7)

Research – Which of the three modes of legitimation enables product innovation
- how were the illegitimacies solved successfully – according to the 3 modes:
  o usual – solutions followed usual practices (linking problem is addressed)
  o ceremonial – solutions relied on practices that were legitimate in the larger environment, but innovators did not actually use the practices to carry out the linkage activities (e.g. champions, project management)
  o reframed – solutions used legitimate practices or understandings as metaphors to alter how people think about particular linkage activity

findings:
- solving problems with illegitimacy is associated with success
- successful innovators solved most illegitimacy problems through reframing (but reframing is not enough to assure success – reframing was also associated with failed innovations)

Discussion
- there are 8 different ways institutionalized practices impede product innovation
- reframing is associated with the more successful innovation efforts – people need to connect the various principles for innovation to their day-to-day practices (but open whether micro level refraingings are enough)

Engines of Progress: Designing and running entrepreneurial vehicles in established companies (Kanter et al.)
- aim is to show that the perceived paradox of generating and sustaining entrepreneurship in established companies (how to routinize and manage a spontaneous and opportunistic process) can be solved with the example of the Raytheon’s New Product Center (NPC)
  o fight between newstream activities and organizational mainstream
  o problem: design a mechanism that reliably and continuously produces newstreams
  o newstream program = attempt to bureaucratize entrepreneurship (introduce routines and controls to capture benefit without loosing essence)
  o major organizational issue is the integration of the creative processes into the organizational mainstream, however creativity is not necessarily innovation, but cross-functional stimulus is also needed
  o deadline provision is one of the simplest ways to manage creativity
- NPC demonstrates how newstream development efforts can be effectively linked to, and contribute to the revitalization of mainstream businesses → major success factors: 1) modest expectations; 2) only dealing with development, not commercialization

Raytheon’s NPC
- NPC is applied research group → started in supporting a single business – this single sponsor allowed to build up a track record that then enabled it to gain widespread acceptance and support → multiple sponsors make innovation efforts more likely to be sustained
- purposely kept small → did not create resistance in R&D departments of corporate divisions + allowed constant interaction and exchange among all members
- focus: clear delineation of development and production
- director → allocate resources and focus attention
- staffing: important is picking the right people with great communication skills
- working: left with freedom to work on multiple projects as wished, deadlines introduce reliability
- ideas come from 3 sources: 1) requests from client; 2) general requests for technical help; 3) internally generated
  o ideas not used in Raytheon were licensed out
  o separate status of NPC allowed for technology transfer
- at all times client is involved to check for 1) market; and 2) producability (price)
- factors fostering success (NPC’s view): 1) receiving mainstream champion is needed; 2) client should be involved at early stage; 3) product should become tangible as early as possible; 4) product must be priced
right; 5) client should believe they did the invention; 6) beware of client’s design engineers → balance thinkers and doers

- most important success factor was close link with mainstream → successful corporate entrepreneurship derives from stressing the coordination even more than the independence

**How new products centers should operate:**

- **goal:** aid the company’s growth and profit
- **ingredients:** needs right people and right environment → creative engineers whose talents for invention are reinforced by an atmosphere designed for that purpose (both generalists and specialists needed as links for transferring the product)
- **relationships with clients:** effective channels of communication needed + sound understanding of all elements of client’s business + trust

**Sustained product innovation in large mature organizations:**

**Overcoming innovation-to-organization problems (Dougherty & Heller)**

- product innovation is important to adapt to changes in markets, technology and competition
- academic work has identified ideal organization type to support innovation in terms of configuration, culture, strategy and leadership
- **sustained product innovation** = generation of multiple new products as strategically necessity over time with reasonable success rate
- **new product** – either new in terms of customers, or product or process technologies
- research seeks to **find barriers that noninnovative firms must deal with to become innovative** – concentration on 1) sustained product innovation, 2) organizations with stable, noninnovative practices

**Innovation problems**

- mature organizations often privilege existing businesses over new products, avoid uncertainty in favor of the tied and true, and emphasize control over flexibility and creativity
- **routine operations, and inertia** of current practice restrain creativity
- 2 levels of problems:
  - **project level** (e.g. positioning the product strategically in the market, developing production, marketing and sales, securing expertise, managing external relations, understanding new markets…) → problems concern issues that could be resolved within or by a product team
  - **organizational level** (innovation-to-organization connection) – required for sustained innovation, changes are made through multiple time solving problems at the project level at different levels → problems concern reaching across major organizational boundaries

**3 key areas where innovation-to-organization connections need to be made**

- **resource availability** for new products
  - major problem: prevailing practice supports established activities
- **collaborative structures and processes** → to solve problems creatively and connect to existing business
  - major problems: 1) organizational routines limit interfunctional interaction and thus development of customer understanding; 2) reward system punishes for stepping outside established work roles
- **strategic value and meaning** – incorporate innovation as a meaningful component of the organization’s strategy
  - ideal: strategy explicitly values innovation, openly welcomes initiative and clearly rewards resolution of problems
  - when not available, process (collaborative structure) and resources can also not be aligned

**Analysis – Results**

- in all types of innovation roughly same number of problems → proportion of problems solved indicates more effective innovation
- successful innovators solved more problems at project level, not more at organizational level (but only due to individuals, not the structure) → innovations occurred in spite of organizations, not because of them → thus are not sustainable

- 3 main findings from data analysis → successful innovation only one-time events carried by individuals
  o success depended on the efforts of particular individuals to use their organizational positions – are able to link resources, establish collaborative processes, but connections made are fragile and vulnerable
  o innovators had limited access to resources, limited structures and processes to work with and faced tenuous strategic connections for innovation → innovation was unseen
  o strategic support from senior management was nonexistent or only temporary

- the 3 areas:
  o resources → champions with long background have often necessary networks to move innovations, but even they have not enough power to shift entire systems to solve project-to-organization resource problems
  o collaborative structures and processes → generally knowledge of how to collaborate laterally and vertically was missing (not part of the day-to-day work)
  o strategic value and meaning → an anti-innovative climate generally prevailed – innovation was not valued and thus activities not legitimate or part of the responsibilities (if strategic attention span is shorter than development time of average innovation, organization does not value innovation)

Discussion
- those projects that succeeded walled themselves off from the anti-innovation configuration of the rest of the organization → creative bubbles, but those are vulnerable
- when product innovation did occur, it did so in spite of organizational systems and only because of the unstinting efforts of individuals (operational or middle level) through their established networks connections and experiences → but this did not solve innovation-to-organization problems and is vulnerable
- for large, mature organizations to be innovative and develop new products continuously and weaving them into ongoing functioning an organization-wide power basis is needed – they have to change
- power of the meaning supporting innovation is crucial → if senior managers focus on managing the meaning of innovation and make concomitant changes in processes and resources, it is possible to create sustained innovation
The product family and the dynamics of core capability (Meyer, M.H., Utterback, J.M.)

- to be successful firms need the right mix of 1) capabilities in implementation, 2) manufacturing, 3) distribution and 4) product design
- single product efforts have 2 problems: 1) redundancy of technical and marketing effort; 2) lack of long-term consistency and focus → firms have to focus on product families
- product family – foundation for a range of individual product variations; all products that share a common platform, but have specific features and functionality required by different sets of customers
  o a product family addresses a market segment
  o an individual product within a family targets a niche within the segment
  o design groups → create basic designs, standard components and norms for subsystem integration
  o implementation teams → create different product models, integrating component technologies to achieve specific product goals
- integration – renewing existing product family through integrating the best components in new structures
- diversification – building on and extending capabilities to build the foundation of new, but related products
- product families and their successive platforms are applied result of firm’s underlying core capabilities

Mapping Product Families

- individual products are the offspring of product platforms that are enhanced over time; product families and their successive platforms themselves are the applied result of a firm’s underlying core capabilities – in well-managed firms such core capabilities tend to be of much longer duration and broader scope
- product family can be used as a basis for assessing the dynamics of a firm’s core capabilities → steps:
  1. map the chronology of a product family (using a hierarchical structure encompassing the family itself, platforms within a family, product extensions and specific products) → conveys sense of continuity or the lack thereof
  2. assessing core capability: find the specific core capabilities in the four generic capabilities – product technology, market understanding, distribution, manufacturing
- measure each capability in relation to competitors

Core capabilities and performance

- higher levels of core capability are associated with sustained success; however the higher levels of core capabilities precede the higher levels of performance
- market dynamics temper the relationship between core capability and performance

Using core capability assessment to improve a product family

- companies must continue to invest in renewing product platforms – especially in markets with accelerating rates of product introduction and competitive intensity
- investment efforts should be directed at the product family – if they are at single products the necessary leverage is missing

Explaining the ebb and flow of core capabilities → 4 fundamental inhibitors of core capability creation:

- lack of patience: using an unrealistic, short time horizon
- failure to adopt innovations and new architecture: technological discontinuities can trap companies in their earlier successes → planned renewal and sustained development of core capabilities needed as defense
  o high levels of planning and development must also be coupled with high levels of modularity in designs and emphasis on layering technologies within an overall product architecture
- coasting on success: strategic focus and aggressive reinvestment are essential to rapidly changing markets with high levels of technological change (portfolio management kills success)
- breaking up design teams: try to at least keep the heart of the design team together

Managing toward a better future

- argue that a product family requires a multidimensional core – not only a common technology and design heritage
- the product family idea needs: 1) product family planning over several generations; 2) budgeting targeted to multiyear planning for related products
Knowledge, integration and the locus of learning (Pisano, G.P.)

- paper links the 2 approaches of innovation “learning-before-doing” and “learning-by-doing” to the structure of the underlying knowledge, using the process development approaches in the chemical and biotechnical industries as objects of study → there is no best way to learn, but different approaches may be required in different knowledge environments

- proposition that competitive advantage stems from firm-specific skills and capabilities has made learning the focal point of concern
- if organizational capabilities are embedded in routines – implementing and replicating such routines must be a central facet of organizational learning
- organizational learning is a problem-solving process triggered by gaps between actual and potential performance
- 2 strategies for learning:
  - learning-by-doing: used mainly when prior knowledge is weak, high-fidelity feedback requires experiments in the actual production environment – innovation process is iterative
  - learning-before-doing: used when reliable theoretical models and heuristics exist, laboratory experiments, simulation and other forms can be productively harnessed

Process development as a learning process

- starting point is the description of the product, or a product design and a set of functional specifications as targets
- output of process development is an organizational routine for commercial production → technical specifications and standard operating procedures and instructions
- integration across functional boundaries plays a critical role
- performance is affected by interactions between technical choices and actual operating conditions and capabilities → whether or not laboratory tests are feasible depends on how far the test conditions can be made to represent the actual operating conditions; if it is highly possible, costly learning-by-doing can be avoided
- the knowledge necessary for actually predicting performance under actual operating conditions is embedded in formal or informal models containing the relevant underlying variables, their interaction and impact on outcomes
  → when underlying basic knowledge is strong, laboratory experiments provide a reasonably accurate prediction of the outcomes and thus learning-before-doing is feasible and can smooth the actual implementation process.

Outcomes of study of chemical and biotechnology firms

- biotechnology firms (which have a weaker technology background) spend more time on learning-by-doing than on learning-before doing → the more time they spend on the process research part – opposed to pilot development and commercial start-up – the longer their total process development efforts took

Conclusions

- qualitatively different types of organizational competencies are required to exploit different types of knowledge bases → the locus of strategically valuable resources and competencies may vary accordingly

Competence-based diversification (Chiesa, V., Manzini, R.)

- process of diversification has been analyzed from 2 main viewpoints: 1) external focusing on markets, products, clients, areas served; 2) internal perspective focusing on specific factors within the firm affecting the process of diversification
- authors propose a framework for interpreting the diversification process from an internal perspective

Theoretical base → 3 levels of competences:

- system view capability – capability to foresee the evolution of the firm’s context and thee capability to view the firm as a coordinated and integrated set of resources (objectives, organization, guidelines for procedures, culture and values)
- **distinctive capabilities** – repeatable patterns of action that allow the coordinated and integrated deployment of the firm’s knowledge and resources (organizational routines)
- **capacity to embody the distinctive capabilities into core outputs**

**Internal determinants and sources of diversification**

- **system view capability** – allows to identify opportunities for diversification + are resource new products may share with existing ones
  - Management determines the why (strategy), where (link to capabilities possessed), what (which critical resources and capabilities) and how (guidelines for shaping the organizational structure) of diversification
  - Managerial resources might be shared and be the actual source of synergies, however if the “fit” does not exist the diversification might have negative impacts
- **distinctive capabilities** – possibility to exploit the distinctive capabilities of the firm through transferring and/or replicating the organizational routines
  - Most authors focused on exploitation of intangible resources, not routines – resource-based (broaden exploitation), competence-based (exploit distinctive competencies) and evolutionary theorists (tacit skills needs to be reinforced through continuous application) – stretch and leverage resources
- **capacity to embody distinctive capabilities in core outputs** – opportunity to exploit the core outputs of the firm for different products/services
  → in the author’s view, a deeper understanding of how diversification relates to the use or change of a firm’s organizational routines is needed

**Diversification Trajectories**

- Authors state that **diversification patterns can be classified along 2 dimensions: 1) resources and 2) routines**
  - **routine-based diversification** (new resources, existing routines)
  - **resource-based diversification** (existing resources, new routines)
  - **unrelated diversification** (new resources, new routines) – most common way
  - **replication-based diversification** (existing resources, existing routines) – safest, but least common way
- **trends in diversification** – in a dynamic view, real patterns of diversification probably follow complex trajectories, consisting of a combination of various single processes of diversification

**Conclusion**

- Frameworks puts in relation the **path of diversification with the internal forces** which guide and constrain the process of diversification; each step has concrete and relevant implications for the firm’s organization and resources
- Competence-based competition literature emphasizes that **success in dynamic competitive contexts depends on continuity and coherence** – framework allows to monitor this
- Use of the model is 2-fold: 1) used for internal analysis – what changes are required by a particular innovation; 2) retrospective analysis – analyzing reasons for success or failure
Central problems in the management of innovation (Van de Ven, A.H.)

- innovation is the most central concern to management, however, the encompassing problems confronting general managers in managing innovation have been largely overlooked
- process of innovation = development and implementation of new ideas by people, who over time engage in transactions with others within an institutional context
  - 4 factors that facilitate and inhibit the development of innovations: 1) ideas, 2) people, 3) transactions, 4) context
  - 4 central problems in management of innovation: 1) process problem of managing ideas into good currency; 2) human problem of managing attention; 3) structural problem of managing part-whole relationships; 4) strategic problem of institutional leadership

Innovative ideas

- as long as an idea is perceived as new to the people involved, it is an innovation → most have components from 2 directions: 1) technical (new technologies, products, services); 2) administrative (new procedures, policies, organizational forms)
- usefulness of an idea can only be determined after the innovation process is completed and implemented → 1) how and why are certain ideas successful (earn good currency); 2) how and why people pay attention to only certain new ideas

The management of ideas (process problem of managing ideas into good currency)

- people become attached to ideas over time through a social-political process of pushing and riding their ideas into good currency
- managing the life-cycle of ideas into good currency (developed for legislative bodies, but also similar to project management): threatening, disruptive event → solutions surface → networks galvanize → political debate → legitimation → institutionalization → demise if they fail to address problem or the regime holding them steps down
- social-political dynamics → ideas are central as the rallying point around which collective action mobilizes and organizational structures emerge and are modified
- however, some basic limitation to the process exist that lead to inertia and premature abandonment of some ideas: 1) short-term problem orientation; 2) inventory of ideas is seldom adequate for the situation; 3) management of attention – how to trigger action

The management of attention (human problem of managing attention)

- realistic view of innovation should begin with an appreciation of the physiological limitations of human beings to pay attention to nonroutine issues and their corresponding inertial forces in organizational life
- physiological limitations – limited capacity to handle complexity and maintain attention:
  - in complex situations, individuals create stereotypes as a defense mechanism – they become conservative and apply more subjective criteria removed from reality → decision error prone, means become more important than ends
  - as correctness of outcomes form innovative ideas cannot be judged, perceived legitimacy of decision process becomes dominant evaluation criterion
  - dissatisfaction with conditions triggers search for improvement, however individuals unconsciously adapt slowly to changing environments → often thresholds for actions are often not triggered (statistics also do not help – false expectation that someone else will take care)
  - if triggering threshold is reached, action is likely to be driven by crisis – solutions are likely to be mistakes
- group and organizational limitations: conformity pressures (group think – due to strive for consensus and out-group conflict stimulating in-group consensus), inertia and incompatible preferences
  - the older, larger, more successful, the more likely that structures and systems discourage innovation (routine focus)
- ways to manage attention:
  - focus not only on customers, but the most demanding ones → source for innovation
  - direct personal confrontations with problem sources are needed to reach the threshold of concern and motivate people to act; however this creates stress → vigilance needed for sound decision making – requires sufficient time and slack resources
  - double loop learning – monitoring becomes input not only to action but also the criteria of evaluation itself – practices are called into question → changes in strategy are possible
  - management of attention must be concerned not only with triggering action thresholds, but also of channeling action toward constructive ends
The management of part-whole relationships (structural problem)

- **innovation is not an individual activity** – it’s a collective achievement → differing perceptions and frames of reference (proliferation of people); amplified by the proliferation of transactions or relationships among people and organizational units
- **transactions** (exchanges which tie people together – negotiation, agreement, administration) are micro elements of macro organizational arrangements
- prevailing approach to handle the complexity and interdependence → specialization in parts to recreate the whole (whole is greater than sum of parts), however, many problems lead to sum of parts smaller than whole: lack of communication, misunderstanding, delay and errors… → impeccable micro-logic often creates macro nonsense and vice versa
- **solution is concept of a hologram** – managing complexity by placing the essential elements of the whole into each part → integrate all essential functions, also solves the problem of whether innovations should be technology or customer driven → 4 interrelated design principles of holographic organization:
  - **self-organizing units** – autonomous group should develop an innovation
  - **redundant functions** – allows flexibility and for capacity for self-organization; needed for interdependent action and knowledge of the blueprint of the overall innovation is essential for survival and reproduction of the innovation effort
  - **requisite variety** – learning is enhanced by having the complexity of the environment built into the organizational unit
  - **temporal linkage** – capacity to burry past to create new opportunities needed

Institutional leadership and innovation context (strategic problem)

- innovation is a network-building effort that centers on the creation, adoption and sustained implementation of a set of ideas among people who, through transactions, become sufficiently committed to these ideas to transform them into good currency
- creating **intra- and extra-organizational infrastructures in which innovation can flourish** is the strategic problem of innovation → **institutional leadership**
  - **external**: collective action is needed in the long run to create a social, economic and political infrastructure to sustain members of a community
  - **internal**: critical is creating a cultural context that fosters innovation and an organizational strategy, structure and systems that facilitate it → supportive leadership needed; for an institution – infusion of value is needed
- **4 key functions of institutional leadership**: 1) mission; 2) purpose in structure and systems; 3) defending institution’s integrity; 4) ordering internal conflict
- transforming innovative ideas into a set of guiding ideals has institutional and technical processes (see figure 3, p.117)
- distinction between institutional and technical processes → 3 signification implications for addressing problems of managing attention, ideas and part-whole relations (cybernetic principles):
  - **principle of negative feedback** – clear set of values and standards are needed which define the critical limits within which organizational innovations and operations are to be maintained
  - **experimentation-and-selection approach** – needed so that organization develops a capacity for double-loop learning
  - **preserving uncertainty and diversity of the environment within the organization** – required to trigger innovation

Entrepreneurs, champions and technological innovation (Maidique)

- successful radical innovation requires a special combination of entrepreneurial, managerial and technological roles within the firm – as the firm grows and changes, these roles also change and tend to be performed by different people in different ways
- article combines theory of entrepreneurial roles and Scott’s theory of corporate development
- the critical roles of business definition, sponsorship, technical definition and technical communication are decoupled as the business growth, however, need to be formed into a network for radical innovations
- 3 principle arguments:
  - **entrepreneurial role is essential for radical technological innovation**, but manifests itself differently depending on the firm’s stage of development
  - radical technological innovation, to be successful, requires top management participation in the entrepreneurial network
in addition to the independent entrepreneur and the product champion, there is an important intermediate entrepreneurial role, especially prominent in diversified firms – the executive champion.

Entrepreneurship and corporate development

Entrepreneurs and champions

- **champions are needed** → 4 conclusions: 1) new ideas encounter sharp resistance; 2) overcoming that requires vigorous promotion; 3) proponents of new ideas work through informal organization; 4) one person emerges as champion of the idea

- SAPPHO study → 5 areas of difference between successful and unsuccessful innovators → 4 categories of key individuals

  - **Areas of difference:** 1) strength of management; 2) marketing performance; 3) understanding of user needs; 4) R&D efficiency of development; 5) communications

  - **Categories of key individuals:** 1) technical innovator; 2) business innovator – responsible for overall progress of the project (most important); 3) product champion (also decisive); 4) chief executive (power and status, besides commitment and enthusiasm also play an important role)

  → technical innovator provides technical definition, the business innovator provides sponsorship or impetus and the chief executive provides business definition or context (Bower’s model of the resource allocation process) → role of the product champion is to serve as a catalyst for increased sponsorship or impetus

Stages of development of the firm

- **Chandler** – 3 basic stages: small, integrated, diversified (divided into dominant business firms, related business firms and unrelated business firms)

  - development of the production process (Abernathy & Utterback) is composed of 2 parts, product and process innovation – at the beginning it is fluid, the product innovation is the driving force, when a dominant design emerges, process innovation becomes dominant, but by time the entire process becomes specific → also impact on managerial relations (but not explored)

3 major corporate evolution contexts and entrepreneurial roles

The small technological firm

- **technological entrepreneur** – defines business + sponsor and definition agent → CEO’s power and vision are in immediate contact with both technical experts and customers

The integrated firm

- what entrepreneur has created passes beyond his scope of authority and technological ability

- **top management has role of sponsor** – role has evolved from technical definition to sponsorship; still possible because of the single line of technology is graspable by them – directly deal with product champions for radical innovations

- **middle managers act as integrators between technical specialists and top management (product champions)**, however, this adds a conservative bias to proposals and innovations become more incremental than radical – **top management has to get in direct contact**

The diversified firm

- if focused on a dominant business, not different from the integrated firm

- if diversification enters fields with which the dominant entrepreneur is not intimately familiar, the process changes → new kind of champion emerges, bridging gap between entrepreneur and technological champion: executive champions

- executive champion = more senior in the managerial structure than the technological champion, but also has limits to his/her responsibility – must important function is to get top level attention that is needed for radical innovations

Conclusion

- general trend of a growing company is towards more rigidity, automation and bureaucracy → usually major innovations originate outside the existing industry, but some firms can revolutionize themselves from within through entrepreneurial sponsorship
- **Successful entrepreneurial sponsorship for radical innovation is top management tasks** – they must attack the problem of change and create an environment suitable for champions.
- For the most radical changes, the top manager must be involved in the entrepreneurial network that lead to it, for that only he can make decisions providing the necessary resources and absorbing the risks.

**Designing and managing systems for corporate innovation**

*(Burgelman et al.)*

- How does a firm’s innovative activities reflect its technology strategy, how it serves to further develop innovative capability → technology strategy is enacted through a sequence of tasks which serves to augment the firm’s existing technological competences and to build new ones.

**Innovation challenges in established firms**

- Innovation challenges derive from the evolutionary process model of the firm → 1) *induced strategic action* – in light of structure and strategy and familiar external environment; 2) *autonomous strategic action* – outside scope of current corporate strategy, guided by strategic recognition capability of management.

- *Induced process* → *incremental or architectural innovations* – important for the short to medium term.
- *Autonomous process* → *radical innovations* – unexpected, not necessarily large – important for long-term survival and development (e.g. to sustain growth).

→ Both processes need to be balanced, but difficult as they require different management approaches.

**Strategic management of corporate research**

- *Corporate research* → long-range, high-risk, exploratory research → subtle and complex strategic management.

- *Functions of corporate research* (helps meet requirements of induced and autonomous strategic processes):
  - Support of existing businesses (induced process).
  - New strategic directions (autonomous process) – key contribution; not only results in directly applicable findings, but also increases *absorptive capacity*.

- Problematic is however to transfer the technology from research to development.

- *Managing key interfaces*:
  - *Corporate research* – divisional R&D interface (induced process) → difficult because of the differing orientations and expectation (short term versus long term, science versus technical problem solving).
  - Careful use of administrative, geographical and personal linkages is important (last has greatest impact on quality of collaboration).

- *Corporate research* – business research interface (autonomous process) → difficult because of the differing orientations in work environment (scientific & codified versus ad hoc), professional orientation (serendipity vs. planning), quality of personnel (deep focus vs. broad focus) and conflicting personal interests (becoming a venture manager).

  - *Business research* = developing new areas of business based on corporate research by linking new technological solutions to market needs and obtaining additional resources to create a commercially viable business.

- *Linking corporate research to corporate development strategy*:
  - Clear charter for corporate research is necessary + management must ensure that corporate research supports corporate development strategy.

  - *Assessing technological opportunity* → difficult because of the fundamental uncertainty of new technologies (usefulness cannot be immediately appreciated, impact often depends on complementary innovations, difficult to conceptualize new systems, unanticipated uses, effectiveness in linking to human needs) → qualitative judgment.

  - *Role of different levels of corporate research management*: 1) technicians, 2) bench scientists, 3) group leaders, 4) R&D managers, 5) director of corporate R&D → *group leaders are a crucial element, as they have both deep insight into technology and are sufficiently familiar with and networked in the corporate environment to act as product champion*.

  - Allocating resources to corporate research – both scientific and financial scrutiny needed (one by research, the other by business management).

**Managing corporate entrepreneurship**
- technology-based internal entrepreneurial activity often emerges spontaneously → difficulty is how to deal with it – but as it explores the boundaries of the firm’s set of core and distinctive competencies it’s a vital part of the strategic process

- one way used by management to take advantage of the autonomous strategic initiatives has been the creation of a separate new venture division (NVD) with the prospect of becoming a new business unit → however 2 serious problems involved:
  - NVD-operating division interface problems → conflicts of strategic interests (e.g. domain protection, synergy considerations) and administrative frictions (e.g. personnel transfer issues)
  - NVD-corporate management interface problems → strategic interface problems (e.g. lack of diversification strategy, limits to rate of strategic change, corporate image); administrative frictions (e.g. inadequate measurement and reward systems, resistance to institutionalization)

→ Framework needed to assess entrepreneurial initiatives and to come to conclusion on a variety of organization design alternatives – 2 key dimensions:
  - assessing strategic importance – consider implications of initiative for the firms product market position (top management is not in the position and depends on middle-level managers who champion autonomous initiatives based on their own assessments) – needs to be based on specific, substantive factors
    - determining administrative linkages → the more important, the closer has to be the administrative link
  - assessing operational relatedness – degree to which an entrepreneurial initiative requires competencies and capabilities that differ from the available ones (again middle-management needed)
    - determining operational linkages → the more related, the more efficiency linkages are between new and existing business, the closer has to be the organizational link (aim is to minimize transaction costs)

- choosing design alternatives (list is not exhaustive): (operational linkages; strategic importance)
  - direct integration (strongly related, very important) → strong administrative and operational linkages – resistance must be anticipated; champions are important
  - new product department (partly related, very important)
  - special business units (unrelated, very important) → administrative linkage needed to ensure attainment of explicit strategic objectives
  - micro new venture department (strongly related, uncertain) → peripheral projects that are likely to emerge in operating divisions on a rather continuous basis – loose administrative linkage, but strong operational linkage
  - new venture division (partly related, uncertain) – high quality middle-management needed; long-term focus
  - independent business units (unrelated, uncertain) – risk sharing not uncommon
  - nurturing and contracting (strongly related, not important) – typically address market niches that are too small – top management may want to help entrepreneurs spin off – creates relationship and occupies niche for competitors
  - contracting (partly related, not important)
  - complete spin-off (unrelated, not important)

- implementing design alternatives → 3 major issues must be considered:
  - framework should be used to clarify the community of interests and interdependencies
  - management must establish measurement and reward systems in line with the different designs
  - new information may modify the perceived strategic importance and operational relatedness over time

- internal entrepreneurs must also be handled with care not to repress innovation or make them leave the company

Conclusion

- internal, like external, entrepreneurs enact new opportunities and change the resource allocation pattern of the firm – to facilitate and manage this process better new organization designs are necessary
- large established corporations fulfill an important function with ability to fund corporate research to provide a substratum of discovery and invention that feeds the innovation process → if seen in light of the many failures of small company innovation also not more expensive
When is virtual virtuous? – Organizing for innovation (Chesbrough & Teece)

- virtual organizations have become popular, however authors argue that it is more a hype and that the distinctive role that large integrated companies can play in the innovation process should not be underestimated.

What’s special about virtual?

- **advantages of virtual organizations**: 1) incentives – power of market forces enables quick access to technical resources and highly trained and motivated people; 2) responsiveness – flexibility is increased
- however, while the incentives to take risks increase when going from integrated corporation to the extreme of the virtual corporation, the reverse is true for the ability to settle conflicts and coordinate activities (control), as so much personal reward is at stake.
- challenge for managers is to choose the organizational form that best matches the type of innovation they are pursuing.

Types of innovation

- **autonomous innovations**: can be pursued independently from other innovations – decentralized virtual organization can manage development and commercialization
- **systemic innovation**: benefits can be realized only in conjunction with related complementary innovations – integrated corporation has advantage, as in virtual organization members would be dependent on others over whom they have no control.
- **appropriateness of the different organizational forms is based on information flow essential to the innovation**:
  - o information needed to integrate an autonomous innovation with existing technologies is usually well understood and may be codified in industrial standards
  - o systemic innovations, however, require sharing and coordinated adjustment throughout an entire product system – arm’s length contracts lack sufficient coordination – thus in most cases the open exchange needed will be easier and safer within a company than across company boundaries.

Case of industry standards

- coordinating systemic innovations is particular difficult when an industry standard does not exist and must be pioneered – by virtue of size and scope an integrated company may be able to advance a standard simply by choice to adopt a particular technology (consumers and smaller companies will follow if network externalities are strong enough)
- once a standard has been established, virtual organizations can manage incremental innovations quite well
  - When innovation depends on a series of interdependent innovations, it is systemic, independent companies will not usually be able to coordinate themselves to knot those innovations together – scale, integration and market leadership may be required.

The virtuous virtuals

- those virtual companies that succeeded are at the center of networks and hold and extend core competencies internally; additionally they are often large enough not to be vulnerable to hold-up strategies and to drive and coordinate systemic innovation
- **hollow company is endangered in the long run**, as otherwise in the long-run the rewards will go to other players in the network that invested in long-term R&D, or simply through hold-up strategies.

Choosing the right organizational design

- few companies can afford to develop all potentially advantage giving technologies internally – mixed approach to purchasing and developing internally
- **balance should be assessed** by 1) type of innovation; 2) current capabilities in- and external; 3) ability and need to influence the direction of technology; 4) need to be able to pace technology… critical parts to the value-chain must be developed internally, less critical, short-term oriented technologies can be acquired through alliances or the market.
→ history has shown that winners are those companies that make major internal investments to shape markets, rather than those that relied on others to lead the way – since so many important innovations are systemic, decentralization without strategic leverage and coordination is the wrong organizational strategy

**Learning form the Market (Leonard-Barton, D.)**

- growth and nurturing of core technological capabilities require constant fertilizing by streams of information – most important is the knowledge flowing in from the market, as it shapes science into the commercial product/service
- understanding user needs is a key factor leading to commercialization success → What sources and channels can be developed to feed market information into new-product development projects? – emphasis is on importing knowledge from market under conditions of considerable uncertainty and using nontraditional techniques → more art than science, also avoids some hazard associated with listening

**New-Product Definition Situations**

- new-product definition situations are shaped by 2 basic factors:
  - **maturity of technology design within a firm**: products follow a kind of life cycle, at first, when they are new to the world, focus is on technical feasibility, redesigns then emerge with increasing frequency as one moves down the axis toward mature designs and changes become more cosmetic than functional
  - competition influences movement up the vertical axis, but pressures of internal org. routines and current customer sets push developers down toward incremental improvements
  - dominant designs also shifts designs to maturity, however, eventually they are also challenged (current capabilities are rigidities)
  - **alignment of product line with current customer base** (market alignment): focus on current customers helps generating current profits, but is also a rigidity as the information provided will not always serve the future
  - companies need to move to seek new customers or even new markets as in most cases those will stimulate new technological capabilities, however, the further they go, the more uncertain the environment becomes – have to ask who is actually the customer

- **new-product developments at the extremes** → 5 generic situations
  - **user-driven enhancement** (high maturity, high alignment) – an improved solution to a known need → development is reactive – competition defines meaningful parameters on which to achieve parity or superiority – even w/o extensive market research lower costs, more features, better quality stand to win
  - **developer-driven development** (low maturity, high alignment) – a new solution to a known need; user may not be able to imagine a specific solution to a need, but developers might
  - **user-context development** (medium maturity, medium alignment) – a new solution to an unexpressed need; can only be created when developers immerse themselves in a user environment
  - **new application or combination of technologies** (high maturity, low alignment) – a novel solution to an identified need, however, the technology is mature and well understood, just applied to an entirely different domain
  - **technology/market coevolution** (low maturity, low alignment) – an evolving solution to an uncertain need; technology often run far ahead of customers, but to become a success, technological potential and market need have to coincide in both time and place for the necessary synergy to occur → risky

**Importing Knowledge from the Market**

- different new-product development situations described require different interactions with the market → communication of the product concept and elicitation of user reactions becomes progressively more difficult and potentially more expensive as the commercialization situation departs form market alignment and moves toward market creation
- **market research techniques: inquiry** (province and strength of traditional market research tools) → **user-driven enhancement**
  - **surveys, focus groups and mall studies** - uncover needs and desires about which the informants are aware and can articulate; relative ability to guide product specification is greater when a product category already exists
  - **lead users** – careful choice of customer representatives can look into the future; lead users face needs the general marketplace will encounter only later on and they are positioned to benefit significantly – however, they need to be representative
**IB 3-2**

**Innovation Management**

**Week 4**

- **latent need analysis** – uncover latent and less readily articulated needs

- **market research techniques**: empathic design → developer-driven development, user-context development and new application or combination of technologies – for all 3, no directly analogous product is yet on the market to serve an unarticulated but observable need, but potential users can be identified

- **empathic design** = creation of product or service concepts based on a deep understanding of unarticulated user needs → 3 characteristics that set it apart from market research: 1) based on actual observed customer behavior, 2) design conducted through direct interaction between technological experts and users; 3) tends to draw on existing technological capabilities that are redirected or imaginatively deployed in the service of new products or markets

- **3 major types of empathy-inducing mechanisms:**
  - developer’s “market intuition” → 1) user-developers – holder of technological knowledge is end user at the same time; 2) industry experts – former users or educated employees to represent potential customers; their rich personal knowledge is the foundation for their intuition, however, when they get too deeply involved with the users, they may lose their forward vision; additionally as their expertise is largely tacit and undocumented there is always a tension between need for improving current returns and their long-term focus
  - **market matching**: occurs only if the organization is set up to encourage and reward active searching for new applications of technology → 1) technology transfer – is an unnatural process as divisions create barriers; 2) partnering with customers – variety of customers needed to enable widespread leverage of a base technology in diverse markets
  - **anthropological expeditions**: most unusual, but also promising option to get a deep understanding of the user world is for developers to immerse themselves in the user environment → 1) observing users’ practices – has widest application for empathic design, even for highly or totally unknown markets; 2) capturing practice on film – advantage is that it can be stored and evaluated together with users; 3) role-playing the future – direct observation necessary for actors to play the part of users in the future

- **empathic design techniques are most useful in the process of creating new-product concepts** – however they also need to be tested once identifies → traditional market research – prototypes are essential

- **market research techniques**: creating a new market (neither technologies nor customers are certain) → 3 possibilities:
  - **extrapolation of trends** – foresee movement of maturing societal, technological, environmental, economic, or political trends and what users will eventually want – for some upcoming needs may be obvious, but the timing is often extremely unclear
  - **scenarios of the future** – extrapolate different trends into different directions to create pictures of alternative futures (only directed to provoke possibilities, not to predict with assurance)
  - **market experimentation** – for short-lead-time, inexpensive to manufacture articles, very viable and provides reliable data → firms attempting to create, or at least influence an emerging market can adopt very different experimentation strategies – 3 major categories:
    - 1) Darwinian selection – experiment with multiple models in the market simultaneously; 2) product morphing – use market feedback to incrementally morph toward a commercially viable product; 3) vicarious experimentation – wait and learn from pioneers’ failures

**Using prototypes to coevolve product concept**

- models and prototypes that fall far short of the ultimate product can serve many different purposes
  - **prototypes can help in enhancing the product** – as users often try to understand a new-product concept by analogy they are constrained until they can actually perceive the functioning
  - **prototypes can stimulate product evolution by creating markets** – the developers’ ability to communicate the exact potential of their technology increases only as the technology design matures; customers are made to think about the future product

**Absorptive Capacity: A new perspective on learning and innovation**

*(Cohen, W.M., Levinthal, D.A.)*

- **outside sources of knowledge are often critical to the innovation process**
  - authors argue that ability to **evaluate and utilize outside knowledge is largely a function of the level of prior related knowledge** as it confers an ability to recognize the value of new information, assimilate it and apply it to commercial ends → **absorptive capacity**
  - absorptive capacity can be the byproduct of both R&D and manufacturing, or direct effort (training)
Cognitive structure that underlie learning

- *prior knowledge, at the individual level, increases absorptive capacity* as it 1) creates a context into which new knowledge can be embedded and thus made sense of; 2) prior knowledge itself may be a set of learning skills → learning capability
- *problem-solving skills develop similarly* – new problems are approached with creative variations of known solutions to similar problems → capacity to create new knowledge
- absorptive capacity and creative capacity are quite similar, for both an intensive exposure to relevant prior knowledge is necessary
- 2 related ideas are implicit in notion that ability to assimilate information is a function of the richness of preexisting knowledge structure → 1) learning is cumulative; 2) learning performance is greatest when object of learning is related to what is already known → *diversity of knowledge is important*

From individual to organizational absorptive capacity

- though firm’s absorptive capacity depends on the individuals and develops cumulatively, its not simply the sum of the individual capacities, as it refers not only to the acquisition or assimilation of information but also the org.’s ability to exploit it → depends on interface with environment and interface between subunits
- firm’s absorptive capacity depends on individuals who stand at the interface (external or internal) – centralization or decentralization of function
- however, gatekeepers absorptive capacity does not constitute absorptive capacity of his or her unit within the firm – also a function of the absorptive capacity of the employees he relays the information to
- *tradeoff between diversity and commonality of knowledge across individuals* → 1) effective communication needed – necessitates overlapping knowledge that creates a background; most basic are shared language and symbols; 2) innovativeness – needs diverse background and knowledge structures as it augments capacity for making novel linkages and associations
  - too much specialization undermines communication; learning-by-doing lets knowledge among individuals converge undercutting absorptive capacity and innovative performance
  - cross-function interfaces are important to create the diversity needed
- question remains whether *absorptive capacity needs to be internally developed*, or if it can be bought → authors suggests that buying is limited, as firm-specific knowledge is needed, which is usually tacit and needs to be acquired by experience

Path dependence and absorptive capacity

- prior knowledge permits the assimilation and exploitation of new knowledge – some portion of the prior knowledge should be closely related to facilitate assimilation and some fraction must be fairly diverse to permit effective, creative utilization of the new knowledge
- 2 basic features of absorptive capacity in an evolving uncertain environment → *cumulativeness and effect on expectation formation* imply that absorptive capacity development is domain specific and is path or history dependent
  - accumulating absorptive capacity in one period will permit its more efficient accumulation in the next
  - possession of related expertise allows firm to better predict the nature and commercial potential of technological advances
- *creates self-reinforcing conditions for both successful and unsuccessful firms*
- unsuccessful firms are locked out by lack of investment in absorptive capacity in the beginning and by aspiration levels that will be more directed at performance
- organizations with higher levels of absorptive capacity will tend to be more proactive, while organizations with modest absorptive capacity will tend to be reactive → these modes should remain rather stable over time, as the systematic neglect of opportunities resulting from the lack of absorptive capacity will not help to rise the aspiration level that contributes to absorptive capacity
- *firm needs some absorptive capacity to value it appropriately*

Absorptive capacity and R&D investment

- *firm’s ability to exploit external knowledge is often generated as a byproduct of its R&D* → authors consider the responsiveness of R&D activity to learning incentives as an indication of the empirical importance of absorptive capability
- model they develop is based on 3 classes of industry-level determinants of R&D intensity: 1) demand – often characterized by level of sales and price elasticity of demand; 2) appropriability – degree to which firms capture the profits associated with their innovative activity; 3) technological opportunity conditions –
how costly it is to achieve some normalized unit of technical advantage in a given industry (2 dimensions – quantity of extraindustry technological knowledge, degree of improvement in profits)
- **basic model of absorptive capacity and R&D incentives**: technological opportunity and appropriability mediated by competitor interdependence work on the R&D spending – both are in turn influenced by the absorptive capacity as is R&D spending directly (see Exhibit 1)
- incentives to learn are affected by 1) quantity of knowledge to be assimilated and exploited & 2) ease of learning (more difficult environment increases marginal effect of R&D on absorptive capacity)
- **model of sources of a firm’s technical knowledge**: technical knowledge is created by firm’s R&D department and extra-industry knowledge and spillovers form competitors’ knowledge – for the latter 2, however, the absorptive capacity determines the extent to which it is utilized; this absorptive capacity itself depends on the firm’s own R&D

→ the factors that affect learning incentives (ease of learning and quantity available) **influence the effects of appropriability and technological opportunity conditions on R&D**

- **predictions**:
  - *direct effect on ease of learning*: as ease of learning diminishes, learning becomes more dependent on a firm’s own R&D and thus spending increases as 1) marginal impact on absorptive capacity is greater; and 2) appropriability increases
  - *technological opportunity*: predict that an increase in technological opportunity (amount of available external technical knowledge) will elicit more R&D in more difficult learning environments
  - *appropriability*: predict that spillovers will provide, in part, a positive incentive to conduct R&D due to the interaction of spillovers with an endogenous absorptive capacity

**Results**
- tested the prediction ins the context of an empirical model of business unit R&D intensity in which technological opportunity, appropriability and demand conditions are considered as the principal industry-level determinants of firms’ R&D spending
- technological opportunity **theory suggest that when targeted quality of knowledge is less an increase in the relevance of knowledge should have a more positive effect on R&D intensity** → basic-science becomes more important than applied research – largely confirmed
- appropriability **positive absorption incentive associated with spillovers is greater in industries in which the difficulty of learning is greater** – overall the positive absorption incentive associated with spillovers may be sufficiently strong in some cases to more than offset the negative appropriability incentive

**Implications for innovative activity**
- **explains why firms invest in basic research**, despite that findings spill out into the public domain → broadens knowledge and gives deeper understanding that is useful for exploiting new technical developments
- innovations that are fully incorporated in capital equipment will diffuse more rapidly than more disembodied innovations that require some complementary expertise on the part of the potential user
- **explains also why cooperative research ventures are more common in application research and more focused to short term gains**: participating firms must be prepared to invest internally in the absorptive capacity that will permit effective exploitation of the venture’s knowledge output
Strategic Linking: Designing formal coordination mechanisms

(Nadler, D.A., Tushman, M.L.)

- **strategic grouping** = focusing of resources by product, market, discipline, geography → driven by strategy considerations, however it puts together some resources, but splits others
- **strategic linking** = set of formal linking mechanisms that work to enhance, encourage and facilitate coordination between distinct groups split by the strategic grouping → driven by task interdependence
  - different types of task interdependence require different types of formal linking mechanisms – if they are not adequate work becomes poorly coordinated, if they are too complex, it will be too costly

Varieties of task interdependence

- multiple levels of analysis needed – set of linking mechanisms to deal with (work-related interdependence):
  - work flows between distinct units
  - need for disciplinary- or staff-based professionals to have contact across the firm → the greater the rate of change in their discipline, the greater the need for interdependence
  - work flows associated with emergencies, crises, or other nonroutine events → can impose higher interdependence
- interdependence is a source of uncertainty, the greater the task interdependence is, the greater the need for coordination and joint problem solving (increase in complexity of mechanisms needed)
- different classes of interdependence impose different information processing requirements
  - pooled interdependence – units operate independently, but share same scarce resources
  - sequential interdependence – each unit in the work flow is dependent on prior units → coordination and timing is important
  - reciprocal interdependence – common product makes units dependent on each other

Strategic linking: A range of linking mechanisms

- structural linking mechanisms can be analyzed in terms of their ability to handle information flows and complex problem-solving requirements → following mechanisms rise in ability to deal with complexity:
  - hierarchy = formal distribution of power and authority → follows directly from grouping decisions
    - coordination and linking between managers at the same level is accomplished by common boss as information channel – this is however limited by his cognitive/information processing capacity → other formal mechanisms to complement needed
- structural linking:
  - liaison roles – individuals form departments get responsibility to interconnect with other departments, while still remaining in their own – part time, normally no formal authority
  - cross-unit groups – task forces, teams, groups focus on certain problems
  - integrator role (can also be department) = individual (or department) is given full time post to link departments (brings general management’s point of view to lower levels in the organization), e.g. product or project managers – however usually do not have formal authority
    - can actually work the other way round, that organization is formally grouped around products or projects and functional integrators are used
  - matrix structure: gives formal authority to both project and functional levels → balances power and allows pursuit of multiple objectives by introducing concept of 2 bosses – however, very complex and should only be used where no other linking alternative is workable

Making structural linking decisions → alternatives vary in:

- costs involved and amount of resources needed → the more extensive the linking, the more costly
- dependence on the informal organization → the more complex mechanisms rely more on a well functioning informal organization
- information-processing capacities → the more complex, the higher the ability

Problem in strategic linking is to choose the sets of formal linking mechanisms that effectively deal with work-related interdependence, balancing costs and information-processing capacity in the light of the work-related interdependence
- formal linking mechanisms need to be complemented by formal reward and control systems working in the same direction – those too must be contingent on work requirements and the more complex tasks require more complex and subtle reward systems
How to integrate work and deepen experience (Leonard-Barton, D., et. al.)

- **leaders in global manufacturing need to** 1) build and refresh areas of expertise to **create core competencies** and at the same time 2) integrate the changing competencies to **create innovations** that can compete → need to integrate and still maintain functional expertise

- **solution to these needs** → **creative use of development projects**: 1) test integrative abilities; 2) strengthen inter-functional relationships while leaving room for increased functional expertise

- development projects: helping might be single project leader, shared work space, CAD/CAM… + project must fit the objectives of the organization that is responsible for carrying it out

**Leveraging capabilities, breaking rigidities**

- **core capabilities** form the capacity for action and enable a company to provide value to customers → **consist of 4 elements**, whose interaction determines how effectively the organization can exploit them:
  - knowledge and skills – technological know-how and personal know-who (ties to important groups)
  - managerial systems – incentive systems, educational programs, methodologies that embody procedural knowledge…
  - physical systems (= compilations of knowledge)
  - values – attitudes, behaviors, norms that dominate in a corporation

- core capabilities can become core rigidities – become obstacle for developing new capabilities or for maintaining the right balance

- most overlooked and most misunderstood element is “values” – also the most difficult to change
  - status that companies accord different disciplines can create powerful capabilities, but also result in rigidities, as e.g. fewer skilled people are attracted to the low-status units (self-reinforcing); cross-functional development projects can be used to overcome this rigidity

**Managing development to build capabilities**

- **4 principles can help companies correct conflicts and imbalances and build core capabilities:**
  - incremental approach to improving and expanding capabilities → do not aim at the great leaps and push on too many fronts at the same time
  - focus on process as well as product – sole focus on one results in the other one hindering development and profitability; even less-than successful approaches in one can be highly successful for the other
  - challenge conventional thinking – e.g. make clever use of benchmarking, be more resourceful and industrious in tapping the best minds in the field, break the conventional flow of information (e.g. let technicians listen to customers)
  - coherent vision, leadership and organization (most important components to success) → vision enables a project to take off; the right leadership and organization allow, in light of inevitable failure, to pull it through

**Prototypes: Tools for learning and integration**

- **building prototypes early and often** can help learn rapidly, minimize mistakes, successfully integrate work of the many functions → gives **common language and focal point** by showing how the work interacts and problems can be spotted early

- prototypes are not only physical embodiments, but also computer simulations, subsystem models, etc.

- successful use of prototypes requires analyzing → 1) compare intended and achieved design; 2) cost and ease of manufacturing; 3) degree to which all customer needs are assessed (also latent)

- 85% of costs are fixed during the first 15% of development → the later a change needs to be made, the more costly and time consuming it will be

- prototypes also are effective tool for monitoring, guiding and improving the development effort

**Technology integration: Turning great research into great products**

(Iansiti, M., West, J.)
authors argue that R&D spending is not a good indicator of competitive strength, as the research findings have to be translated into products for the market → **technology integration is key to achieve superior R&D productivity and speed and superior products**

- **technology integration** – main problem is not creating novel technologies, but choosing among them and integrating them in a coherent way to create competitive advantage → choice has large impact on performance in terms of time to market, productivity and product quality
- need has risen, because of: 1) increased number of technologies; 2) increase in breadth of technologies in a given product; 3) proliferation in sources of new technology; 4) shorter product life cycles; 5) increased uncertainty in the marketplace; 6) increased number of standards and manufacturing processes
  - defines interaction between research, manufacturing and product application → view on the entire project with output as focus (was lacking in the past)
  - often done using integrations
- findings show that technology integration processes are more important than disparities in project management methods, leadership qualities and organizational structure in explaining variations in performance (most effective ways of organizing and managing have already been adopted and wrong technologies eventually lead to failure under all conditions)

- by exploring the semiconductor industry, the authors conclude that the integration approach adopted must be in harmony with a company’s capabilities and its local culture and conditions → no one right fit!
- most pressing problem is to choose the technologies that work together in a n increasingly complex production system
  - US: team with extensive knowledge, but less experience; used centralized approach with the team refining the new manufacturing process and after that handing responsibility over; much experimentation capacity needed → **revolutionary technologies**
  - Japan: senior integrator network uses collective intuition rooted in experience, rather than extensive experimentation; close collaboration with suppliers → **evolutionary technologies**

**Conclusion**

Novelty of technology and a complex content in which a technology must be applied makes a company’s excellence in technology integration critical, the effectiveness is linked to the ability of the integration effort to leverage local expertise, customs and traditions → different contexts lead to different best technology integration approaches.

**Antecedents and consequences of cross-functional cooperation: A comparison of R&D, manufacturing and marketing perspectives**

(Song, M.X., Montoya-Weiss, M.M., Schmidt, J.B.)

- article focuses on the drivers and consequences of cross-functional co-operation
- authors argue that for NPD process (new product development) a cross-functional integration of all 3 functional perspectives is necessary: R&D, manufacturing and marketing
- antecedents of cross-functional cooperation are divided into 2 categories: internal facilitators and external forces
  - barriers to cross-functional cooperation in NPD: 1) personality differences between functions; 2) cultural differences or thought-worlds; 3) language or jargon; 4) organizational responsibilities and reward system; 5) physical barriers

**Hypotheses and Results**

- **H0**: The perceptions of the antecedents and consequences of cross-functional cooperation are similar across the R&D, manufacturing and marketing functions. → generally supported
- **H1**: External forces positively impact the degree of cross-functional cooperation achieved among R&D, manufacturing and marketing in the NPD process
  - uncertainty (external forces): market competitiveness, technological change, competitor response time, environmental uncertainty) puts pressure on firms to adapt by becoming more efficient and effective – requires cooperation
not supported; possible explanation is that at the project level, management, not the environment is the primary driver of the coordination mechanisms – senior management determines the strategic direction in light of the external environment and shields the project; thus the external environment moderates, rather than directly influences (also for H3)

- **H2**: Internal facilitators of cross-functional cooperation positively impact the degree of cooperation achieved among R&D, manufacturing and marketing in the NPD process.
  - **Internal facilitators**: evaluation and reward procedures, top management support
    - supported

- **H3**: External forces positively impact the use of internal facilitators for fostering cooperation among R&D, manufacturing and marketing in the NPD process.
  - not supported

- **H4**: Cooperation among R&D, manufacturing and marketing is fostered more by internal facilitators than by external forces.
  - supported

- **H5**: Cooperation among R&D, manufacturing and marketing positively impacts new product performance in the market.
  - e.g. facilitates the completion of NPD projects on schedule, within budget and with fewer design changes
    - supported, but significantly stronger for the R&D group than in manufacturing; relationship between cross-functional cooperation and performance is stronger than relationship between internal facilitators and performance

- **H6**: Internal facilitators positively impact new product performance.
  - supported

**Conclusion and managerial implications**

- research underscores importance of incorporating multiple functional perspectives
- **R&D, manufacturing and marketing are far more interfunctionally integrated than is often noted** (new paradigm?) – effective cross-functional cooperation is perceived to be a significant driver of new product performance
- controllable, internal facilitating mechanisms are the primary determinants of cross-functional cooperation and new product performance (at least at the project level)
- R&D differs from manufacturing in terms of the degree of importance placed on the determinants of performance (emphasis on formal mechanisms of cooperation versus achievement of cross-functional cooperation) ➔ all critical functions should take part in the NPD process from the beginning
- **top manager has dual role in NPD process – must actively champion the project and provide strategic direction and at the same time foster an internal culture of cross-functional cooperation**
**External technology acquisition in large multi-technology corporations (Granstrand, O. et. al.)**

- paper suggests a **topology of strategies for technology acquisition** and explores the **importance of external technology acquisition** over time (1982-1987) and its **link to corporate strategies** at the corporate level, as well as its linkages at the product level
- **external acquisition of technology is an increasingly important strategy** at both company and product level
- **at company level**, external acquisition of technology is positively correlated with company strategies emphasizing sales growth, product diversification and R&D investments
- **at product level**, is associated with increasing product performance, increasing R&D costs and increasing technology diversification (also new technologies are rather acquired than old ones)
- **increase in technology breadth** needed for products results in multi-technology products and corporations
  - 1) complement in-house R&D with external sources; or 2) focus on technology-based diversification (to reduce risk)

**Framework for analysis**

- **technology base is an asset** can be acquired, developed and exploited in various ways
- different technology acquisition and exploitation strategies can be combined or employed at different levels of the organization
- basis is the **contractual form** of supplying and appropriating technology degree of integration can be judged on the general intent of the contract – specific and inflexible for arm-length transactions, flexible and general with a great deal for trust and a common will in truly integrative settings (most important is the employment contract)
- **technology acquisition (sourcing) strategies** (decreasing in level of integration): 1) internal R&D, 2) acquisition of innovative firms, 3) joint ventures, 4) technology purchasing (contract R&D, licensing), 5) technology scanning
- **technology exploitation strategies** (decreasing in level of integration): 1) internal exploitation 2) creation of innovative firms, 3) joint ventures, 4) technology selling (contract R&D, licensing), 5) divestment, 6) storage, loss and leakage (unavoidable)

**Empirical analysis**

- **corporate level**: internal R&D is considered the most important source of technology, but increase in perceived importance of external acquisition strategies (except licenses) – however most see it as necessity, not opportunity
- **product level**: as number of sub-technologies in the technology base of the products increases technology externalization increases alongside with increased spending on in-house R&D – reasons:
  - technology diversification needs larger set of different technologies high R&D spending
  - internal handling of high R&D need difficult due to problem of finding sufficient R&D competence
  - efficiency of in-house R&D is dependent on external inflow of information – complementarities between internal and external acquisition
  - competitive supply of externally available technology, stimulated by product specialization among component supplying firms

**Discussion and managerial implications**

- external acquisition of technology is an increasingly important strategy at both company and product level
- **at company level**, external acquisition of technology is **positively correlated with company strategies** emphasizing sales growth, product diversification and R&D investments
- **at product level**, is associated with increasing product performance, increasing R&D costs and increasing **technology diversification** (also new technologies are rather acquired than old ones)
  - **nonlinear R&D costs with rise of number of technologies** incorporated in a product + pressure to keep costs and development time down
  - **technology diversification** linked to growth in R&D costs and growth of sales external technology acquisition enters as intermediate variable between technology diversification and sales growth – contributing to economic performance
- however, **effective technology management is needed to benefit**
hi-tech products: emphasis on scientific creativity, advanced customer demands, elitist recruitment, technological leadership and protection

multi-technology products: emphasis on technology scanning and other external acquisition forms, combination of innovation and imitation (incremental), technology synergies and fusion, composing interdisciplinary R&D teams, avoidance of NIH effects and communication and coordination in general

external technology acquisition is complement to internal R&D, not substitute (see absorptive capacity) – quasi-integrated corporate systems of innovation arise, where in-house R&D is managed together with a mix of strategies for external acquisition of technology

optimal degree of reliance on external sources is difficult to determine – risk of external reliance alternative strategy is not product specialization, but technology-based product diversification, leveraging internal R&D knowledge and spreading the costs

The globalization of R&D: Results of a survey of foreign-affiliated R&D laboratories in the USA (Florida, R.)

paper examines the globalization of innovation in form of the phenomenon of foreign direct investment in R&D with focus on the USA main conclusion is that it is driven in mainly by technology factors, not as suggested by previous literature by market forces – especially important is the objective of firms to secure access to scientific and technical human capital

past view on FDI in R&D oriented to foreign markets and support of offshore manufacturing investments

new view on FDI in R&D reflects efforts to harness external scientific and technological capabilities and generate new technological assets

article examines scope, activities, performance and organization of foreign-affiliated R&D laboratories in the US – 5 key contributions:

- motivations and activities of foreign-affiliated R&D laboratories technology-oriented or supply-side factors are increasingly important in motivating and shaping FDI in R&D – most important gaining access to science and technology and developing links to the scientific and technical community

- central element of the motivation and strategies of foreign-affiliated R&D laboratories is gaining access to human capital (scientific and technological talent)

- foreign direct R&D investment is a heterogeneous process with considerable variation in the nature and activities of foreign-affiliated R&D laboratories across industrial sectors (especially Biotechnology)

- in balancing the need for overall corporate coordination with the autonomy required for innovation and creativity, study shows considerable autonomy of R&D laboratories in developing and managing their scientific and technical agendas and staffing

- internal organization of foreign R&D laboratories does not try to resemble organization of home country, but rather emulates American practices in organization and management (is in contrast to manufacturing, where transfer and replication of key organizational practices is common)

Technology and markets in foreign direct R&D investment

despite both technology and markets playing a role in motivating FDI in R&D, supply-side factors are increasingly important in motivating the activities of foreign-affiliated R&D laboratories (one of the factors influencing might be increased dependence on external sources of technology)

- 3 most important activities of laboratories were linked to the technological side: 1) developing new product ideas; 2) obtaining information on scientific and technological developments in the US; 3) obtaining access to high-quality scientists, engineers and designers

- 2 activities have large, positive and significant associations with R&D spending: 1) gaining access to scientists and technologies; 2) developing links to the scientific and technical community technology-oriented posture with human capital strategies being the central element

FDI in R&D is a heterogeneous process with some variation in activities and outputs across industrial sectors and technology fields (particularly in biotechnology), however, importance of human capital and focus on technology-oriented activities is consistent along all 4 studied sectors

Innovative output and sources of innovation

- foreign-affiliated R&D laboratories are reasonably innovative and take on a technology-oriented posture to some degree

- main source of project ideas is the in-house research staff, followed by the customers – however the sources of innovation differ substantially by industry and technical field
External management and organization
- external relationships between foreign-affiliated R&D laboratories → balance corporate control and autonomy
- findings show that laboratories possess considerable autonomy in initiating new projects and hiring new scientific and technical staff – they have to report to both sister facilities and corporate headquarters in the home country, but such communication is principally concerned with administrative and coordinative functions – it does not impinge upon the design of new projects and the direct organization or the performance of R&D activities

Internal management and organization
- in using project teams, cross-functional teams and individual efforts, the R&D facilities mixed the approaches, in the varying sectors to a different extent
- foreign-affiliated R&D laboratories seek to emulate and learn from prevailing US organizational and management practices – stands in contrast to the pattern in manufacturing where transfer and replication of home-country practices is common

Management of an international network of industrial R&D laboratories (De Meyer, A.)
- R&D has not been immune to the trend of internalization – product innovation has been a key driver in the internationalization of the firm as has been getting access to global sources of technology and enhancing the exploitation of products across different markets to improve the competitiveness
- Global R&D plays a key role in process of the internationalization of product development – however it is linked to a number of difficult management problems: 1) R&D is characterized by economies of scale and scope; 2) R&D activities are unstructured and intangible and thus require person to person communication; 3) R&D activities are often close to strategic programs to be kept secret; 4) R&D knowledge is an important invisible asset, which is difficult to control in a decentralized setting
→ aim of paper is to show why companies engage in international R&D activities and how they manage the international network of laboratories that is created to overcome the potential drawbacks of international R&D

Why do companies create international R&D networks
- 3 potentially relevant factors: 1) demand side; 2) supply side; 3) response to the various aspects of the competitive environment → not very useful categorization, because the laboratories have a regular commitment to the performance of more than one type of R&D
- additional reasons for the creation of foreign laboratories: 1) break through internal isomorphism; 2) destroy some of the product coherence; 3) develop strategic control over external technology suppliers → internationalization of R&D is related to some form of learning
- grouping of R&D in 2 big categories: 1) immediate technical problem-solving – no international network necessary; 2) building up a technical knowledge base – learning requires a variety of inputs; to be useful and applied, the learning needs to be recognized, distributed and validated at the company level → network is necessary
- faster learning and more relevant information is key to explaining the internationalization of R&D network’s function is building and maintaining a knowledge base, creating favorable conditions to increase the technical learning process in the future and this with the purpose of applying the knowledge for the business’s long-term objectives

R&D as action oriented technical learning
- learning = process within the organization by which knowledge about action-outcome relationships and the effects of the environment on these relationships is developed
exposure to different sources of knowledge is important (internationalization), however, to be effective a mechanism needs to be created to **diffuse, validate and integrate the new knowledge across the whole network of laboratories**

- **knowledge credibility** – to contribute to the technical learning system a laboratory needs to gain credibility by creating results that have a significant impact on the economic performance of the firm – in establishing credibility an early project agenda and a clear definition of the strategic mission of the laboratory can help

- **diversity in approach** – to tap into local pools of creativity diversity in culture, hierarchical organization and procedures needs to be allowed (concept of requisiste variety)

- **planning and control contribution to learning** – to benefit from internationalization of R&D in the organizational learning process of the company, the planning, control and evaluation process, independent of its positioning on the scale from absolute control to absolute freedom has to be transformed into a learning process

- **communication network** – important for the diffusion, validation and integration of newly acquired know-how – core element is personal contact, but this is limited thus there is an increased emphasis on documentation of work and the use of electronic communication (which however has limitations and cannot replace the personal contact)

- **networking as a core element of the technical action learning** – networks were seen the most appropriate way of organizing the relations within an international R&D operation (tight and complex controls and high subsidiary involvement in the formulation and implementation of strategies)

**Conclusion**

- **internationalization of R&D is tool to improve technical learning capability of the firm** – management of international R&D operation concerns the way in which the organizational artificial intelligence system can be improved

**5 elements contribute to this system:**

- creation of knowledge credibility
- diversity in the structure and organization of the different laboratories
- international communication network attempting to replace the informal personal contact
- use of planning process as a learning process
- network organization which stimulates creation, validation and diffusion of knowledge
Competition, cooperation and innovation (Teece, D.J.)
- paper argues that link between firm size and ability to innovate is outmoded because the boundaries of the firm have become fuzzy – strategic alliances are increasingly necessary to support innovative activities and antitrust law has to recognize this

Introduction
- right balance between competition and cooperation in innovative processes needs to be found
- economic profession has largely treated innovation in technology sectors as occurring inside a black box, only looking at relationships of market structure and innovation and firm size and innovation, stressing the value of pluralism and rivalry, not looking at interfirm and intrafirm organizational issues
- however, in reality the rivalry and competition is induced on though the global system and non-market forms of cooperation can complement to a well-functioning national system of innovation
  → complex forms of cooperation are usually necessary to promote competition, especially in fragmented industries and this has to be recognized by antitrust policy

Innovation and competition
- Schumpeter claimed that large firms are necessary to promote innovation – as they: 1) can afford cost of R&D; 2) can absorb failures; 3) have element of market control necessary to reap rewards of innovation → exploration of links between innovative performance and market structure → however:
  o discussion on links between firms size, market concentration and innovation is inconclusive
  o difficulty in defining firm boundaries in meaningful way in today’s world (we have neither perfect competition nor complete monopoly) – use of alliances is increasing where law permits – has to be recognized
- alliances = form of contractual relationship, but more the emphasis is relational rather than transactional exchange; there is a state of continuous indebtedness and mutual obligation between the parties and there are implicit negotiations of a socially significant order through symbolic activities and ceremonies

Innovation, coordination and cooperation
- intensely competitive environment, coupled with the global dispersion of productive-technical competence, often requires complex forms of cooperation among competing firms → operational and strategic coordination needed to develop and profitably commercialize new technology
- global dispersion of competence: industrial competence is increasingly wider dispersed and global communications make linking of dispersed knowledge feasible
- need for operational coordination: innovation is a special kind of economic activity with very special kinds of informational and coordination requirements:
  o accessing complementary assets – profitable commercialization requires timely access to complementary assets on competitive terms
  o coupling developer to users and suppliers – timely feedback is necessary and linkage between science and engineering, manufacturing and marketing is necessary; important is that both development and commercialization of technology is regarded
  o coupling to competitors – horizontal linkages can assist in the definition of technical standards for systemic innovation; can also assist in overcoming appropriability problems
    ▪ reduces duplication of effort; diversified risk; extended resources
    ▪ critique is that the views of the innovation converge to just one possibility – however also in the perfect competition the level of diversity is not necessarily optimal
  o connection among technologies: 1) with prior technologies (path dependencies); 2) to complementary technologies (systems interdependencies; 3) to enabling technologies (new technologies may simultaneously affect several different activities)
- strategic coordination – activities which affect the distribution of returns to innovation through impacts on prices and competitive entry
  o on the one hand often necessary to capture value from technology, but can also limit public welfare and thus most often without question seen as anticompetitive

Governance structures to facilitate innovation
- **price system**: concept of the invisible hand and the efficient outcome of perfectly competitive markets through the single means of the price - however, prices do not always convey all the necessary information, especially in today’s global competition and thus they may not optimally direct resources

- **internal organization**: difficulty of regulating economic activity with incomplete contracts has provided reason for internalizing activities; however full integration does not always elicit the desired outcomes, as the incentive and compensation structures are changed

- **strategic alliances and interfirm agreements**: the reciprocal relationship with the aim to reach a common goal by pooling resources and activities goes beyond the exchange transactions where one side just supplies cash
  - alliances can involve equity swaps or investments, which provide mechanisms for distributing residuals and also can lead to higher levels of strategic coordination
  - are attractive form for an environment characterized by rapid innovation and geographical and organizational dispersion in the sources of know-how – are actually a hybrid structure between the price-system and the hierarchy

**Strategic alliances and the logic of managerial capitalism**

- alliances are likely to be inferior to vertical integration if the innovator is in the position to integrate at low cost
- for US high-tech firms alliances are advantageous, as they can team up with those that have world-class manufacturing facilities
- when intellectual property protection is weak, strategic alliances are likely to be more effective

**Conclusion**

- successful technological innovation requires complex forms of business organization – the price system alone does not suffice to achieve the necessary coordination for cooperative working and alliances in particular, management and public policy need to adapt:
  - management – different skills are required
  - public policy: importance of cooperation needs to be recognized in antitrust policy

**Learning from collaboration: Knowledge and networks in the biotechnology and pharmaceutical industries (Powell, W.W.)**

- core capabilities of organizations are based increasingly on knowledge-seeking and knowledge creation competition is best regarded as a learning race where interorganizational linkages (both formal and informal) are critical to knowledge diffusion, learning and technology development
  - learning form collaborations and learning how to collaborate are both important tasks which require the development of skills to facilitate the transfer of information and knowledge and their subsequent deployment in other situations
  - in biotechnology and pharmaceutical fields, ability to collaborate with diverse array of partners to speed timely development of new medicines has been rapidly developed, however, much less defined is the difficult and vital task of transferring information and knowledge obtained form external parties throughout the organization (both informal and formal mechanisms have advantages and disadvantages)

**The twin faces of collaboration**

- **two foci on collaboration**: 1) transactions and mutual exchange of rights (contractual focus); 2) relationship and mechanisms through which information flows and mutual adjustments take place (processual focus)
- firms in technologically intensive fields rely on collaborative relationships to access, survey and exploit emerging technological opportunities as structure of an industry becomes shaped by interorganizational relations, the nature of competition is altered
  - collaboration raises entry barriers
  - interfirm cooperation accelerates rate of technological innovation
  - reliance on collaboration has potentially transformative effects on all participants (external relations – more administrative innovations; dense network – ties may alter participants’ perceptions of competition)
collaboration may itself become a dimension of competition (portfolio of partners – resource and signal to markets of quality of the firm’s activities and products)

Regardless of whether collaboration is driven by strategic motives, such as filling missing pieces of the value chain, or by learning considerations to gain access to new knowledge or by embeddedness in a community of practice, connectivity to an inter-organizational network and competence at managing collaborations have become key drivers of a new logic of organizing.

- internal capability is indispensable in evaluation ideas or skills developed externally, while collaboration with outside parties provides access to news and resources that cannot be generate internally

Network structure of biotechnology field
- field is multi-disciplinary and multi-institutional
- key challenge for all players is in learning from collaborations with external parties and in constructing a portfolio of collaborators that provides access to both the emerging science and technology and the necessary organizational capabilities
- in learning, it is important to take 2 hurdles: 1) leaping form information to knowledge; 2) jumping form individual-level learning and expertise to organizational-level learning and routines (learning how to apply ability to learn to a multitude of projects)
- to take lessons learned on one project and make them systemic (portable across multiple relationships) is critical
- methods for facilitating learning can be formal or informal, where informal is more promising if it can be used regularly

Innovating through alliances: expectations and limitation (Bidault, F.; Cummings, T.)
- paper analyzed innovation processes and the key managerial issues pertaining to effectiveness in cross-industry technology partnerships and found a fundamental tension between dynamics of innovation and the logic of partnering – however extent of the tension depends on nature of the innovation project and on the characteristics of the partnership and can be countered or supplemented by the appropriate management structure
- commonly stated reasons for alliance effectiveness: 1) cheaper and faster way to develop new products and processes; 2) reach critical mass of human and financial resources; 3) knowledge and skills from different companies improves innovation process

Research approach
- look at cross-industry technology alliances → technological convergence is known in literature as important source of innovation
- cross-industry alliances: 1) more innovative than alliances with competitors; 2) occur more frequently than in past; 3) high risk of failure; 4) degree of innovation is incremental

Conditions for innovation in the context of partnership (widely accepted major requirements)
- thorough understanding of the user’s needs → usually available in partnership
- sound knowledge of marketing and distribution → usually available in partnership
- need for a champion → problem in a partnership is that champion needs to be accepted in both parent organizations and thus needs knowledge of both cultures and power distributions
- need for a sponsor (external champion supporting the internal champion against attacks that might lead to discontinuation of project) → in joint-development partnership, there are usually at least 2 sponsors, one in each parent company which continuously have to agree (thus it is very difficult)
- innovation projects need flexibility and appropriate controls (some opponents) → appears more difficult in a partnership as companies often seek control of the joint project as a means of preventing the other from getting excessive benefits and any change in orientation requires renegotiation
Innovation Management

- innovation need easy and fast communication (between R&D, marketing and manufacturing) → knowledge sharing is especially important in a partnership, however the managers are also afraid of losing proprietary information to a partner
- innovation is dependent on ability of innovator to keep possession (appropriability) → definition of shared ownership reduces appropriability
→ all, but the first 2, appear to incorporate sources of conflicts and tensions and thus we can say that to some extent there is a tension between partnering and innovation

Innovation and partnering: A tension?
- innovation as an unsystematic process needs adjustable, flexible management and champions, thus it depends on autonomous decision-making and is contrary to the logic of partnering which emphasizes clarity and explicitness (partnering entails formal management through contracts, aimed at reducing uncertainty)
- this tension may not by itself inhibit new product development, but it may reduce the effectiveness of innovation in the partnership on the critical dimensions of innovation performance:
  o project timing – partnering generally entails longer development time
  o cost – more difficult to control and thus higher (rule of thumb: total costs of joint R&D increase according to square root of total number of partners)
  o technological performance – compromise degrade performance
- yet, partnerships also have positive effects, however, they might be offset

Assessing the tension between innovation and partnering (hypotheses)
- level of tension specific to an innovation-driven partnership is an indicator of its chances of success
- sources of tensions:
  o nature of the innovation project – strong relationship between highly innovative projects and need to meet innovation requirements (innovativeness can be assessed by: discontinuity, technological familiarity, market familiarity, potential economic impact, stage in R&D process)
  o characteristics of the partnership:
    ▪ context of the partnership – attitudes and priorities of the partners toward the project (can be assessed by: expectations, experience, risk aversion, economic weight)
    ▪ project management – if properly organized, it provides an opportunity to overcome some hurdles (can be assessed by. Management structure, degree of formality)
- management structure is an action variable, while the other 2 dimensions are more or less given

Conclusion and managerial implications
- while dynamics of innovation imply flexibility, tolerance of ambiguity and autonomy of the team, logic of partnering leads to some rigidity, based on existence of a contract specifying goals and means → opposing

Strategic Networks – The organization of the future (Hinterhuber, H.H.; Levin, B.M.)
- strategic networks = collection of units/organizations with specific core competences creating a network of strategically structured business cells → time and flexibility advantage; can be observed inside large companies as well as between small companies
- Porter diamond – identifies perquisites for existence of clusters in geographic markets → 1) inputs; 2) demand; 3) related and supporting industries; 4) structure and rivalry

Development of strategic networks
- most important success factors: reputation, innovation, architecture
- architectures can be classified along 2 dimensions: 1) operational linkages, 2) capital linkages → development of corporate interrelationships can be shown as a spiral within this framework (see figure 2)
- beginning of many industries – small rivaling firms → conglomerates → strategic business units → strategic networks
- important in partnerships is the server → non-core activities are taken out of the value-added chain and some of the core activities requiring larger scale development are jointly developed with partners → only extremely focused units functioning in a network coordinated by a server can be quick and flexible enough
- intelligently set up networks between smaller or medium size firms can very well be superior to a large competitor who splits itself in smaller units

**Network types**
- *internal networks* – very focused within companies
- *vertical networks* – creating a network vertically up and/or vertically down
- *horizontal networks* – alliances with similar firms in similar markets in order to develop and/or exploit a particular technology or penetrate a geographical segment (very few successful examples)
- *diagonal networks* – formed between companies trying to exploit synergies in order to create new, interdisciplinary markets

**Conclusions – Network development from a European Perspective**
- changes in communications technology permitting instantaneous analyses and responses even in large concentrated markets, completely new rules of the game are created permitting smaller units, provided they are organized and driven in a proper way, to achieve an absolute strategic superiority against the large concerns dominating the industry and still thinking in terms of market shares
- Americans are best at managing diagonal networks; Japanese have perfected vertical networks; Europeans balance vertical and horizontal networks in some industries
- however, solid and continuous relationships between units and submission to the server requires a number of perquisites none of which are fully existent anywhere in Europe
- possible development of strategic networks → Industrial holding companies
- also see last sentence
Multi-Technology Corporations: Why they have distributed rather than distinctive core competencies (Granstrand et. al.)

- accumulating firm-specific competencies is important for the long-run competitiveness, despite they defy evaluation by established financial techniques and must often be re-combined across established functional and divisional boundaries

The importance of technological diversity

- technological diversity (which is increasing) is driving force behind 4 major features of contemporary business: 1) corporate growth; 2) increased R&D investment; 3) increasing external linkages for new technologies; 4) opportunities to engage in technology-related new businesses

- 3 major forces behind technology diversification in companies: 1) opportunities to new technologies into products and systems; 2) continuing relevance of old technologies; 3) coordination of innovation and change in core products with complementary changes in the production system and supply chain

- article challenges 4 notions → they contain some truth, but are dangerous when carried to extremes
  o for every company exists a narrow set of core technological competencies to focus on
  o major innovations are often associated with competence destruction
  o companies should not only downsize but disintegrate
  o companies should focus or specialize on a narrow set of core businesses

The distributed competencies of large corporations

- technological diversity → large firms have significant competencies outside their intuitively obvious distinctive technologies
  o despite being also heavily diversified in their product mix, they have a broader range of technological competencies than products → reasons are the systematic interdependence with the supply chain and widening technological opportunities

- coordinating change in the supply chain → there are strong technical interdependencies what firms develop and make themselves and what they require from their suppliers
  o the more complex the supply chain, the higher the proportion of technological resources large firms are likely to spend outside their distinctive technological competencies

- learning about emerging technological opportunities → despite being fairly stable, technological competencies have been extended over time with the emergence of new opportunities with advances in science and technology
  o large firms build up and maintain a broad technology base in order to explore and experiment with new technologies for possible deployment in the future
  o external technology sourcing was an important complement to in-house R&D
  o new technologies are often combined or fused with established ones
  → competence enhancement dominated over competence destruction

- measuring and classifying firm’s technological competences → authors develop a fourfold classification, based on 2 dimensions of any large firms’ technological competencies:
  o 2 dimensions: 1) patent share – percentage of total patenting of a firm in a field; 2) index of the firm’s revealed technology advantage
  o 4 resulting classifications: 1) distinctive; 2) background; 3) marginal; 4) niche
  o if all technical fields contained the same number of patents, each company’s competency profile would be a perfect straight line sloping from marginal to distinctive – however, the fields are of unequal size and importance → for background competences companies need to spend more, but it does not by itself give them a competitive advantage
  o high spending in the background technologies e.g. reflects a more complex supply chain

Implications for management

- distributed rather than core technological competencies → management in large firms needs to sustain a broader set of technological competencies to coordinate continuous improvement and innovation in the production system and supply chain (must become multitechnology firms)
  o multitechnology focus must occur in 3 areas: 1) across number of technical fields; 2) in different parts of the organization; 3) among different strategic objectives of the corporation
2 major challenges: 1) identification, measurement, evaluation and coordination of technology is non-trivial; 2) no universal recipe for the appropriate mix is available

- technology and the boundaries of the firm:
  - 4 intermediate positions between full-scale integration and disintegration: 1) full design capability; 2) systems integration capability; 3) applied research capability; 4) exploratory research capability
  - 2 factors influence corporate decision on the degree of outsourcing or internalization of technological competencies: 1) autonomous versus systemic innovation; 2) number of independent sources - the more the less danger of external monopoly power
  - whatever type of innovation and number of external sources, firms should always maintain capabilities in exploratory and applied research – if innovation is systemic also the systems integration ability should be retained; if number of external sources is limited also the design ability
  - external forces change over time

- technology diversification – with or without business diversification
  - just as products are becoming increasingly multi-technology, technologies are becoming increasingly multi-product and multi-firm → explains technology diversification dominating technology substitution and why technology-related business diversification is feasible and often successful if corporate technological and organizational competencies can be matched with major emerging opportunities
  - corporate performance is positively associated with technological diversification, however also with greater focus in business operations → can be explained by difficulties with organizational origin
    - R&D costs increase more than proportionately to number of new technological competencies acquired – costs of integrating knowledge across well-established disciplinary frontiers

Conclusions
- dynamic interactions between technology, products, firms and markets → managers need to give attention to the distribution of corporate technological competencies beyond the core, the enhancement and integration of new competencies and the potential for related new product markets
- do not confuse technologies with products – corporate policies differ in 4 important ways:
  - what may apply to outsourcing production does not apply to outsourcing technological competencies
  - creative destruction in products and even firms is not associated with corporate competence destruction in technologies (has more to do with failure in development, production, marketing and organizational adaptation)
  - rapid increase over past 15 years in technological alliances and exchanges among large firms is not the consequence of the progressive outsourcing of R&D, but is linked to diffusion of new technologies and is accompanied by increase in R&D spending
  - there is no clear match between technology diversification (or focus) and product diversification (or focus)

Entering new Businesses: Selecting strategies for success
(Roberts, E.B.; Berry, C.)
- to answer questions on which products markets to enter and how to enter them to avoid failure and maximize gain, authors develop a new framework in form of a matrix with the dimensions of familiarity of both market factors and technologies and assign the approaches to the resulting regions
- different entry methods make different demands upon the corporation → depending on the situation the benefits and costs change

Entry strategy: A new selection framework
- new business development may address new markets, new products, or both – however, new products or markets still may be familiar or unfamiliar
  - familiarity with technology may exist as technology is within the company but not currently embodied in products; familiarity with a market may exist in terms of understanding which is not necessarily a result of participation within it
- characterizing businesses along market and technology factors as base, new familiar or new unfamiliar results in a 3*3 technology/market familiarity matrix (see fig.2, p.606)
Alternative strategies
- research has found that familiarity of accompany with the technology and market is a critical variable that explains much of the success or failure in new business development approaches \( \Rightarrow \) companies should develop new businesses within areas related to the base business – a very limiting constraint
- authors see deficiencies of this research in that the modes of entry were disregarded

New business development mechanisms
- *internal development* – exploits internal resources, but may need a long time till payoffs occur; unfamiliarity with new markets may lead to errors
- *acquisitions* – rapid market entry at low cost, however, difficult if the new business area is unfamiliar to the parent (incompatibility)
- *licensing* – rapid, low-cost access to proven technology, but no substitute for internal technical competence + dependence
- *internal ventures* – use of existing resources, but making it a separate entity within the existing corporate body may enable company to harness and nurture entrepreneurial behavior – however, internal climate often unsuitable
- *joint-ventures or alliances* – allow distribution of risk and expenses, however, have great potential for conflict
  - growing in importance are “new style” joint ventures in which large and small companies join forces – the small provide the technology, the large the marketing capability
- *venture capital and nurturing* – lowest level of required corporate commitment; provides window on new technology or market and experience in guiding and understanding of the venture development process helps effective internal corporate venturing
  - nurturing also involves provision of managerial assistance to the recipient of the venture capital
- *educational acquisitions* – also provide windows on technologies or markets, but additionally bring in an initial staff; however, the financial commitment is higher and there is a high risk that the entrepreneurs will depart

\( \Rightarrow \) no one mechanism is ideal for all new business development – the careful selection of a strategy can reduce the risk associated with new business development in unrelated areas

Determining optimum entry strategies
- *general rule*: strategies requiring high corporate involvement should be reserved for new businesses with familiar market and technological characteristics, while entry mechanisms requiring low corporate input seem best for unfamiliar sectors
- 3 regions and appropriate entry strategies:
  - base/familiar sectors: although all entry mechanisms are possible, the most attractive include *internal development, licensing and acquisition* – new entries in the base/familiar combinations rapidly transfer into the base/base sector
  - familiar/unfamiliar sectors: companies are only able to competently carry out new business analysis in their own sphere of familiarity – thus it needs outside knowledge \( \Rightarrow \) 2 stage approach may be best: 1) building corporate familiarity; 2) allocate more substantial resources
    - over time, active involvement can help the investor to more into a more familiar market/technology region
    - best suited: *venture capital, venture nurturing or educational acquisitions*
  - marginal sectors:
    - joint ventures may be very attractive in the unfamiliar/base combinations – as both partners can offer each other something – over time familiarity is increased, thus joint ventures may be optimal entry mechanisms, but future development may be best achieved by internal development or acquisition
    - in familiar/familiar sector, internal ventures, licensing or acquisitions may provide useful means of obtain rapid access to a proven product embodying the new technology
    - acquisitions may be potentially attractive in all marginal sectors
- in testing the matrix, general support has been established \( \Rightarrow \) new business development success rates in unfamiliar areas may be increased by limiting corporate input with the decision-making process to low levels until corporate familiarity with the new areas has developed

**Competing in the age of digital convergence (Yoffie, D.B.)**
**digital convergence** = unification of functions; the coming together of previously distinct products which employ digital technologies

- author argues that **mastering digital convergence** does not require a magical new set of technologies (no breakthroughs); **instead success will emerge by adopting a strategy the author calls CHESS**
  - **C** = creative combinations
  - **H** = horizontal solutions
  - **E** = externalities and standards
  - **S** = scale and bundling (advantages of dominant firms, but to sustain advantage they need to be willing to aggressively cannibalize their historic market position)
  - **S** = system-focused development (new production techniques) – need to be flexible and adaptive, but at the same time very time-sensitive

- development of key digital technologies allows companies to create new functionality and extend product features into new areas → problem is predicting the appropriate time frame and the course of digital convergence
- digital convergence is not a unilinear path – some technologies mature and converge before others
- mass acceptance of convergence requires content besides the infrastructure
  → companies that follow CHESS strategies may find opportunities to redefine the rules and change the game

**Drivers of digital convergence**
- **semiconductor** (Moore’s law → cheap computing power), **software and digital communication technologies** (lower costs of delivering information)
- **government deregulation** (important for lowering costs of delivering information as well as undermining traditional cost/price relationships → bandwidth should become as cheap as computing power)
- **managerial creativity**

**A CHESS strategy for digital convergence**
- rapid acceptance of the internet has created excitement in digital convergence – however weak intellectual property regimes, inertia and lack of standards and compelling value-added services could greatly slow down spread of many of these new technologies – moreover, very few companies have demonstrated profitable business models
- during the introductory phase of new information technologies barriers to entry seem to disintegrate, opening a **temporary window of opportunity for new players** – however, after each discontinuity it is always a few large incumbents that retain significant status across technological generations due to economies of scale, network externalities and need for standards
  - **C** = creative combinations
    - success is most likely to be fueled by creative combinations of old and new technologies → creative destruction may be the “end” of the process, but it is not necessarily the means.
    - in past highest return on radical innovation has been within existing industry boundaries – difficult in area of converging technologies – one solution is to build broad-based alliances (are no panacea)
    - creatively extending existing technologies offers much higher probabilities of success; additionally such an approach offers some degree of compatibility with an installed base and thus eases the transition by reducing switching costs
  - **H** = horizontal solutions
    - scale economies, government deregulation and technology are driving the information industry towards a horizontal structure (competition between component firms) and away from a vertical orientation
    - horizontal structure is **advantageous in the light of growing scale economies and rising importance of network externalities** → firms control large share of the horizontal layer and works through creative combinations with other complementary firms to deliver a product to the final customer
    - however, horizontal model has weaknesses – vertically integrated firms have the advantage of lower transaction costs → there needs to be a high degree of coordination, common interfaces and standards in a horizontal industry to work
  - **E** = exploiting externalities to set global standards
    - setting standards or creating dominant designs or a dominant architecture may be even more important in converging industries
    - network effects and the resulting virtuous (or vicious) cycles are important as is the threat of lock-in and lock-out
    - lock-out, the exclusion of a company in a standard and the associated irreversibility (or at least high costs) of an adoption of a standard in the next generation leads to a Heard mentality
standards can be set by 3 approaches: 1) gain control by following Trojan Horse strategies; 2) embrace open standards, try to enhance them and ultimately lead them; 3) proclaim the standard and try to implement it through brute force – increasingly difficult

- S = scale and scope

scale has become critical partly because of the forces driving standards and horizontal markets, but also because of the reality of globalization: huge size of customer-base gives incumbents 2 advantages: 1) huge annuity from servicing installed base; 2) network externalities make defection by customers and complements very difficult

though necessary, scale is not sufficient – a broad scope by a firm can gain an advantage over focused approach if they can bring together competencies through bundling their products into adjacent markets

bundling helps leveraging the installed base

however, scale and scope do not guarantee dominance for large incumbents in converging industries, or even the next generation of technology within an existing industry boundary (as before the natural incumbent and the necessary scale and scope economies that are relevant are not known)

scale and scope economies can also become a liability to incumbents in converging industries if they the firm does not develop a capability for rapid change and a willingness to cannibalize its businesses

- S = System-focused processes

the internal processes within the firm well have to make dynamic adjustments – successful internal processes have to reflect at least 2 potentially conflicting imperatives: 1) flexibility and adaptiveness; 2) time-sensitivity

processes need to be iterative (start with broad vision and allow for new information to be integrated) and system-focused (focused on tight integration of the entire project rather than its component pieces)

while time-to-market is always important, new technologies in converging industries must pass through a whole spectrum of windows (technical, competitive, financial, marketing) – these are transitory and when they close, even superior products fail
Managing Intellectual Capital: Licensing and cross-licensing in semiconductors and electronics (Grindley, P.C.; Teece, D.J.)

- one of the most significant emerging business developments over last decade has been proactive management of intellectual capital by innovating firms
- managing intellectual property (IP) has become a central element in technology strategy – spurred by increasing protection afforded IP worldwide and greater importance of technological know-how to competitive advantage
- active IP stance \( \rightarrow \) licensing and cross-licensing have grown in importance to 1) maintain design freedom; 2) generate royalties
- in complex industries (electronics and semiconductors), cross-licensing is generally more complex leading to a portfolio approach of cross-licensing – cross-licensing on individual patents would result in too high transaction costs and would also expose the potential licensee to large risks (in industries where a wide set of technologies is used)
  - usually, technology is not transferred in a cross-license, as parties are capable of using the technology in question without assistance – the cross-license primarily confers rights to use patented technology and avoids monitoring costs and adjusts royalty payments to reflect overall contributions to the stock of IP currently in use
- cross-licensing is typical of industries involved in cumulative systems technologies, where one innovation builds on another and products may draw on several related technologies (aim is design freedom, not technology exchange)
- key to successful cross-licensing is a portfolio of quality patents that covers large areas of the partner’s product markets \( \rightarrow \) gives leverage in accessing patents and balancing royalties as well as increasing ability to fund further R&D
- cross-licensing has double positive effect on innovation \( \rightarrow \) 1) earning return on innovation; 2) allows firms to concentrate innovation and patenting activities according to their comparative advantage – thus firms can develop complementary rather than duplicative technology

The licensing legacy
- RCA \( \rightarrow \) created to produce radio equipment, as there was a deadlock situation between the different patent holders (rights were transferred to RCA)
- AT&T \( \rightarrow \) need for design freedom; government forced cross-licensing by 1956 antitrust consent decree, but practice was already in place before to widely cross-license at low rates; as they did not produce, but were a service provider had strong interest in fast dissemination of new technology – now as a deregulated company using IP more strategically
- IBM \( \rightarrow \) main objective is to maintain design freedom, but also to earn revenues (also, for a short term bound by a consent decree – 1956 – to certain compulsory licensing terms)
- TI (Texas Instruments) – semiconductor industry is characterized by rapid technological development, short product life cycles and large number of overlapping patents \( \rightarrow \) necessitates cross-licensing to ensure “design freedom”, but TI also has strong focus to obtain value from its IP
  - however, TI does not license out its core IP rights (areas in which it has a strong leadership position)
  - IP in form of applying for patents is pursued actively, but excessive costs of patenting lead to 3 possible outcomes of screening: 1) no patenting, but publishing to preempt others; 2) maintaining as a trade secret; 3) filing a patent \( \rightarrow \) aims is to create patent portfolios that are strategically valuable

Types of cross-licensing
- capture model – license to use, in a given field-of-use, all patents within a technological field which exist or applied for during the license period (usually 5 years) and retaining of survivorship rights to the patents until they expire
- fixed period model – no survivorship rights

Royalty valuation process
- proud list process (at TI) \( \rightarrow \) each firm identifies a sample list of its most valuable patents and this is used as a representative proxy group for estimating the value of the entire portfolio – each of the sample patents is
evaluated by both sides according to its quality and coverage; dollar amounts are summed for all the listed patents and expressed as a royalty rate percentage of the licensee’s total sales
- however, also some strategic considerations – like an upper limit on royalties feasible; long-term strategic considerations; goal of setting a standard – must be taken into account

Questions remaining:
- how much emphasis should be put on 1) manufacturing vs. licensing (cross-licensing); 2) licensing revenue earning vs. freedom-to-operate
- in more mature industries of semiconductors and electronics and in light of increased global competition, a competitive advantage requires more emphasis on strong IP rights; also made possible by demise of second sourcing requirements

Policy issues
- cross-licensing agreements are 1) pro-innovation and 2) pro-competitive
- the royalty flows are a protection against free-riders

Lessons for innovation management
- cross-licensing enables firms to protect their IP while at the same time obtaining freedom to manufacture – new IP and licensing circumstances have increased incentives to build IP portfolios and to innovate
  - use IP to support core business → market still rewards developing and commercializing products and process, not developing IP
  - develop a valuable patent portfolio → give bargaining power to obtain design freedom and collect results from R&D
  - concentrate R&D where the firm is strongest (provided it is also a commercially important field to cross-licensing partners) – matter in creating a valuable portfolio is not aim of R&D, but quality of the patents in a field that one’s competitors need to license

Conclusion
The old regime, whereby the antitrust authorities pressed major IP owners to give up whatever rights they held, where the courts were reluctant to enforce IP rights and were eager to see IP as a barrier to competition rather than as an instrument of it, has faded away. As a result of these developments, a new order has emerged in which IP rights are valuable. Firms must either invest in R&D and develop patentable technology, or pay to license the patent portfolios of others. The free ride appears to be coming to an end, and IP management is now critical to the success of new entrants and incumbents alike.

Capturing Value from Knowledge Assets: The New Economy, Markets for Know-How and Intangible Assets (Teece, D.J.)

Knowledge and Competitive Advantage
- stock of useful knowledge and extension of its application are essence of modern economic growth
- liberalization of markets → increase in competition
- expansion of what’s tradable → market-based exchange relationships cannot yield competitive advantage as they are replicable (efficient markets level competition)
- strengthening of intellectual property regimes → knowledge assets are often inherently difficult to copy, but also legal means have been strengthened; growth of IT has amplified importance of intellectual property and injected IP into new contexts
- growing importance of increasing returns → diminishing returns activities have been replaced by activities characterized by increasing returns (positive feedback; standards and network externalities; customer lock-in; large first-copy costs; producer learning)
  - different corporate strategies needed in which timing is of central importance
  - rewards go to those good at sensing and seizing opportunities rapidly (= dynamic capabilities) → also requires not only superior technology, but complementary assets → companies must constantly transform and retransform
- **decoupling of information flows from the flow of goods and services** → more virtual structure are viable (IT facilitates specialization and enables sharing of learning and experience)

- **ramifications of new information and communication technologies** → potential to bring together previously fragmented flows of data, permitting real time monitoring of markets, products and competitors
  - knowledge needs to be shared for larger organizations having advantages

- **product architecture and technology fusion** → complexity is increasingly common and product become sets of components where innovation at the architectural level is more demanding and less frequent + integration of previously disparate technologies
  → development suggests a new dynamic of competition and competitive advantage: ownership and successful deployment of non-tradable assets – critical dimension of knowledge management is capturing value from innovative activity

**Capturing value from knowledge and competence**

- proper structure, incentives and management can help firms generate innovation and build knowledge assets – how competences and knowledge assets are configured and deployed will dramatically shape competitive outcomes and the commercial success of the enterprise

- **nature of knowledge:**
  - codified/tacit → uncodified knowledge is slow and costly to transmit; codified messages are better structured and less ambiguous
  - observable/non-observable in use → observability enable imitation and reverse engineering
  - positive/negative knowledge → also failures can generate knowledge
  - autonomous/systematic knowledge → systematic innovation requires modification to other sub-systems
  - intellectual property regime → patents, trade secrets, trade marks

- **replicability, imitability and appropriability:**
  - knowledge assets are normally rather difficult to replicate (tacit knowledge involved) – but replication enables expansion and learning and improvement (tacit knowledge is not well understood)
  - imitation is replication performed by a competitor – even harder
  - appropriability regimes describe the ease of imitation – it is a function of both the ease of replication and efficacy of intellectual property rights as a barrier

- **appropriability and markets for know-how and competence** → only assets with strong appropriability regime can be a source of competitive advantage: non-tradable assets (location, knowledge and competences)
  - know-how/IP differs from physical commodities in: 1) recognition of trading opportunities; 2) disclosure of performance features; 3) uncertain legal rights; 4) item of sale; 5) variety – thin markets; 6) unit of consumption
  - the inherent difficulties identified vary according to the type of know-how/IP at issue – e.g. IP market for chemicals works rather well in comparison with the one for electronics (the market for chemicals is more efficient)

- **complementary assets** → asset structure of the firms is perhaps most relevant aspect of positioning when considering the commercialization of knowledge – competitive advantage can be gained or lost on how expertly the strategy for gaining access to them is executed

- **dynamic capabilities** = ability to sense and size new opportunities and to reconfigure and protect knowledge assets, competencies and complementary assets and technologies, select appropriate organization forms and allocate resources astutely and price strategically to achieve sustainable competitive advantage
  - **external sensing** – opportunities and necessity for change needs to be seen and actions be directed to implement a new regime with skill and efficiency (limited by bounded rationality) (e.g. by scenario planning to understand drivers of change)
  - **organizational action** – ability to quickly contract requisite external resources and direct relevant internal resources is necessary to seize opportunities

**Implications for the theory of the firm**

- **firm is a repository for knowledge** – embedded in business routines and processes → knowledge base includes technological competences, knowledge of customer needs and supplier capabilities and through the difficulty to imitate it can provide the foundation for competitive advantage

- **essence of the firm is its ability to create, transfer, assemble, integrate and exploit knowledge assets**

- knowledge perspective stresses the **entrepreneurial rather than administrative side of corporate governance**
  (dynamic capabilities)

- competences/capabilities view sees proper **boundaries of the firm** and governance structure being determined not only with reference to transaction costs, but also with reference to technological and knowledge concerns (tacit knowledge and its transfer properties determine the boundaries of the firm)
Conclusion

- knowledge, competence and related intangibles have emerged as key drivers of competitive advantage
- management has to focus on entrepreneurial governance, not administration (dynamic capabilities)

Managing in an age of modularity (Baldwin, C.Y.; Clark, K.B.)

- more and more industries have to adapt to a new industry structure – embracing modularity (building complex products or processes from smaller subsystems that can be designed independently, yet function as a whole) as the computer industry did long ago

- modularity is achieved by partitioning information into visible design rules (need to be understood and adhered to by all) and hidden design parameters (only needed to be understood by the designer of the module)
  - visible design rules fall into 3 categories: 1) architecture; 2) interfaces; 3) standards for testing a module’s conformity to the design rules
- modularity enables companies to handle increasingly complex technology → designers, producers and users (can mix and match elements) gain enormous flexibility
- modularity also boosts the rate of innovation as it allows for parallel experiments
- however, modular systems are also much more difficult to design, as the designers of modular systems must know a great deal about the inner workings of the overall product or process to be able to develop the visible design rules

Modularity today – in non computer sectors

- today we are in a period of great advances in modularity (e.g. in car production modularity increasingly becomes established way of doing business and competition among module suppliers intensifies spurring them into a race for innovation; or in finance)

Competing in a modular environment

- modularity results in a different competitive setting, modular clusters of companies with differing strategies (no one strategy is right)
- managers have to choose among 2 strategies: 1) compete as an architect – creating visible information and attract module designers; 2) compete as a designer of modules – advantage comes from mastering hidden information and superior execution of brining modules to the market

Implications for organizational design: needed are knowledgeable leaders

- managers in modular markets need to cope with higher rates of innovation and swifter change → success depends on mapping a much larger competitive terrain and linking one’s own capabilities and options with those emerging elsewhere, possibly in companies very different from one’s own
- entrepreneurship is the pursuit of opportunity beyond resources currently controlled – also financial and employees
- as modularity heightens the degree of uncertainty in the design process – creating, watching and nurturing a portfolio of options is necessary → leaders must redesign their organizations to be flexible – they must introduce modularity within their organizations
- modularity within the organization expands the range of possible product varieties → leadership and values are critical to articulate a strategy and plans for the product line’s evolution and to address concerns of teams; important is also that teams communicate the hidden information with the rest of the organization (learning!)
- to take full advantage of modularity, companies need highly skilled, independent-minded employees eager to innovate and managers that have an intimate understanding of the knowledge behind their products

Discovering new value in intellectual property (Rivette, K.; Kline, D.)

- battles are increasingly being waged not for control of markets or raw materials but for the rights to new ideas and innovations, the management of intellectual property (IP) must become a core competence of the successful enterprise
- aim of article is to demonstrate how companies can manage and deploy their patents not just as legal instruments but also as powerful financial assets and competitive weapons (IP contains not only patents, but also trade secrets, trademarks and copyrights)

- strategic management and use of patents can significantly enhance a company’s success in 3 broad ways: 1) by establishing a proprietary market advantage; 2) by improving financial performance; 3) by enhancing overall competitiveness

**Establish a proprietary market advantage**

- patents enable companies to stake out and defend a proprietary market advantage even in times of rapid change; they can translate into category-leading products, enhance market share and lead to high markets, or sometimes even serve as foundations for new industries

- 3 ways patents can help companies secure a proprietary advantage:
  o protect core technologies and business models – companies must ensure that they protect and leverage whatever it is that adds the most value to their business and whatever represents the most vital sources of their competitive advantage
  o boost R&D and branding effectiveness – patents can help build category-leading products as well as enhance the branding efforts devoted to these products
    ▪ bracketing = patent everything else your competitor has not patented to lock him out of the market
  o anticipate market and technology shifts – owning IP also helps companies develop favorable partnerships and licensing relationships and helps to keep costs down

**Improve financial performance**

- companies’ biggest assets today are intangible ones like patents – but in most cases they are not managed well; ways to realize the hidden financial value of patents:
  o tap patents for revenues – by licensing of patent rights; after you sunk the costs of R&D leverage that sunk costs
  o reduce costs – proper management of patent assets yields significant savings of reduced portfolio maintenance costs (through out what you don’t need) and taxes (donate unnecessary patents)
  o attract new capital and enhance corporate value – you can repackage patents to be highly attractive to investors; patents can also be useful in bolstering corporate financing efforts and can communicate potential earnings to investors and the financial community (there is a correlation between patents and profits – but largely disregarded)

**Enhance competitiveness**

- value of patents as competitive weapons and intelligence tools becomes most evident in day-to-day transactions; block competitor’s product development plan; gain entry into a hotly contested new market; find most attractive acquisition opportunity; reduce risks involved in a high-stakes merger

- ways companies can bolster their competitiveness by using patent strategies:
  o outflank competitors
  o exploit new market opportunities – having entry protected by patents
  o reduce risk – information contained in patents can help companies seeer their R&D and merger & acquisition programs around infringement and due diligence potholes
    ▪ infringement dangers are real and can also lead to shareholder lawsuits
    ▪ patent mapping can reduce risks inherent in mergers – but financial evaluations are just about to recognize the value of patents also in mergers; but it is important to look at expiry dates of patents, possible loopholes or improper claims, whether the human capital behind the patents can be retained in a merger, etc.

**Conclusion**

- race to capture lead position in new industry is often determined by the outcome of a patent shoot-out (see e-commerce)
- companies that treat their patent portfolios as a strategic asset and a new core competence will enjoy a big advantage over those that don’t – the effort is made easier by technological advances in patent asset management

**Auditing your patent portfolio**

- assessing the financial value; divide into core and noncore groups
  o for core patents (used in current or future products), value them on how much they contribute to the commercial value of a product or business
- for non-core patents (not used) valuation is easier as they can be the focus of IP licensing efforts
- alternative approach is using portion of total market capitalization as proxy
- another alternative is the Knowledge Capital scorecard → see page 13

- **assessing the business and commercial value** → assign patents to business groups and map those along a dimension of decreasing growth rate and then lay a grid over it and divide vertically the patents by whether they are/will be used or not in the business group
**Competition, Compatibility and Standards (Farrell, J. & Saloner, G.)**

- **compatibility** = result of coordinated product design, enabling products to work together
  - de facto standards or set standards by commissions (problem: slow & lack of enforcement power)
- **benefits of compatibility:**
  - network externalities → value to participant depends on size of the network
  - competitive effects → standardization shifts competition to price terms (commodity markets), which encourage efficiency
  - variety → argued that it limits variety, but can also increase it through mix-and-match possibilities
  - cost savings → scale economies reduce production costs; complements may be more readily or cheaply available; saves on costs of learning how to use products
- **demand-side economies of scale**

**Does standardization enhance competition**

- incompatibility limits competition to the systems layer, once a consumer chooses, the ex-post competition within systems is very limited and ex-ante competition is not necessarily an adequate substitute → w/o standardization there is some monopoly power in the aftermarket, which can be broken by standardization
- competition is also enhanced by reducing threat of being orphaned in losing technology → also smaller firms can compete
- standardization can help in, or help replace, regulation
- **adverse effects** → 1) mix-and-match can also lead to higher equilibrium prices; 2) competition between prospective standards is good, but once one has won, de facto standard may become a source of monopoly power

**Compatibility and innovation**

- decision to adopt a new standard should depend on: 1) gross benefits from switching; 2) costs; 3) availability of better alternatives in the near future → however, inefficiencies can arise from problems of coordination and communication, or from the importance of installed bases leading to excess inertia (sticking with old standard when new should be adopted) or excess momentum (switching when not efficient)
- coordination problems → as information is not perfectly distributed, there is a symmetric excess inertia – all might prefer the new technology, but none switches due to uncertainty
- communication can reduce asymmetry in information, but also builds new problems
- installed base problems → generally there are delays in achieving compatibility on a new standard, the costs of incompatibility are borne disproportionately by the first users to switch
  - new standard is less likely to succeed the more important the transient incompatibility costs and the larger the installed base → sponsor of proprietary standard may take actions to affect the likelihood of adoption of a new standard (product announcements, predatory pricing)
  - switching may also be only convenient for existing users at certain times
  - however, if being stranded on an old standard is undesirable, excess momentum may occur

**Timing of standardization**

- early standardization can yield longer and earlier from of benefits and increase growth, however waiting has also its advantages as a later decision will on average be a better decision (especially when choice is irrevocable)
- authors argue that ability of markets to create better standards is limited: 1) power to determine what gets adopted is often effectively vested in few market participants; 2) incentives to standardize early versus late depend on extent to which it appropriates the benefits from early standardization → attributing problems of market standardization to conventional imperfections of market structure is a mistake → certain standard lessons of economics must be treated cautiously

**Industrial policy**

- compatibility choices affect nature of competition → affect also international trade: 1) demand side economies of scale can act same way as supply-side economies; 2) international standard-setting is often a 2-stage affair (premature standardization at national level)
Choosing how to compete: Strategies and tactics in standardization
(Besen, S.M.; Farrell, J.)

- increasing importance of compatibility standards raises 2 areas of strategic issues: 1) policies towards vertically related firms (suppliers of complements – try to encourage generous supply for you); 2) policies toward horizontal competitors (focus of this article)
- main focus: competition within a standard or competition between standards

- network markets are: 1) tippy; 2) driven by expectations about the ultimate size of a network; 3) history matters – compatibility with installed base

Competition for a prize
- the possible gains from an established standard for one firm are tempting, but fierce competition for a market may reduce potential gains and delay market growth → competition for the market
- standardization shifts competition to price and service terms → competition within the market
- payoffs depend on the skewness of returns and sharpness of the available competitive tactics in the 2 forms of competition

Forms of competition → 3 combinations
- competition to determine the industry standard → standards battle with 4 tactics:
  o building an early lead
  o attracting the suppliers of complements – competitive supply is necessary (movement to some integration)
  o product preannouncements → retard growth of rival’s sales, but may also cut into own sales and needs credibility to work
  o price commitments – public commitment to low prices over the long term can influence expectations favorably
- both players prefer own technology, but also prefer compatibility
  o initial tactics are directed towards persuading the other firm to fight on your turf rather than on his → bargaining problem with commitments (reduce profitability) and concessions
  o types of concessions: 1) low-cost licensing – also assures buyers of second source; 2) hybrid standard; 3) commitment to joint future development; 4) shift of future development to neutral third party; 5) promise of timely information about changes in standards
- firms are dissimilar, one prefers to go alone, the other would like to be compatible to the other and join its network
  o larger firm more likely to prefer incompatibility – however strategic positions with respect to quality or cost can also lead to different preferences about compatibility
  o outcome is largely dependent on timing and commitment issues
  o firm preferring incompatibility can resist by 1) asserting intellectual property rights, or by 2) changing technologies frequently

Conclusion
- processes by which standards are established is a rich area of competitive strategy – by promoting standards, or preventing their adoption, firms crucially affect the competitive environment in which they will operate

Establishing a standard: Competitive strategy and technological standers in winner-take-all industries (Hill, C.W.L.)
- ability of a firm to establish its technology as an industry standard is a critical determinant of its long-term competitive position and success
Why standards are important

- compatibility is normally maintained by adhering to a common technological standard, or set of design principles
- in industries where compatibility is important, value to a consumer of owning a product is an increasing function of the availability of comparable products, which is in turn largely determined by the installed base → self-reinforcement (increasing returns – successful today → successful in the future)
- however, technological powess is not enough to guarantee success in markets where standards are important – strategy also matters

Strategic options → aimed at increasing the installed base

- licensing (and OEM agreements):
  o benefits: 1) wide initial distribution; 2) co-opts competitors – reduced consumer confusion and less battle; 3) builds market expectations – increases supply of complementary products
  o costs and risks: 1) appropriation of technology – licensees may alter the technology later; 2) increased competition in end market – lower profits (in complex, uncertain, dynamic nature of real world, theoretically optimal pricing and fixed amount royalty schemes may be impossible to implement)
- strategic alliances – in general a more effective tool for co-opting competitors that are already well down the road developing their own standard
  o benefits: 1) wide initial distribution; 2) co-opts competitors – reduced consumer confusion and less battle; 3) builds market expectations – increases supply of complementary products; 4) superior technology may result
  o costs and risks: 1) appropriation of technology – can be countered by credible commitment of both partners; 2) increased competition in end market – lower profits
- product diversification – aims at ensuring adequate supply of complementary products, especially those that are key to success
  o benefits: 1) increased supply of complementary products; 2) profit from core and complementary products
  o costs and risks: 1) additional capital commitments – higher costs of failure
- aggressive positioning – penetration pricing, product proliferation (=serve as many niches as possible) and wide distribution → give attention to the critical marketing dimensions of price, product features, distribution and promotions (which are also drivers of the functional level strategies which need to be sufficient to support the aggressive positioning)
  o attention is given to the central issue of the positioning at the time of the initial product launch
  o benefits: 1) accelerates adoption of technology; 2) preempts rivals
  o costs and risks: 1) loss of ability to skim market – foregone initial profits; 2) requires high initial investments – higher costs of failure

Contingencies

- of course in selecting among (or the mix of) the strategic options there are a number of contingencies:
- barriers to imitation → decrease time pressures; however are rarely efficient (e.g. patents can be invented around)
- complementary resources → firm can be viewed as a bundle of tangible and intangible resources that need to be sufficient to support the selected strategy
- capability of competitors → the stronger the competitors, the more attention should be given to them
- supply of complementary products → availability of potential suppliers of complementary products is decisive for whether or not diversification is necessary

Competitive strategy → many possibilities – reduced to 4 alternatives:

- aggressive sole provider → pursuit of an aggressive positioning strategy in isolation with provision of complementary products if necessary
  o contingencies favoring it: 1) high barriers to imitation; 2) firm possesses required complementary resources; 3) supplies of complementary products exist or diversification is feasible; 4) lack of capable competitors
- passive multiple licensing → license to all corners and let the others develop the market
  o contingencies favoring it: 1) low barriers to imitation; 2) firm lacks complementary resources; 3) many capable competitors
- aggressive multiple licensing → license to many firms, but at the same time pursue an aggressive positioning strategy
- contingencies favoring it: 1) firm possesses required complementary resources; 2) barriers to imitation low; 3) many capable competitors
  
  - selective partnering → enter into an alliance to jointly promote a standard
    - contingencies favoring it: 1) firm lacks critical complementary resource that partner possesses; 2) high barriers to imitation; 3) partner is also a potential capable competitor

Conclusion

- standard battles are commonplace – from the perspective of the sponsoring firm for a technology the key strategic issue is how to establish its technology as an industry standard and capture the substantial profits that flow from ownership of the standard