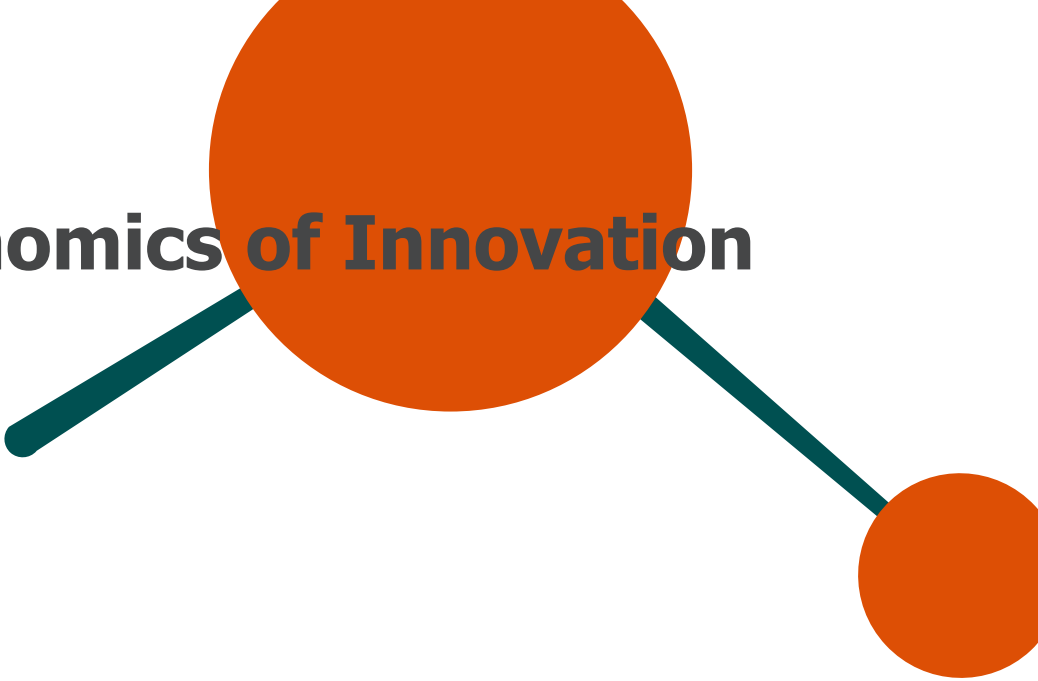
Course: Economics of Innovation



Topic: Innovation, firm and market charactersitics

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Entrepreneurship and new firms

Some basic questions:

- Inventors – what do they do?
- Entrepreneurs – what role do they play?
- Society's capacity to be entrepreneurial – does it differ across time and place?
- Larger firms – are they entrepreneurial?
- Two routes to innovation – individual effort versus team based organised R&D

Innovation and firms

Reasons to innovate:

- Economics literature:

  Motive: it maximises current/future profits

  R&D is investment yielding future returns
- Management literature

  To ensure survival of the firm

  To increase market share

  To satisfy customers
- Choice of being leader or follower

Markets and innovation

- Creative destruction - Schumpeter's term

  Innovation creates profits for owner, but also destroys profits in other firms
- Dynamic competition – characteristic of innovative markets

  Entry of new products and firms and exit of unsuccessful ones
- Distortions possible if

  Too few entrepreneurs

  Too many new firms fail

  Barriers to entry exist

Dynamic competition

Dynamic process of competition can be imperfect:

- New firms may be unable to gain access to finance, skilled labour, technology or information
- This leads to a high failure rate by new firms forcing innovative products out of the market
- Incumbent firms may attempt to prevent new firms entering using large scale R&D
- Incumbent firms may innovate infrequently due to lack of profitability from innovation

Does competition generate the optimal number of products?

- Business stealing effect - New firms ignore loss of profits by incumbents

  Result - Too many products
- Appropriability effect - Firms cannot appropriate all consumer surplus

  Result - Too few products
- Spillover effect - New products demonstrate knowledge to other firms

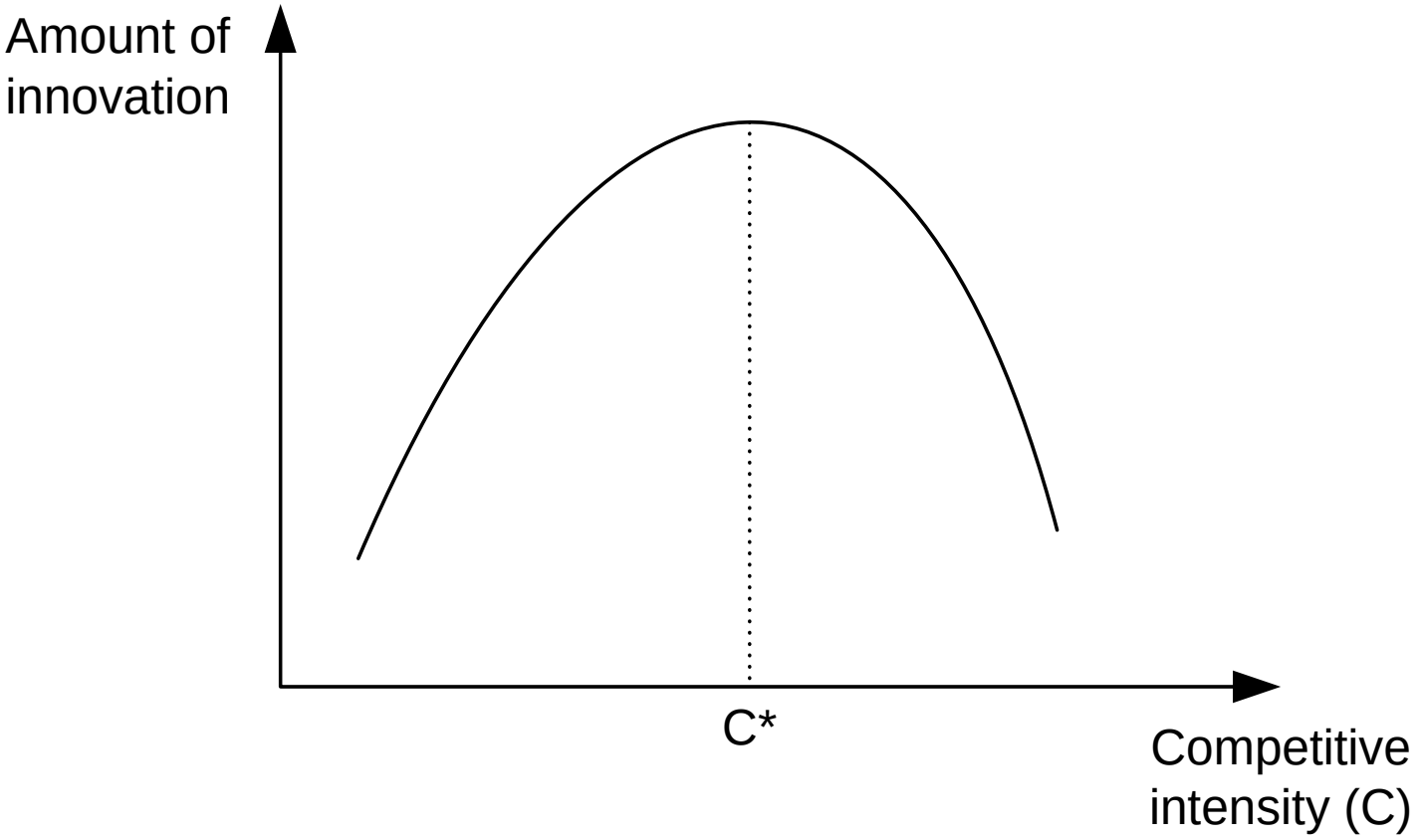
  Result - Too few products

The importance of market power

Schumpeter's first hypothesis was that firms with *larger market shares* should innovate more

- Large market share gives more certainty about recouping returns to R&D once innovation occurs
- It also implies more current profits to finance the expenditure on R&D
- This hypothesis has led to substantial theoretical and empirical work on the relationship between market structure, competition and innovation
- Possible there is an inverted U-shaped relationship (see next slide), but economists cannot yet identify the optimal degree of competition C*

Inverted U-shape between innovation and competition



The importance of absolute size

- Schumpeter's second hypothesis was that *larger firms* should innovate more
- Large size implies diversification of R&D risks and ability to finance

Empirical evidence on this second hypothesis is mixed:

- Large firms are more likely to do R&D or be IP active
- But smaller firms that are R&D or IP active have higher intensities of such activity

Evidence on returns to innovation

Evidence of private rates of return to R&D:

- Investigated using either market value or productivity approaches
- Both approaches suggest private rates of return to R&D are higher than for standard, tangible investment projects
- Excess returns may be reward for higher risk
- High rates of return also suggest that there is not free entry into R&D
- Could be due to barriers, e.g. raising finance, lack of skilled labour, or IPRs
- Also possible R&D requires complementary assets e.g. tacit knowledge and skilled labour

Evidence on social returns

- The productivity approach can also be used to estimate the social returns to R&D
- Do this either by investigating the interactions between firms
- Or by using industry data to observe aggregate returns to R&D
- Many studies have suggested that the social returns are higher than private returns
- This implies that there are positive externalities to R&D from spillovers of technology

Evidence on interaction between competition and innovation

- Absolute firm size is not necessarily beneficial to innovation
- Larger market share has been found to increase the returns to R&D
- But those with very high degree of market dominance may become complacent
- Recent evidence relating rates of patenting to degree of product market competition supports the inverted U-shape

Portfolio management

- Resources are always limited, it is neither possible nor effective to invest in every idea without due consideration.
- It is important to select from many possibilities those with the highest potential; today's innovation projects decide about the future profile of the company, its customers and market share.
- Goal: to create such portfolio of products that is rooted in the company strategy and optimizes the company performance.
- Portfolio management: dynamic decision-making process of evaluation, selection and prioritization of new projects; active project can be fostered, put on hold or even killed; their priorities and allocation of resources can change.
- The process is characterised by uncertainty, changing information, dynamics of opportunities and threats, links between projects. The whole process must be based on the long-term company strategy and must support it

No portfolio management means …	**Immediate result**	**End result: poor new product performance**
A reluctance to kill projects. Many projects added to the list A total lack of focus	Too many projects – resources thinly spread. Projects in the queue. Quality of execution suffers.	Increased time to market Higher failure rates
Weak decision points (broad gates) Poor Go/Kill decisions	Too many low value projects Good projects are starved	Too few stellar product winners Many ho hum launches
No rigorous selection criteria Project selected on emotion, politics	Wrong projects are selected	Many failures
No strategic criteria for project selection	Projects lack strategic direction Projects not strategically aligned	Scatter gun effort Does not support strategy

Portfolio management goals

1. Maximization of value
   - long-term profitability, return on investment, probability of success, …
2. Balance
   - Long-term projects vs. short, fast ones;
   - High risk projects with high potential vs. lower-risk sure bets (e.g. radical vs. incremental innovation);
   - Focus on different market segments (don't pull all eggs into one basket);
   - Different technologies;
   - Different project types: new products, improvements, cost reductions, frontier research.
3. Strategic alignment
   - portfolio is strategically aligned and reflects the business's strategy.

Goal 1
Maximizing the portfolio value

- Net present value, bang for buck
- Expected commercial value
- Multi-criteria project valuation
- Scoring models

Projects net present values and resource requirements

Project	NPV	Remaining resource requirements	Bang-for-buck index	Immediate resource requirements
A	52,0	9,5	5,5	3,2
B	30,0	3,1	9,7	0,3
C	8,6	2,1	4,1	1,4
D	42,0	3,8	11,1	2,5
E	48,5	7,0	6,9	1,3
F	43,8	5,0	8,8	1,5
G	37,5	8,3	4,5	3,8
H	3,0	1,0	3,0	0,7
I	9,5	2,5	3,8	0,5
J	6,2	0,8	7,8	0,8
K	4,5	1,4	3,2	1,2
L	55,0	5,0	11,0	5,0

Rank-ordered list of projects

Project	NPV	Remaining resource requirements	Bang-for-buck index	Immediate resource requirements	Cumulative immediate resource requirements
D	42,0	3,8	11,1	2,5	2,5
L	55,0	5,0	11,0	5,0	7,5
B	30,0	3,1	9,7	0,3	7,8
F	43,8	5,0	8,8	1,5	9,3
J	6,2	0,8	7,8	0,8	10,1
E	48,5	7,0	6,9	1,3	11,4
A	52,0	9,5	5,5	3,2	14,6
G	37,5	8,3	4,5	3,8	18,4
C	8,6	2,1	4,1	1,4	19,8
I	9,5	2,5	3,8	0,5	20,3
K	4,5	1,4	3,2	1,2	21,5
H	3,0	1,0	3,0	0,7	22,2

Project expected value (ECV)

Project	PV	Probability of technical success	Probability of commercial success	Development cost*	Commercialization cost*	ECV
A	30,00	0,80	0,50	3,00	5,00	5,00
B	63,75	0,50	0,80	5,00	2,00	19,50
C	9,62	0,75	0,75	2,00	1,00	2,10
D	3,00	1,00	1,00	1,00	0,50	1,50
E	50,00	0,60	0,75	5,00	3,00	15,70
F	66,25	0,50	0,80	10,00	2,00	15,50

Rank-ordered list according to ECV/D, resource constraint 15 mil

Project	ECV	ECV/D	Cumulative development costs	Adjusted cumulative development costs
B	19,50	3,90	5,00	5,00
E	15,70	3,14	10,00	10,00
A	5,00	1,67	13,00	13,00
F	15,50	1,55	(23,00)	
D	1,50	1,50	24,00	14,00
C	2,10	1,05	26,00	16,00

Rank-ordered list according to ECV

Project	ECV	Cumulative development costs
B	19,50	5,00
E	15,70	10,00
F	15,50	20,00
A	5,00	23,00
C	2,10	25,00
D	1,50	26,00

- ECV model prioritizes more highly the projects with the following properties:
  - closer to launch (increase of PV and consequently of ECV),
  - higher income streams after launch (increase of PV and consequently of ECV),
  - less resources to be spent (decrease of D),
  - higher probabilities of success (increase of ECV),
  - utilize less of the constraining resource (it's easier for them to be above the line).

Multi-criteria project valuation input data

Project	IRR	NPV	SI	PTS
A	20%	10	5	80%
B	15%	2	2	70%
C	10%	5	3	90%
D	17%	12	2	65%
E	12%	20	4	90%
F	22%	6	1	85%

Project ranking

- Project ranking procedure is the following
  - calculate adjusted values of IRR and NPV – multiply them by PTS.
  - rank projects according to adjusted values of IRR and NPV and according to SI.
  - calculate the average value of those three rankings and use it for final ranking

Multi-criteria project valuation, final project ranking

Project	IRR * PTS	Ranking by IPR*PTS	NPV * PTS	Ranking by NPV*PTS	SI	Ranking by SI	Avg.	Final
A	16,0%	2	8	2	5	1	1,67	1
B	10,5%	5	1,4	6	2	4	5,00	6
C	9,0%	6	4,5	5	3	3	4,67	5
D	11,1%	3	7,8	3	2	4	3,33	3
E	10,8%	4	18	1	4	2	2,33	2
F	18,7%	1	5,1	4	1	6	3,67	4

Applicability of financial models

- Main weakness: unreliability of input data, especially in the initial project stage they should be used only in later stages.
- Small errors in probabilities of success rapidly propagate and can result in significant differences.
- The complexity and sophistication of financial models fairly exceeds the quality of input data
- It does not mean that we should not pay proper attention to financial data in the initial project stages. However, we should not make decisions solely on their basis; they should be combined with non-financial models

Scoring models

- Give very good results.
- Important: selection of criteria that really separate the winners from the losers. Such criteria must be based on the analyses of your own company and other companies in the same industry. You must develop the expert base to be used in project valuation.
- One of the models described in [Cooper 2001] uses five main factors:
  - business strategy fit (2)
  - strategic leverage (4)
  - probability of technical success (4)
  - probability of commercial success (6)
  - reward to the company (project profitability) (3)

Goal 2: Balance

- In many cases, the project portfolio is not balanced; often it contains too many small projects and not enough of radical, visionary but highly risky projects necessary to maintain the company competitiveness.
- Suitable tools for creation of the balanced portfolio are bubble diagrams; most frequently used diagram is the risk – reward bubble diagram, which is used by 44 % companies

Risk-Reward bubble diagram

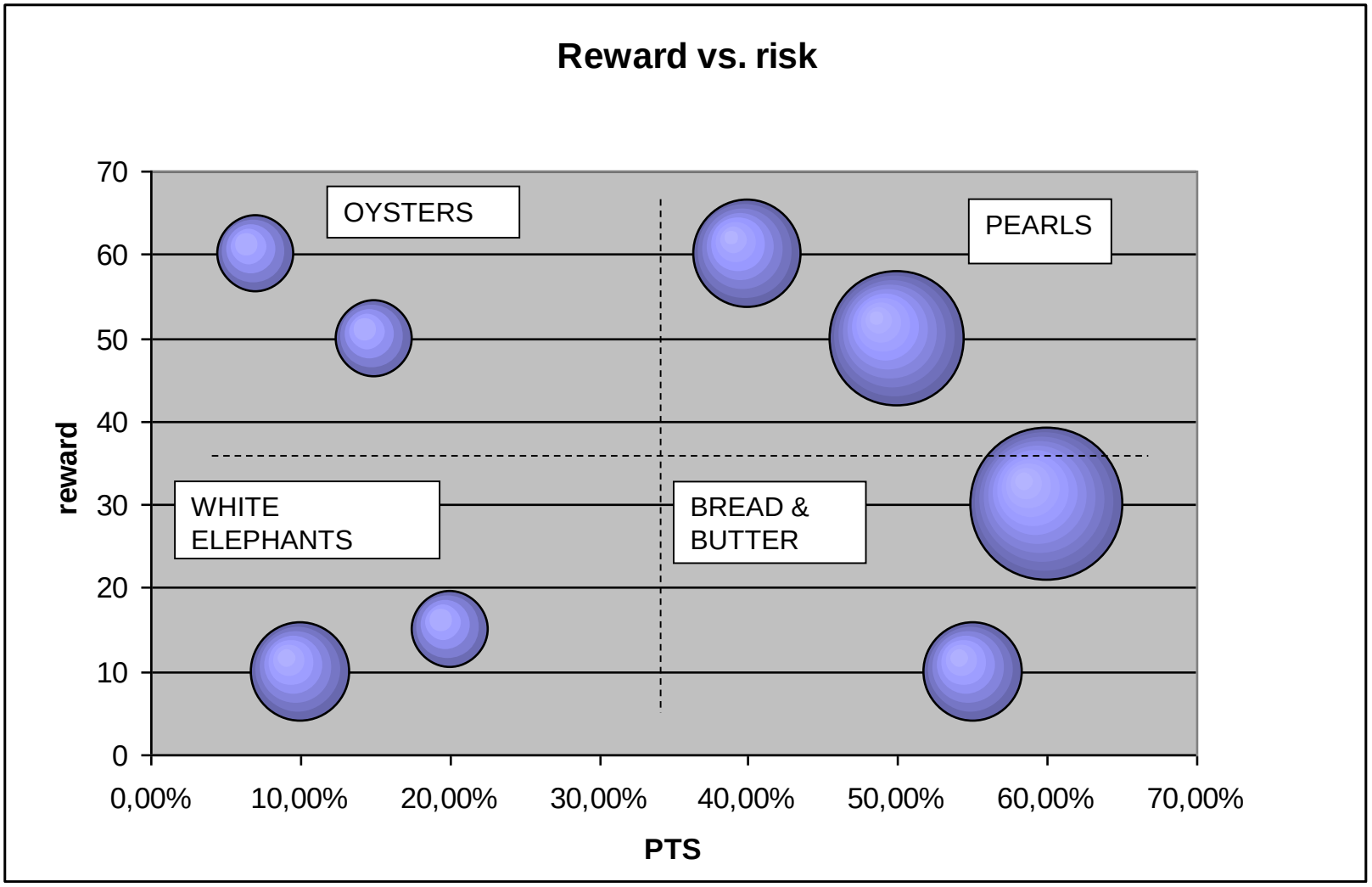


Diagram quadrants

- **Pearls**: potential „star" projects: high probability of success, high expected reward. We would like many of such projects.
- **Oysters**: highly speculative projects: low probability of success, high expected reward. Here the breakthroughs pave the way for solid payoffs.
- **Bread and butter**: simple projects, high probability of success, low expected reward. Often too many of them in the portfolio, consuming substantial ratio of resources.
- **White elephants**: low probability of success, low expected reward; projects that are difficult to kill, often from personal reasons.

Goal 3: Strategic alignment

- Strategy and allocation of resources are closely linked: until we start allocating resources to specific activities, strategy is only paperwork. In portfolio creation we will follow the following objectives:
  - Projects are aligned with business strategy;
  - All projects contribute to achievement of strategic goals and objectives;
  - Allocation of resources reflects specified strategic goals and objectives.
  - In portfolio management we use three basic approaches: top-down, bottom-up and combined.

Top-down approach

- from the strategy formulation (using principles, methods and procedures of strategic management, see e.g. [Grant 2008]). Objectives for new products are often stated in terms of ratio or growth of turnover, profit, market share, etc. during several (usually 3-5) years.

Strategic buckets

- The company management, on the basis of strategy, decides what resources will be allocated to basic categories of development projects (e.g. X % to platforms, Y % to new products, Z % to incremental innovations) and projects are then prioritized within those buckets.
- Resources originally allocated to one category may not sufficient, while there are still free resources in the other bucket. In such a case the resources can be redistributed.
- However, after the final allocation of resources to strategic buckets it should not be possible to reshuffle the resources between buckets. Especially it should be avoided to take resources originally allocated for strategic, long-term goals and use them for short-term, more "urgent" projects, often backed from "political" reasons. Such redistribution undermines long-term strategic goals and all the strategic planning

Bottom-up and combined approaches

- Bottom-up approach build strategic criteria into the model of project selection, usually to the scoring model.
- This approach guarantees that all projects are strategy aligned, however it cannot guarantee allocation of resources in compliance with strategic priorities.
- This weakness can be overcome by the use of combined approach: we first use the top-down approach to establish strategic buckets, and then we evaluate all active projects and projects on hold and prepare their ranked list. Finally we assign projects to corresponding categories (buckets) and study the exhaustion of resources.
- Usually this first iteration is not completely satisfactory and it is necessary to use more iterations to reach satisfactory results.

Reference and source

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