R&D and Innovation

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Challenges

- Life cycle of products – up to 30 years
- Organizing competence – multi-disciplinary collaboration, often distributed development, different cultures
- Increased competition
  - World-class in efficiency required
  - Shorter lead-times
  - Lower development costs – re-use, platforms
  - Increased innovation capability
  - Improved user experience
- Application of lean/scrum in the development of embedded systems
- Recruitment
- Verification
- More safety critical software
The issue

• Most firms do not achieve the innovation performance that is within their reach!

• Some reasons behind this are:
  – Insufficient attention to the creation of innovation potential
    • Too narrow focus on the opportunities that build up the innovation potential
    • Lack of insights about and management of the innovation potential residing in social networks
  – Limited understanding of innovation economics
    • Inadequate use of optimization thinking
    • Dangerous perspectives on lean in R&D
The two sides of R&D - exploration and exploitation

Creating potential for innovation – building options

Realizing chosen initiatives with minimum losses – creating flow
What do we need to know about firm-internal networks for creativity and innovation?

- Effects of different structures
- Effects of changing processes
- Effects of management interventions
Collaborative ideation networks
- Effects of different network structures
Degree centrality: the amount of direct ties to an actor
For actor A, the ego degree centrality is 5. Information and knowledge access, sharing and creation.

Structural holes access to unconnected alters
For actor B = 2. Information dissimilarities, power
Mapping and analyzing innovation networks

Components in an ideation network within one organization

The large component

Subnetworks - not connected to the rest of the organization

Isolates
Mapping and analyzing innovation networks

Identifying collaboration - formal organizational belonging

Development unit 1

Development unit 2

Research

Process development
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Number of direct ties to an actor (degree centrality)

Highly connected persons

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Tie strength - collaboration frequency

Dyad with intense ideation collaboration

Triad with intense ideation collaboration
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Number of ideas each actor has been involved in
Mapping and analyzing innovation networks
Number of "high quality" ideas each actor has been involved in

Person involved in creating many desired ideas
Mapping and analyzing innovation networks

Number of “high quality” ideas each actor has been involved in

- Groups and individuals are influenced differently by their network positions.
- Individuals that create different types of ideas are a determinator for increased ideation performance.
- Formal groups do not benefit from external ties in the same way as informal ones do. Internal group characteristics and processes differ between formal and informal groups.
- Individuals with more ties increases the possibility of coming up with high quality ideas (to a certain degree).
- Informal groups thrive with many group external ties.

Ideation process
[time]

Idea Creation

Idea “Development”
Towards more collaborative processes

- Ideas are significantly improved as a result of comments and further elaboration.
- Employees can more easily add value both in the idea creation and the idea development stages.
- The distributed way of working automatically brings about a higher level of heterogeneity.
- Similarities with community-based innovation such as the one seen in Open Source Software projects and other types of Open Innovation.
- Drawing upon insights from distributed, self-organizing systems such as OSS communities, it is clear that management has to reconsider its role, as well as the managerial repertoire that can be deployed (Dahlander and Magnusson, 2005; 2008).
Paradoxical challenges when managing firm-internal networks for innovation

- Combining strategic direction and focus with autonomy and emergence
  - Create demand for innovation so that we achieve both radical and incremental results?
  - What triggers creativity in different individuals?

- Using a transparent and open approach while retaining sufficient control
  - Control can be exercised more indirectly
  - Need to address different motivational factors of the employees

- Making innovation part of everyday work, without losing the energy gained from discrete events and campaigns
  - When innovation is something extra, it is implicitly not part of the everyday work

- Combining collaboration and competition
  - Need to promote peer-to-peer feedback and knowledge sharing
  - What is measured and evaluated?
  - Incentives for both competition and collaboration?

- Much can be gained from the wealth of knowledge on Open Innovation
  - Many of the problems with openness can be avoided!
  - Sometimes more complicated to apply internally, as the “open” way of working collides with our traditional view of management.
So, what about the role of management?

Formalize the informal flow of knowledge by forcing it into systems, processes and documents
- Need to capture human capital and convert it into structural capital!

Support and use the informal flow of knowledge between individuals, using new management tools and techniques
- Need to understand and leverage networks!
Is this your innovation pipeline?

...and how much does it cost you?
The (sad) reality of most innovation programs

- Innovation capacity over-committed by 2-3x
- Vast majority of projects are "sustaining" or "catch-up" in nature
- New projects "appear" and "get started"
- Senior management assigns projects and tracks players on an ad hoc basis
- Political factors interfering with project management
- Key individual contributors assigned to too many projects
Why is innovation so slow?
Queues – a hidden part of innovation

- Innovation Work-In-Progress / Inventories are physically and financially invisible
- Queues are a main source of waste in R&D and innovation
- Higher capacity utilization increases queues exponentially
- Control the size of the innovation queue!
Lean in R&D?

• At present Lean is proposed as the future paradigm not only for production, but also for R&D activities
• What would a Lean system for R&D look like?
• What are the effects of Lean on R&D performance (efficiency, but also innovation)?
Different perspectives on lean

Lean in R&D is:

• Everything that Toyota does?
• The reduction of waste, primarily by fighting undesired deviation/variation
• The creation of flow, primarily by reducing queues
• A way of facilitating organizational learning
• ...
Escalation of innovation time and costs by stage

- Formulate idea – 1 week (100$)
- Conduct preliminary investigations – 2 weeks (1,000$)
- Design and define specifications – 1 month (10,000$)
- Develop prototype, market research, NPV risk analysis – 2 months (100,000$)
- Scale up, build pilot plant, market test – 8 months (1 million $)
- Build plant, promote, launch market – 16 months (10 million $)

- It is important to save money by stopping bad projects at an early stage, but what is the cost of doing so?
We need to select the good ideas

- Incremental ideas
- Border-line ideas
- Radical and Disruptive ideas
The Risk vs. Return Matrix

Aggregate Project Risk

Forecast Project Expense

Return (IRR)

N Latex Ferritin Liquid
rev cTNI
DM Cyclosporin
FAST
Bence Jones OEM
N Latex B2m neu
Glyc HB
N Latex IgE
SW V 2
CRP mono
igG Subklassen
DOAs
PP (4)

0% 50% 100% 150% 200% 250% 300% >500%

LESS ATTRACTIVE

MORE ATTRACTIVE

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Forecast Project Expense

>$5Mi
$1-5Mi
<$1Mi
Does your firm generate enough potential for innovation?

- When there is uncertainty about demand, firms run two basic economic risks:
  - Costs of over-production
  - Lost sales caused by under-supply

- The balancing of these risks should be based on the specific economics of the business, but is normally skewed by our way of measuring economic results and evaluating ideas

- In terms of innovation this means the balancing of:
  - Costs for unused ideas and failed projects
  - Lost innovation opportunities
How do we deal with both False positives and False negatives?

- True positives – launched and received well on the market. However, only incremental innovation.
- False positives – launched but not received well on the market.

- True negatives – we save money since we did not develop and launch these ideas.
- False negatives – we stop ideas that would generate a lot of money in the future. These could e.g. create new markets. Among the false negatives we frequently find disruptive ideas and breakthrough innovations.
Avoiding uncertain projects?

• “A firm’s new product development process should maximize the likelihood of projects being both technically and commercially successful.” (Schilling, 2010, p. 6)

• Do you measure uncertainty concerning the value of ideas?

• Is anyone willing to run a project with a truly uncertain outcome?
What is the cost of our innovation activities?

• Cost of deployed resources

• Cost of delays

• Cost of lost opportunities
Lean in R&D?

- Some ideas are excellent:
  - Create a flow
  - Holistic/systemic view of the process
- But we need to depart from a more fundamental understanding of the differences between production and innovation, in terms of:
  - Difference between knowledge exploration and knowledge exploitation
    - Production can be optimized, whereas innovation has an open outcome space
  - Uncertainty
    - We do not know on beforehand exactly what is value-adding
    - Variation is the root of economic value in innovation
What to do?

• Understand your innovation economics!
• Measure queues in innovation
• Analyze and model the costs of delays
• Balance resource utilization and flow
• Analyze and model the costs of lost opportunities
• Make sure that you take profitable risks
• Use lean with caution, and with focus on flow
Some recent publications