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Innovation Management
Organizing for innovation
Part 1 – organizational design

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Communication and organization in innovation

- Innovative activities need a specific organization
- The resource-based approach leads to viewing the organization as a set of routines (→ processes) rather than as structure (→ organization chart)
- Consequences
  - The “golden rule”: organizational proximity should be proportional to the intensity of communication flow
  - Tendency to neglect efficiency gains due to specialization and division of labor

Innovation activities require specific organization with the respect to the company for very simple reason: these activities are different from all the rest. e.g. you might organize your sales in a given way for sales and production but when it comes to R&D, then you have to taken into account that these activities are different. Usually the message that comes out is you organize people doing these activities according to two different approaches:
1- Traditional specialization and division of labor: Put all different people in different places. Another perspective to put different people together as they need each other. e.g. putting python developer and hardware people together to achieve the desired result.
2- Realizing engineers are strange managers: the are different from others in a company. (Allen's research)

Allen research results: 1- Does literature have a role in engineering work? They don't tend to use literature mostly instead they communicate among each other.

Information channels in innovation

- Studies on R&D organizations date from the ’70s at MIT (T.J. Allen, “Managing the flow of technology”) and have repeatedly been confirmed even by taking recent advances in ICT into account (for how long?)
- These studies arise from the intuition that development activities are different from research ones
- Two phases of research
  - Twin projects (e.g., dual supply contracts) in order to study different problem- solving strategies
  - Communication network analysis to study interaction between personnel engaged in product design and development

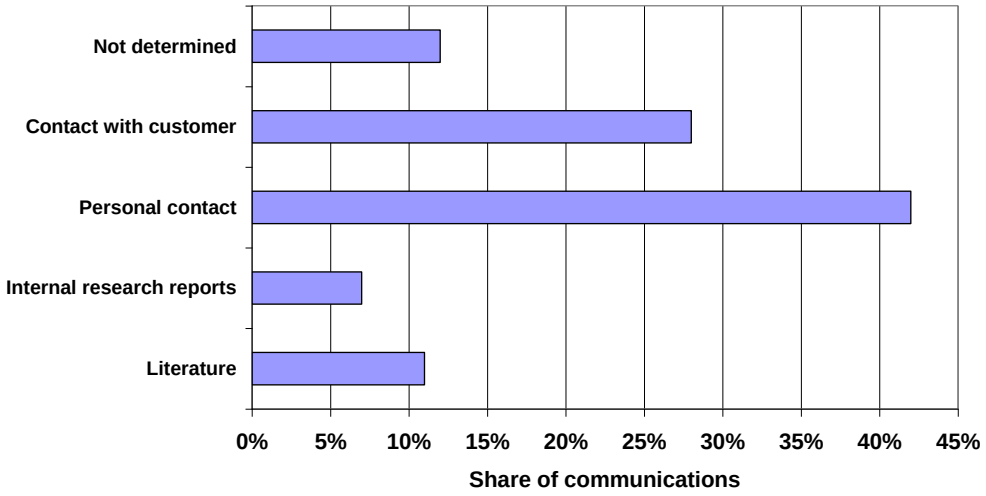
Information channels in innovation

- Phase 1 – the role of literature
  - Hypothesis that literature has a key role in suggesting technical solutions, as it has in technical education
  - On the opposite, it has a limited role when one observes
    - Frequency of use
    - Usage by expert designers

Less role in engineering work.

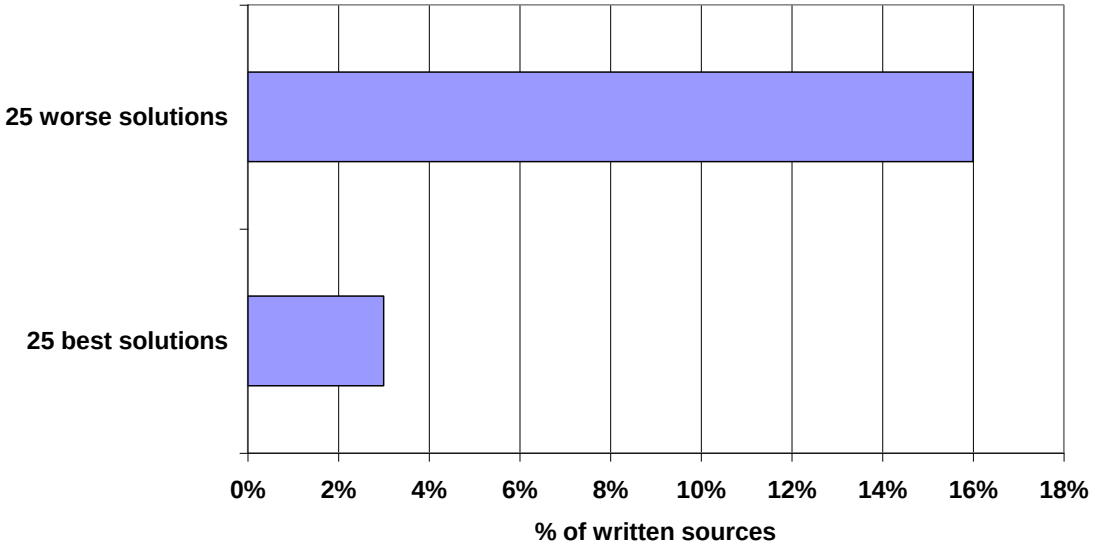
Information channels in innovation

Source of 494 communications providing possible solutions to technical problems (on 17 projects)



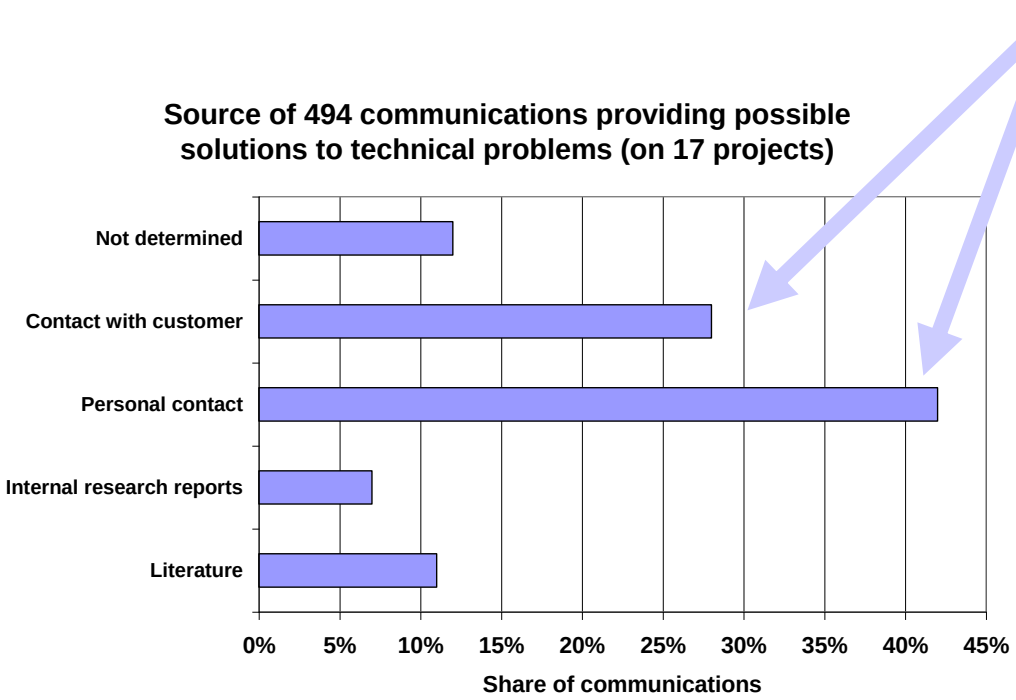
First of all, experience and personal context matter a lot.
If you are an experienced engineer, you probably go more, you will tend not to need to read a book, you have an excellent result (not because you read books) but because you got experience.
If you're an inexperienced engineer, not having experience means you will tend to open book (despite reading books), your results will be poor. Be aware that reading book might not be sufficient to get results because experience matters.

Association between quality of solution and information source



Information channels in innovation

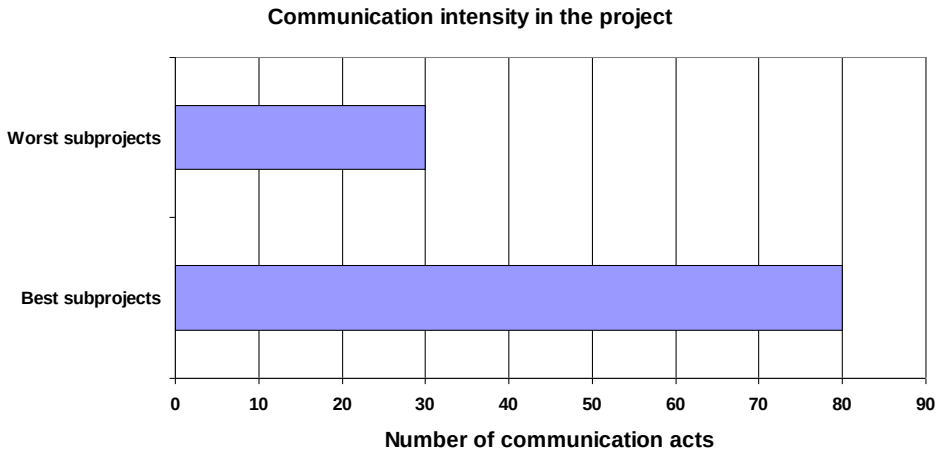
- Phase 2 – communication network analysis
  - Why? Because personal contacts are the main source of information

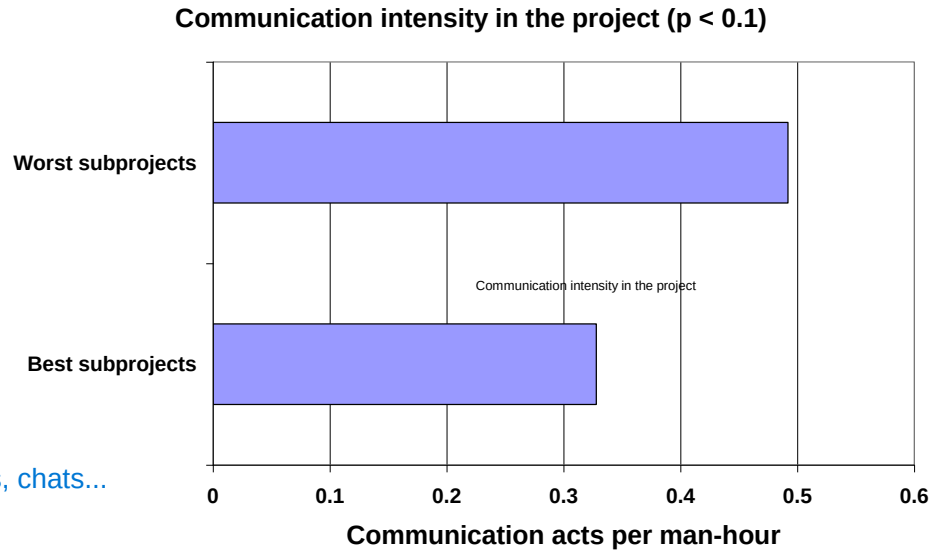


Second, how these personal context arrives?

Information channels in innovation

- Phase 2 – communication network analysis
  - Hypothesis 1 – “communication intensity” (i.e. n. of communication acts) has a positive impact on project quality
  - … but that’s not confirmed by data, if related to project effort (n. of communication acts per man hour)





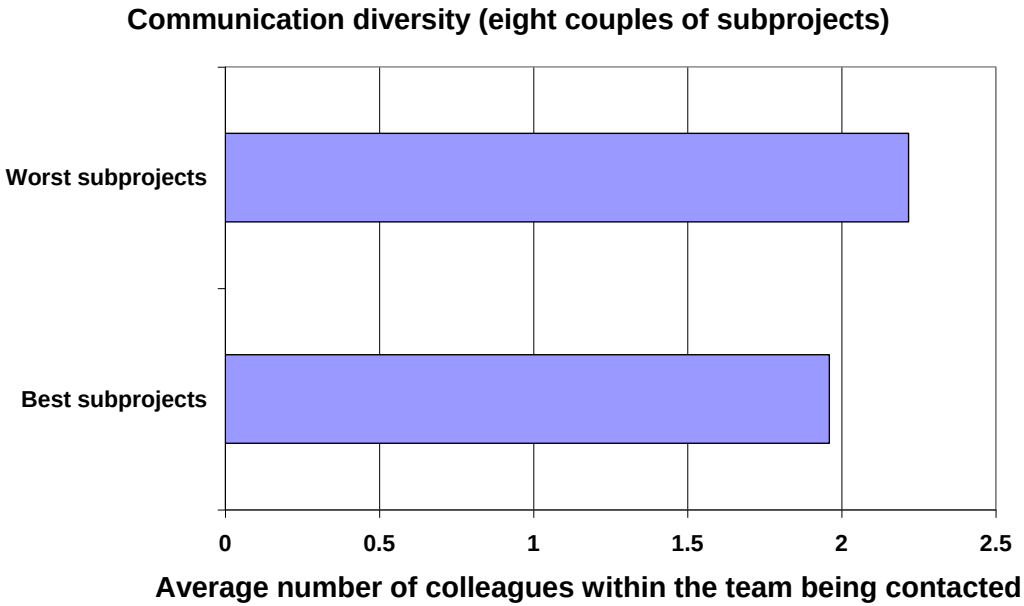
1st hypothesis: More people talk to one another, the better it is.
Good sub projects have higher number of communication acts.
How measured in 70s? survey at end of each day asking people with who they have spoken. How now? monitor online meetings, emails, chats...

Information channels in innovation

- Phase II – communication network analysis
  - Hypothesis 2 – "communication diversity" (i.e., number of colleagues with which communication occurs) has a positive impact on the project…

…not confirmed

2nd hypothesis: How many different people on the team have you spoken? The more people you speak on the team, the better it is.

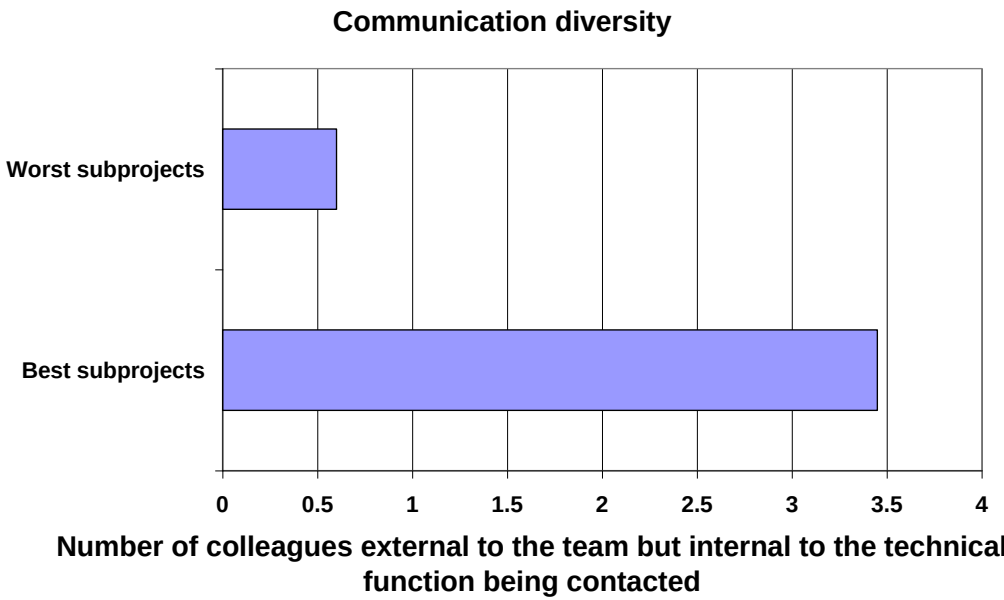


Information channels in innovation

- Phase 2 – communication network analysis
  - Hypothesis 3 - “communication diversity” with respect to the colleagues not on the project team but belonging to the same functional area has a positive impact

… TRUE

3rd hypothesis: Communication acts with people beyond the team. The more people you speak beyond the team, the better it is.

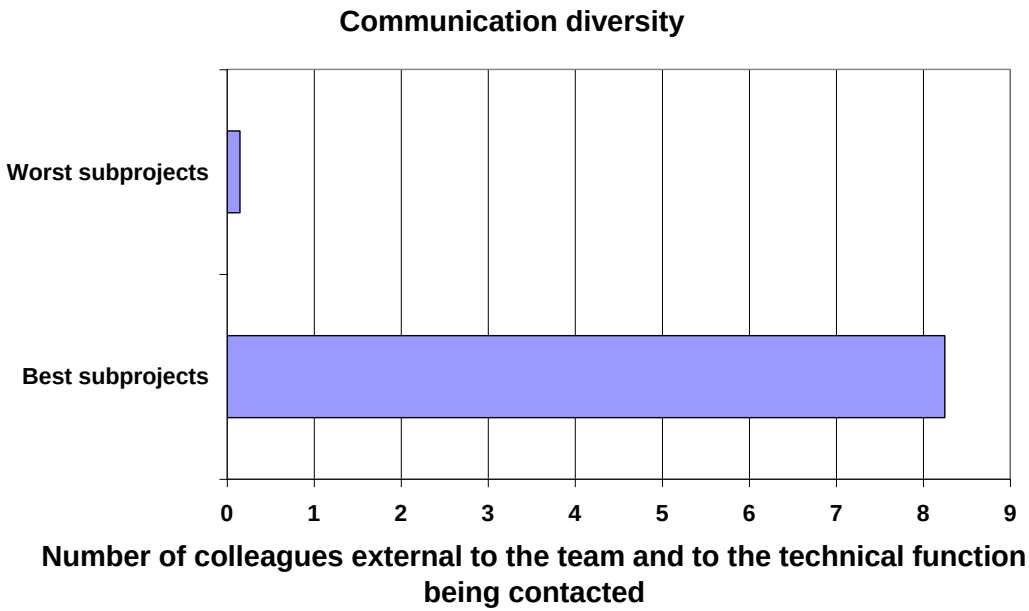


Information channels in innovation

- Phase 2 – communication network analysis
  - Hypothesis 4 – “communication diversity” with respect to colleagues not on the project team and not in the same functional area has a positive impact

… VERY TRUE

4th hypothesis: Speaking to people not only beyond the team but also not in same functional area.



Júnior engineers Internal consultancy problems: 1- You don't even know where to go. 2- Suppose you know where to go (to experts), you don't want to imply admission of your technical ignorance. 3- The experts are busy.

Information channels in innovation

Message: Internal consultancy is great and important specially for the juniors which are the ones who are not able to do it. Because internal consultancy works for experts who need it the least.

- Phase 2 – communication network analysis
  - In short, it's important to create information links
    - Outside of the individual's organizational context,
    - Not necessarily outside of the firm (results are often poor)
  - Internal consultancy is difficult to perform because
    - Designers often compete among themselves
    - Designers are often overloaded with work (don't have time for it)
    - Asking for help implies an admission of one's own technical ignorance
  - In short, internal consultancy works well among the more skilled designers
    - Because the one being helped will probably be able to return the favor
    - Because the one being helped has a strong reputation and is not afraid of asking for help once in a while

Information channels in innovation

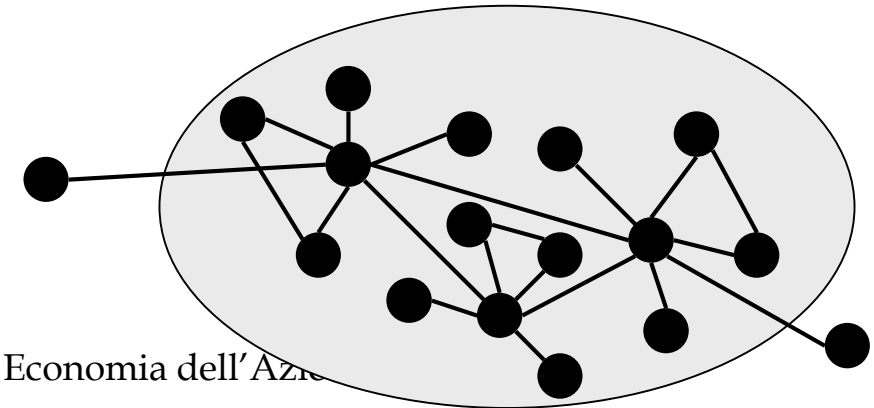
- Phase 2 – communication network analysis
  - Tapping in externally-available knowledge is important, but
    - Direct contact often is ineffective (specificity of knowledge, technical problems and language)
    - Hiring new personnel often leads to failure
  - Allen discovers an alternative vehicle for absorbing knowledge: the technological gatekeeper

Technological gatekeepers: They are a few people within the informal network that connect people within or outside of company.

Approximately 5% of people in a company are gate keepers without officially being recognized.

Information channels in innovation

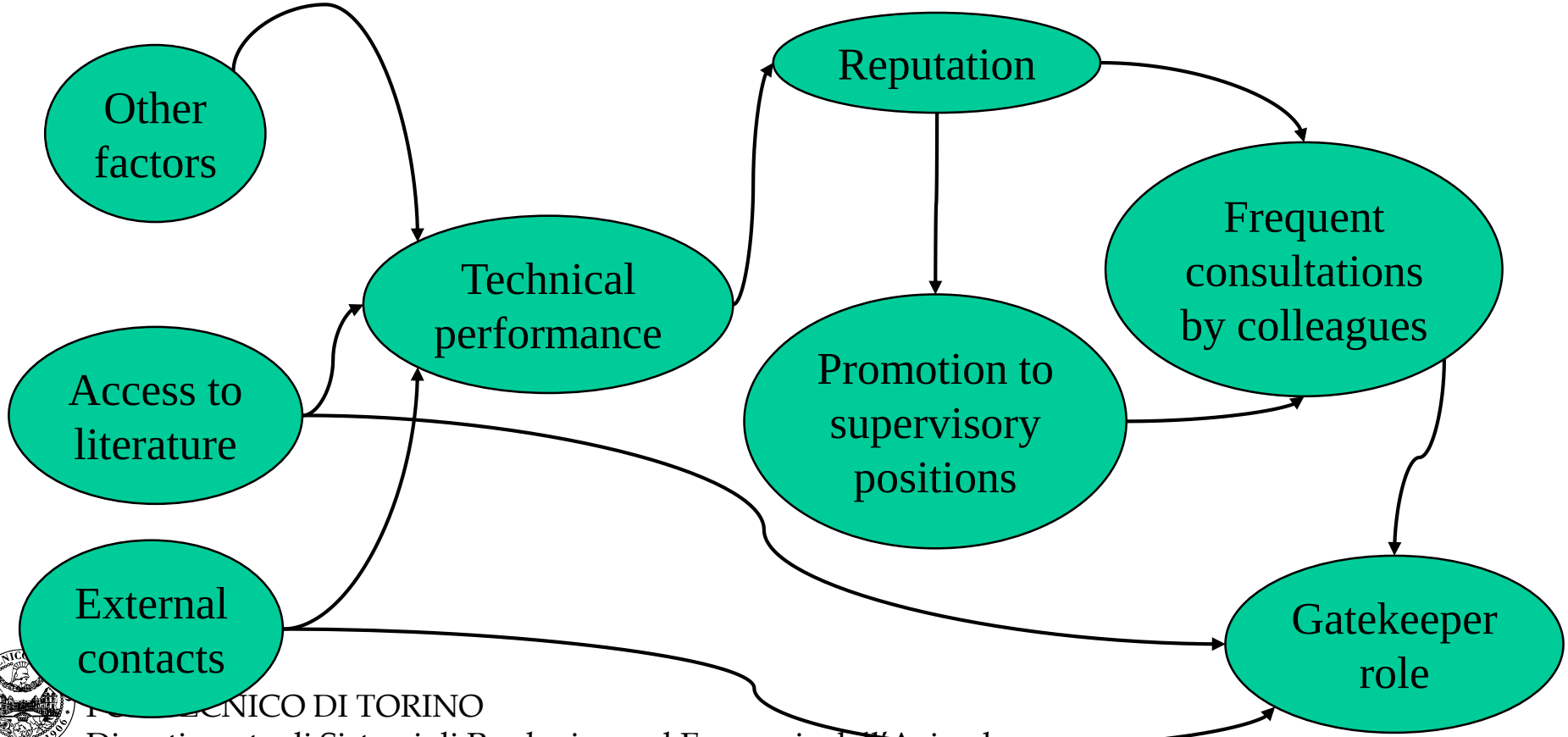
- Technological gatekeepers
  - Are located at focal points of communication flows (hub-spoke)
  - Are exposed to communication flows coming from beyond the firm's boundaries, thanks to
    - frequent contacts with colleagues outside the firm
    - Knowledge and readership of literature
  - Are continuously on the lookout for contacts, both externally and internally (especially with other gatekeepers)
  - Are engaged in "translating" external knowledge (generally explicit and codified in nature) so that it may be effectively used within the firm



Gatekeepers: They are bright, they usually look around for literature sources, news... They have good level of technical performance, usually because of this they have reputation, because of reputation they are promoted at one level. Therefore, reputation and being above basic means everybody goes there.

Information channels in innovation

- Technological gatekeepers
  - Arise following a causal model



Why fail? 1- Bad management: going to the efficient one, results in failed recognition. 2- Being busy with communications, you will lose contact with real needs and knowledge of the company (you will not be a gatekeeper anymore, you become an like an external consultant).

Information channels in innovation

3- Conflict with project and line managers: Your way doesn't meet their expectations.

- Technological gatekeepers
  - The role can easily disappear because of
    - Failed recognition (the gatekeeper gets overloaded with work, because of his technical efficiency)
    - Excessive recognition (the gatekeeper loses contact with internal routines)
    - Conflicts with project and line managers
    - Promotion to management positions → "dual ladder" career paths

4- Dual ladder career paths (large companies): I hire two people and try to assess what kind of angles they are, one is technical and one is more managerial. One becomes knowledge manager, other one budget, teams... manager. After years: knowledge manager solving problems. (good life). Another one: meetings, budgeting, routines... (bad). The point is it is very hard to manage gatekeepers.

How to spot an innovator? There are tests, but still difficult to do it. What happens if you run a company only with innovators? Companies run with two pals, one innovator, other more managerial. e.g. Microsoft, Bill gates (the innovator) with Steve Ballmer.

Information channels in innovation

- Are technological gatekeepers enough to ensure innovation?

No, because they are technical problem solvers, not innovators. Innovation is about making things happen which is different from technical problem solving.

  - Gatekeepers facilitate innovation from a technical point of view, but firms also need entrepreurial innovators to lead and inspire the process (Cohn et al. 2008)
  - Innovators solve problems top-down (broad vision to execution, without getting stuck into details)
  - The management team must include innovators ("*brainy and creative people may come up with ideas, we make the decisions and our functional managers will execute them*" does not work)
  - Some firms (e.g. the original HP, Apple, fashion houses) are formally or de-facto structured with dualistic leadership functions
  - Innovation talent is rare, complex (visionary thinking out of the box + capability to sell and execute the idea) and difficult to identify
  - Career management is tricky (is there an innovation function?)

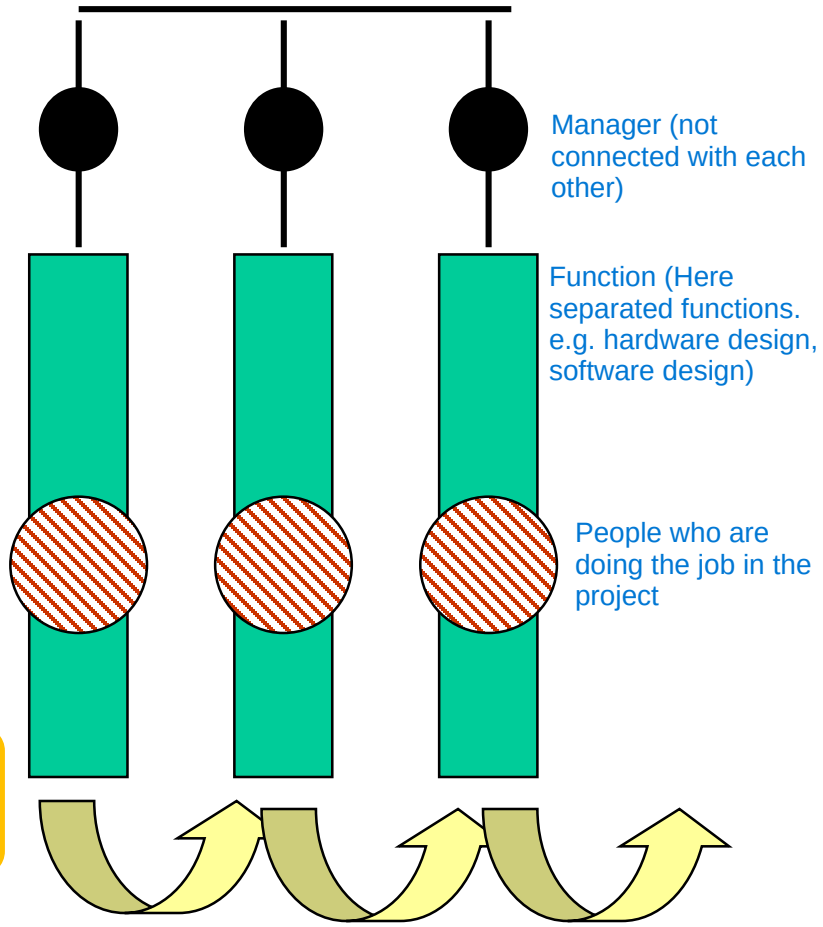
Organizational design

How to organize people with respect to the organizational chart?

- Standard organizational forms: functional organization
  - Work is performed within functions
  - Coordination is performed by line (functional) managers
  - “Over the wall” information transfer
  - Specialist competencies focusing on detail, rather than integrative competencies
  - Internal efficiency (resource pooling)
  - Simple coordination (unique authority)

Advantage: Simplicity in communication, efficient.
Problem: Ineffectiveness of communication - Inter function communications which are needed to make sure that things work are very difficult.
Solutions to solve these problems (next slide)

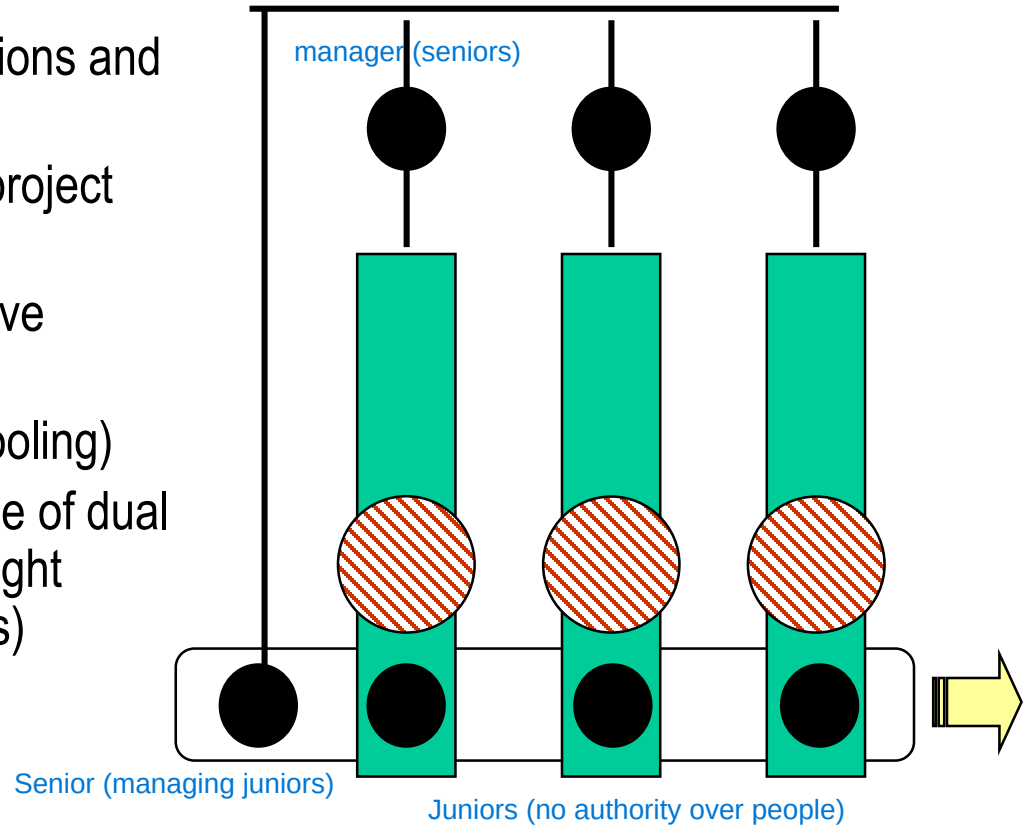
e.g., Apple and its 17 functions (led by experts) and reporting to the CEO



"lightweight" teams and project managers: You create an inter functional team with a project manager which have to deal with inter functional communications and make sure things are solved.

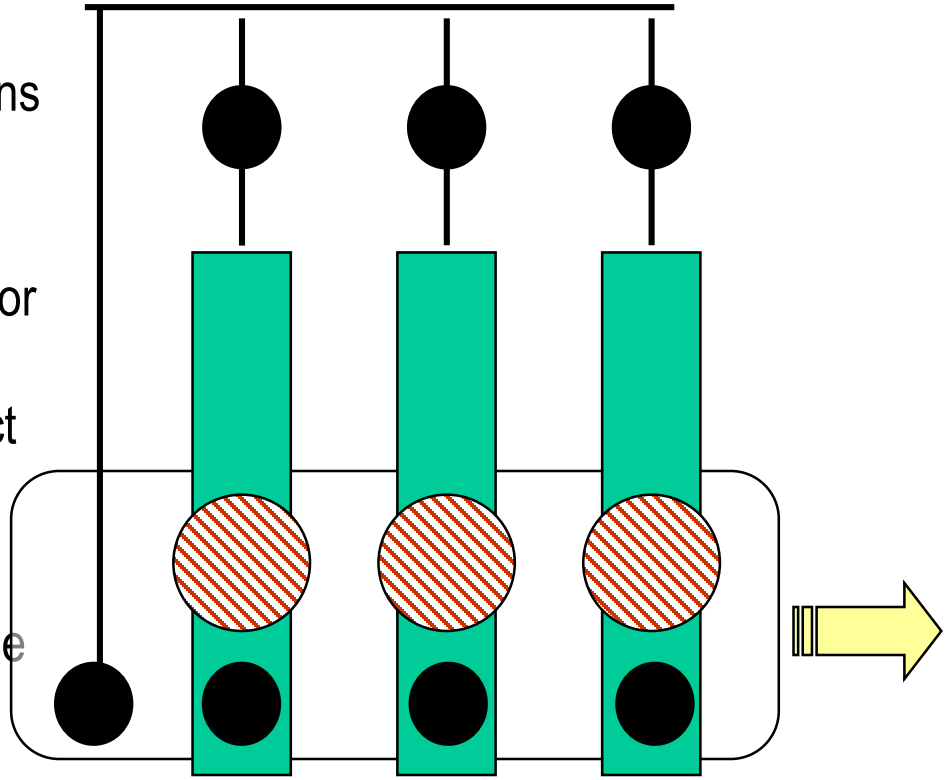
Organizational design

- Standard organizational forms: "lightweight" teams and project managers
  - Work is performed within functions and under line managers
  - Coordination is performed by project managers and liaison officers
  - Specialist, rather than integrative technical competencies
  - Internal efficiency (resource pooling)
  - Coordination problems because of dual authority structure and lightweight project managers (often juniors)



Organizational design

- Standard organizational forms: “heavyweight” teams and project managers
  - Work is performed within functions under the authority of project managers
  - Line managers are responsible for the technical proficiency of resources assigned to the project
  - Coordination is performed by project managers
  - Integrative competencies become stronger
  - Lower internal efficiency
  - Coordination problems (well-balanced dual authority)



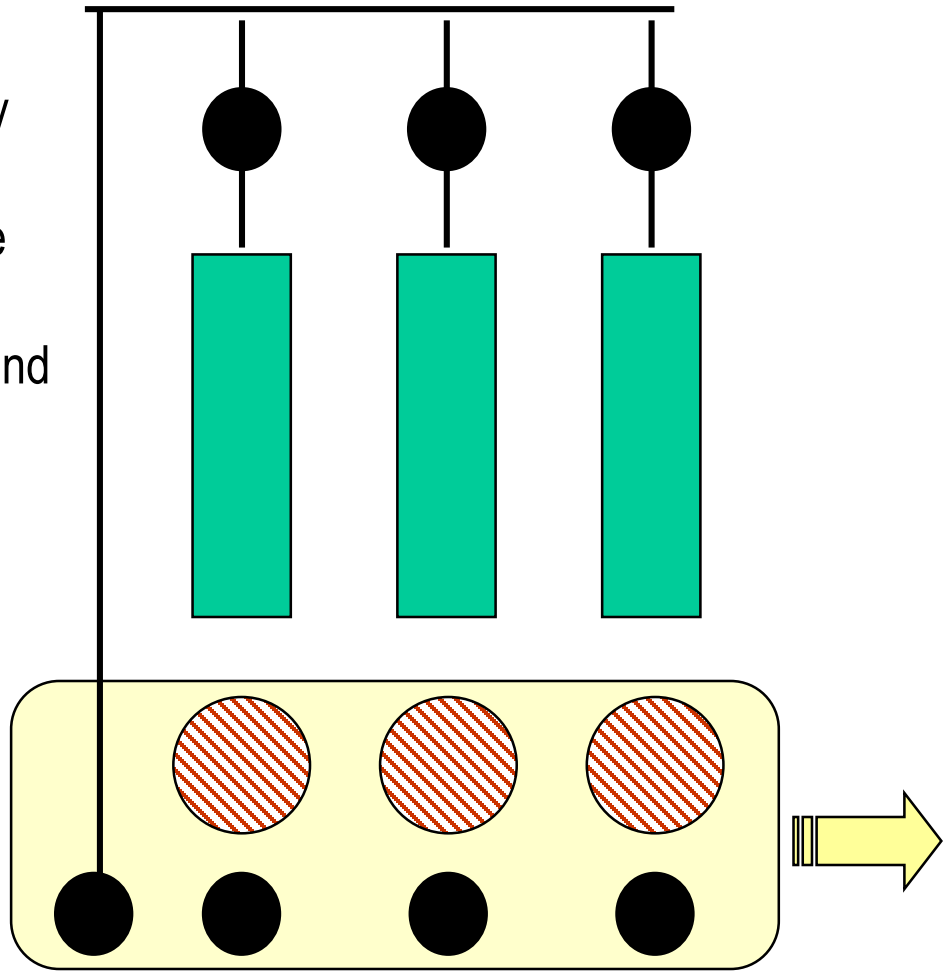
Problems: 1- Confusion over who your boss is. 2- People should work in maximum one or two projects because too many bosses results in inefficiency. This means you have people who work for a project full time (e.g. a couple of years) but are not busy 100% time (inefficient), or you will try to use them to stand for other people who are not present which means you become a generalist not anymore specialist. (costly)

autonomous teams: Take people out of the functions, we create a root which is separate (geographically in a different place) so they are able to solve the problems on their own. Problems: Inefficient, very reflective, risky (people losing contact). When useful: When you have projects which are relatively short.

Organizational design

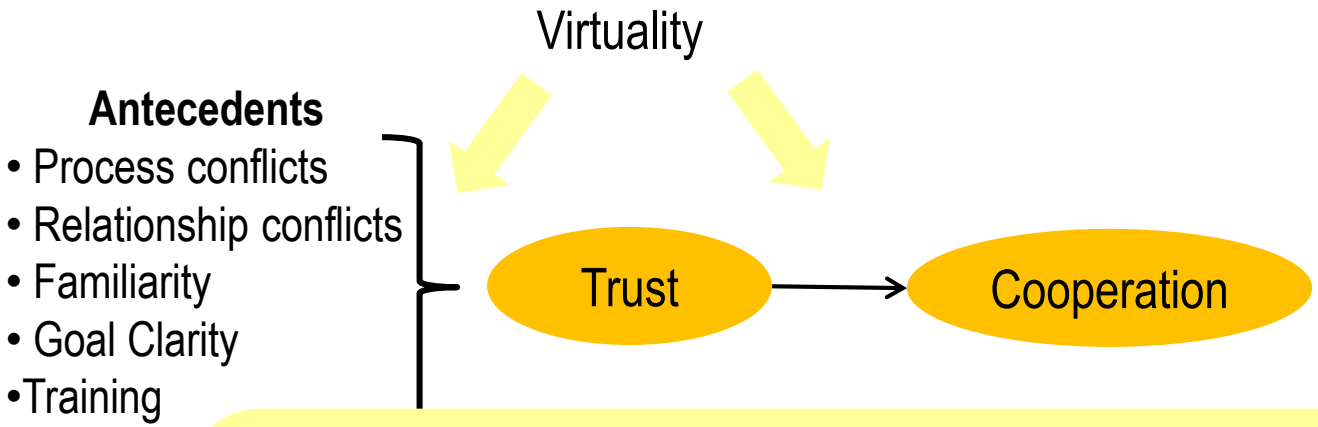
Long project: You will get out of your function. (separated for a long time).

- Standard organizational forms: autonomous teams
  - Work is performed outside functions and under the authority of the project manager
  - Coordination is performed by the project manager
  - Integrative competencies grow and specialist ones decrease
  - Procedures are ad-hoc and “project based”
  - Low efficiency
  - Coordination problems (dual authority)



Organizational design

- An emerging issue is connected to the management of virtual, distributed teams (Bierly et al. 2009)
  - It is important to use the IT tools appropriate to the task
  - Literature insists on the importance of trust among team members



- Virtuality makes it more difficult to generate trust…

  … *however*,…
- … virtuality reduces the role of trust in generating cooperation
- Virtuality creates greater independence, which makes goal clarity very important for team effectiveness
- Physical meetings or temporary co-location can be used to sort out problems arising from virtuality, should IT not be enough

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Innovation Management
Organizing for innovation
Part 2 – the development process

Outline

- Innovation as a process
- Product development processes
- From sequence to concurrency
- Reducing time to market
- Formalizing the process

Innovation as a process

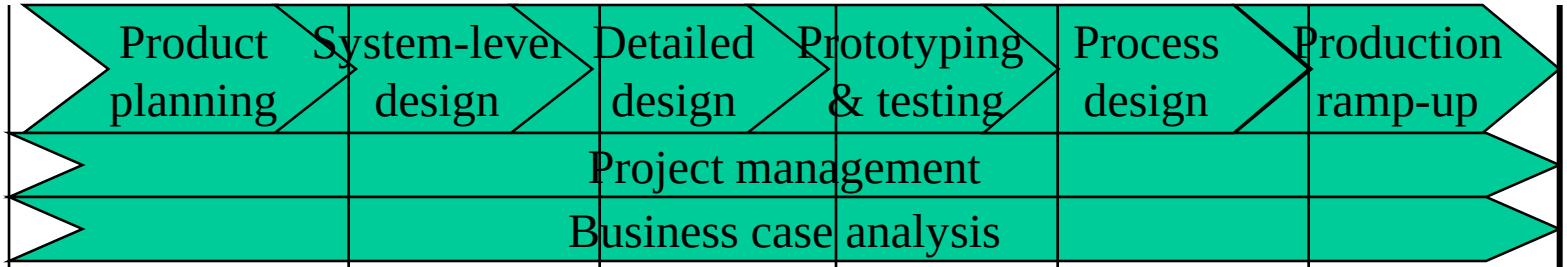
- "Innovation as a process" is coherent with
  - Current management practice
  - Modern theories of the firm
- Limitations are due to the artificial separation between
  - Subject and object of the process
  - Problem-setting and problem-solving
- Divergent from the "reflection in action" paradigm (Schon)
- Fully acceptable in case of
  - Medium to large firms
  - Moderate innovative content

Innovation as a process

- The product development process is
  - Part formalized, partly based on informal and unobservable aspects
  - Path dependent
  - Highly specific with respect to
    - The firm and its past history
    - Products
    - Upstream and downstream interactions

Innovation as a process

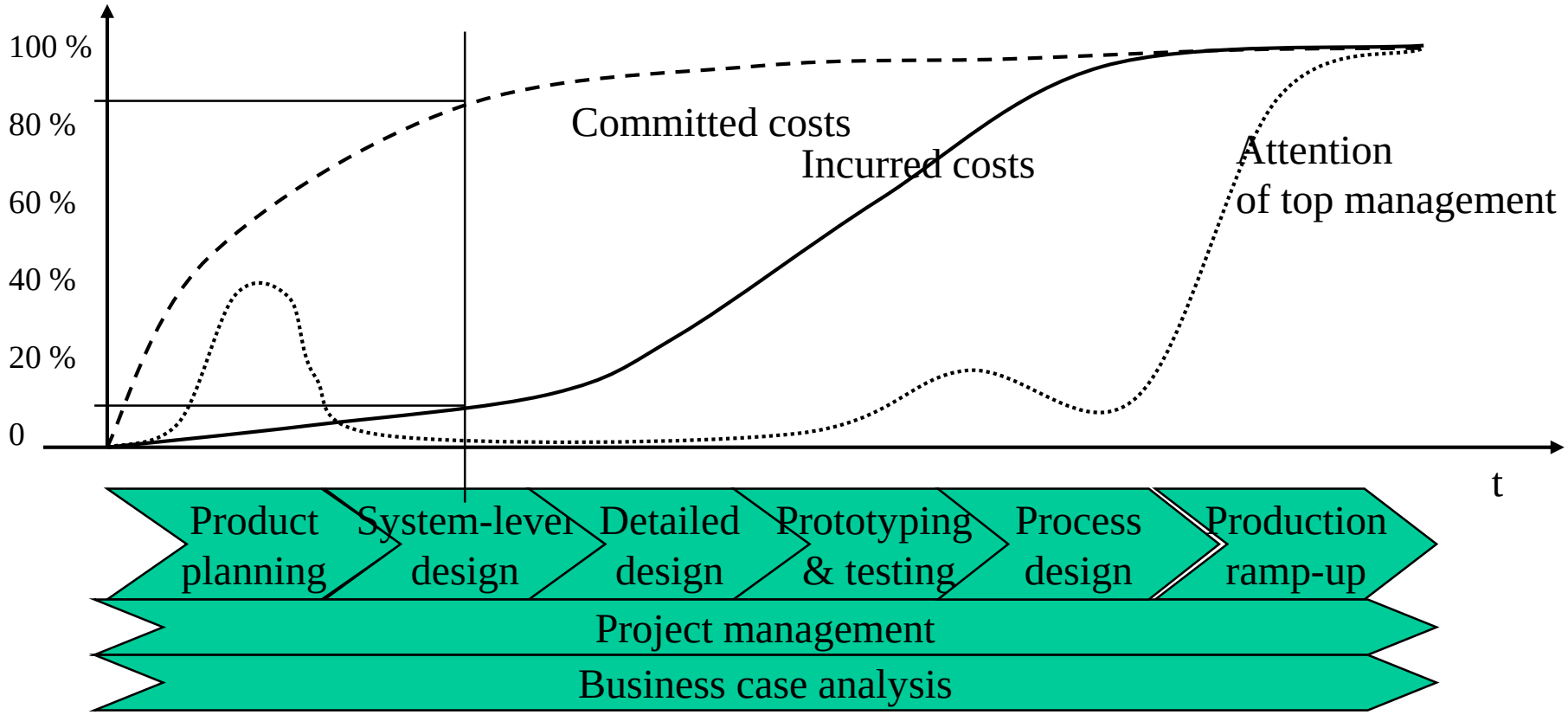
- Example of a stylized product development process



Marketing	XX	X				XX
Purchasing	X	XX	X			XX
Finance	X	X	X	X	X	X
Product design	XX	XX	XX	XX	X	X
Process design	X	X	X	XX	XX	XX
Production	X				XX	XX

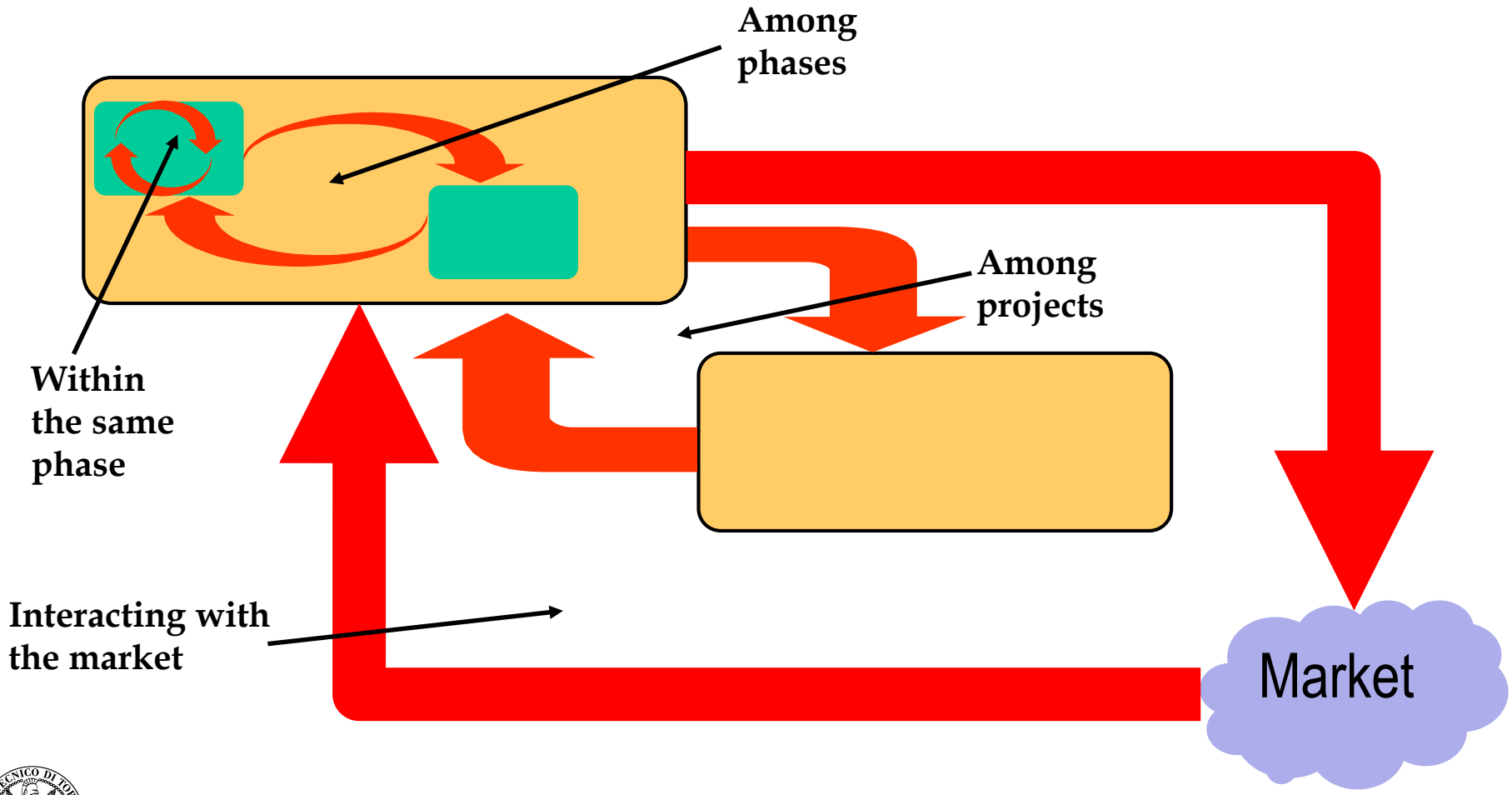
Innovation as a process

- The first steps of the process have a strong “lever effect”



Innovation as a process

- Product development exhibits iterations at different tiers



From sequence to concurrency

- Taylorism in new product development (1920-1970)
  - Efficiency achieved through specialization
  - Sequential “over the wall” management
- Design reviews (1970-1990)
  - Reviews carried out at project milestones
  - Management reviews and peer reviews with colleagues, customers and “downstream representatives”
- Concurrent engineering (1990-…)
  - Development activities performed in parallel
  - Role of IT systems (3D CAD, Model-Based Engineering)
- New paradigms deriving from software engineering (lean/agile)

Digitalization and "lean" approaches

- Virtual prototyping and digital products lead to a paradigm shift in product development w.r.t. management and cognitive approach
  - Virtual models / products are cheap to create and modify → development by *trial and error*
    - Experimentation is used for learning (not only verification)
    - Ex-ante knowledge becomes less important
    - Higher tendency to explore innovative solutions
  - Problems can be spotted earlier (*front loading*)
  - Faster experimentation can be used to
    - quicken the development process (with the same number of iterations)
    - Improve product performance (with the same lead time)
    - Place product development *in parallel* to sales
  - Rapid prototyping / manufacturing as complement / alternative to simulation

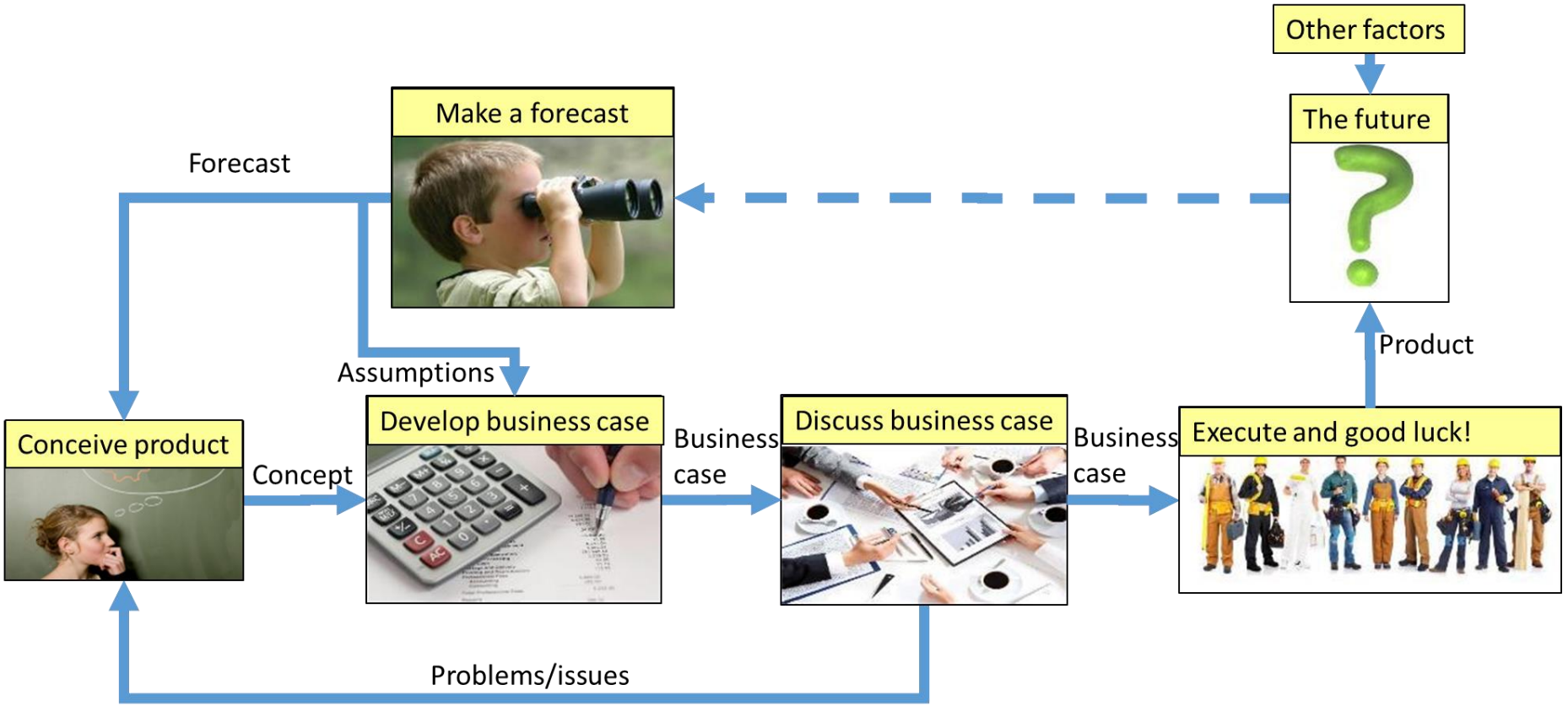
Digitalization and "lean" approaches

- Flexibility is important in new-product development ("flexibility α marginal cost of a design change $^{-1}$")
  - Low flexibility (Thomke 1997) leads to actions aimed to reduce the risk of taking wrong decisions (e.g., market research, stage-gate systems, etc.). These methods
    - are costly
    - can even be harmful in turbulent environments
  - It is possible to use late commitment strategies
    - Rapid and virtual prototyping, soft tooling
    - Real-time market research actions (e.g. Minimum Viable Products in Internet companies)
    - Decoupling development activities (e.g., inner engineering vs. styling, hardware development vs. firmware updates)
  - All this is leading to a paradigm shift (**lean / agile innovation**)

What is the "last responsible moment" for a given decision?

"Individuals and interactions over processes and tools.
Working software over comprehensive documentation
Customer collaboration over contract negotiation
Responding to change over following a plan"

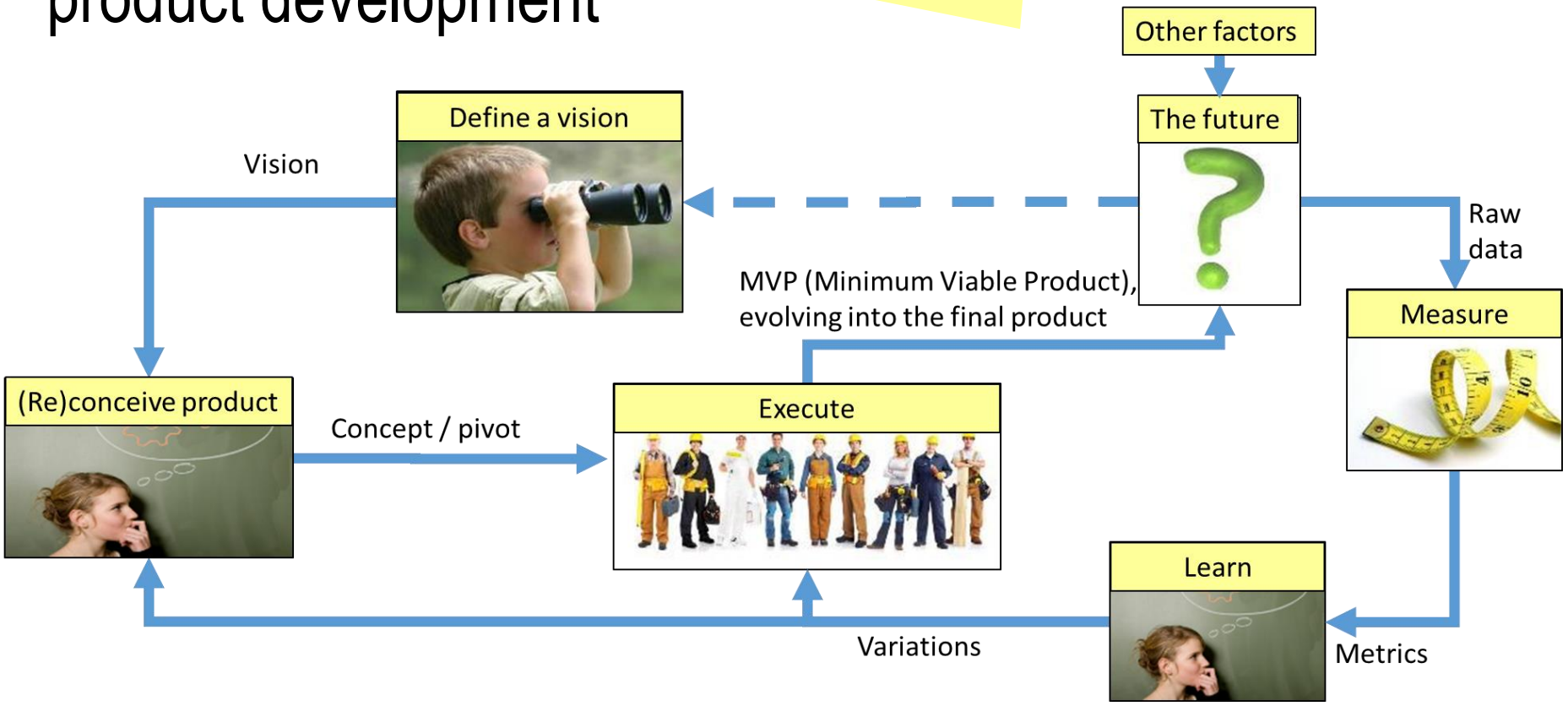
Traditional approach to product development



Lean approach to product development

Where can you profit from "Lean"?

- Must flexibility be low or high?
- Would you expect the "digital" content to be low or high?
- Low or high uncertainty?
- Technology or market uncertainty (or could it be either of the two, but then the iterative process will measure different metrics)?

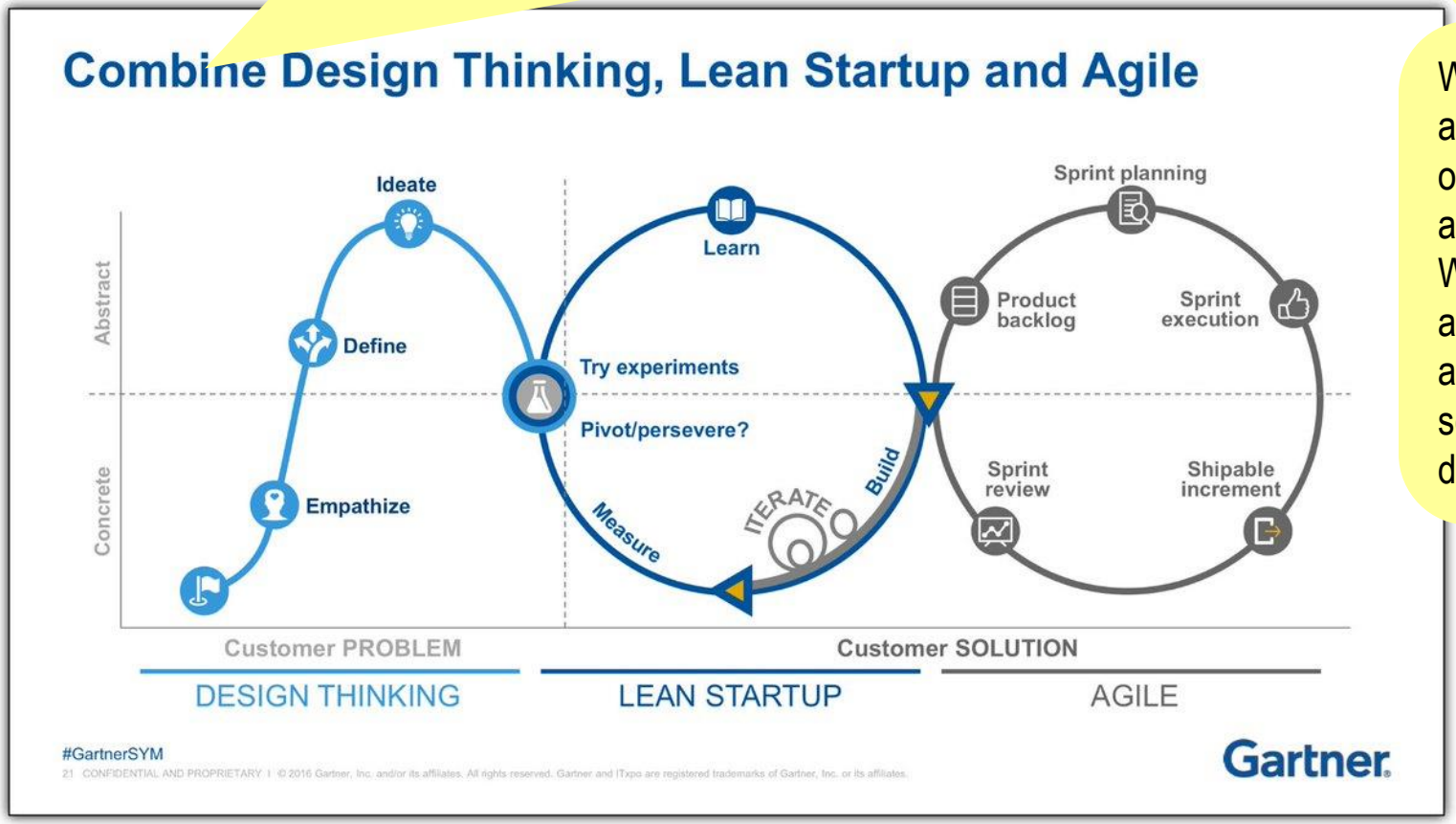


Design thinking = a design approach which is particularly suitable for *wicked problems*, based on

- deep and experimental interaction between designer and problematic situation
- separation between problem setting/finding and problem solving

Lean = a product development approach / business strategy allowing progressive development of sustainable solutions through iterations and pivoting

Agile = a project management approach allowing the progressive / iterative development of complex systems



With traditional approaches, project objectives are given and time/cost follow
With lean/agile approaches, time/cost are usually given, and scope varies/is discovered on the fly

Digitalization and "lean" approaches

Prototypes and MVPs can be of different nature

Representation of VPs

- Data sheets or brochures
- Storyboards
- Landing pages or product boxes
- Videos

Functional MVP

- Preliminary functional prototypes
- Wizard of Oz prototypes (real front end, fake back-end)

Life-size MVPs

- Near-final prototypes
- Mock sales and pilots
- Presales

Innovation games

- Design the product box and try selling it
- Buy a feature

Digitalization and "lean" approaches

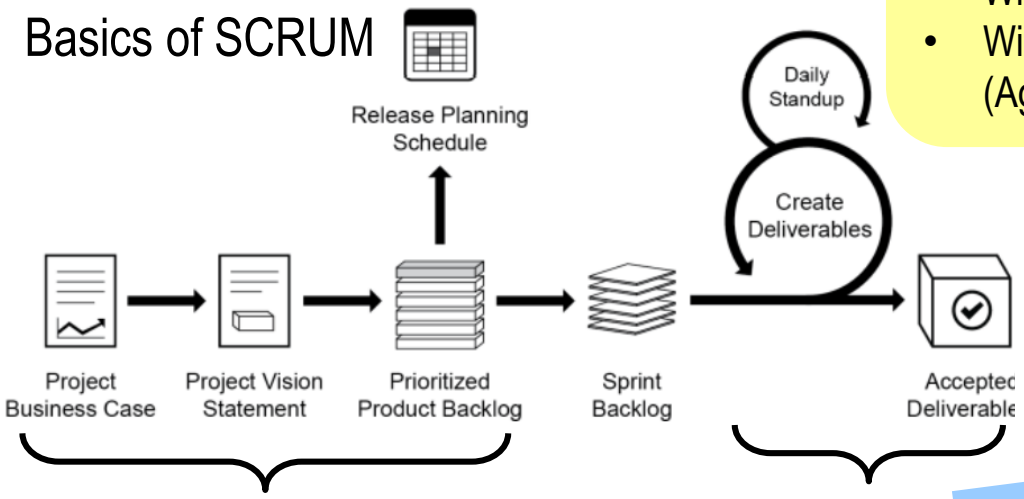
- Specific management methods inspired by Agile SW development and Internet startups
  - Rolling-wave planning
    - Rough plan for entire project + detailed plan for the next 4 weeks
    - Updates every 2 weeks or when needed
  - Progressive discovery / development / validation of customer-facing processes (sales, onboarding, growth engines, A|B testing, etc.)
  - Loose-tight planning (loose for creative phases, tight for repetitive work)
  - Timeboxing
    - Project is partitioned in fixed time boxes and the scope of each timebox is defined
    - No delays allowed, but flexibility in scope (a good way to avoid overengineering)
  - Variants of Agile project management / software development
    - Extreme programming (frequent releases, iterations, face-to-face meetings)
    - SCRUM (empowered teams, self-organized in 2-4 week “sprints” with clear objectives, daily standup meetings, constant monitoring of backlog / progress)

Digitalization and "lean" approach

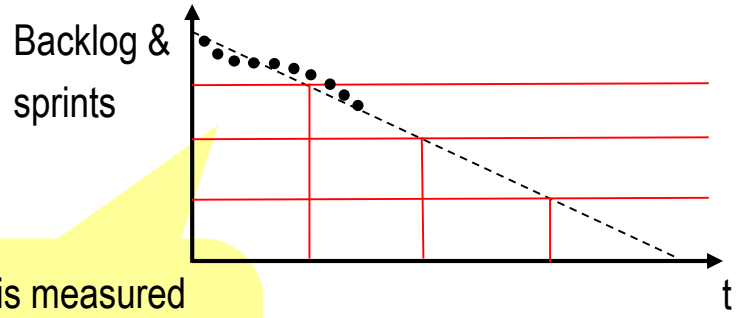
SCRUM can be used with physical products too, despite the "Constraints of Physicality" (Schmidt et al, 2017)

- To their "digital" parts
- When developing modular products
- Within each phase of a traditional, sequential process (Agile Stage-Gate, Cooper & Sommer, 2016)

- Basics of SCRUM



Backlog Refinement



Progress is measured visually via the backlog of tangible outcomes, not activities performed (e.g., bugs, FMEA issues, % of components designed)

Visual planning and control of activities via Kanban boards

Backlog section	To do	In progress	Done