Lezione 3.4
Benefici per le imprese

Per dettagli consultare il capitolo 5 di «Investing in Science»

- Conceptual framework
- How to use procurement and other firm-level data
- Case studies (structured narratives)
- Survey data (statistical tools, Bayesian Networks)
- Company accounts (dif-in-dif econometrics)
- Patents and innovations (non-linear econometrics)
- Start-ups and corporate spin-offs
- Product spin-offs
- Lessons learned for data taking and research design
- Further reading

Benefits on firms: Technological spillovers (1)

The present value of technological spillovers (T_t) is given by:

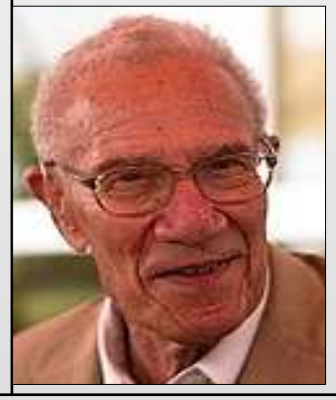
- the **discounted incremental social profits Π_{jt}** generated by **companies (j)** of the RI's supply chain which have benefitted from a learning effect;
- and **other externalities**.

$$T = \sum_{j=1}^{J} \sum_{t=0}^{\mathcal{T}} s_t \cdot \Pi_{jt}$$

Benefits on firms: Technological spillovers (2)

BENEFITS	APPROACH	DATA REQUIRED
Learning-by-doing benefits for the supply chain	Incremental shadow profit (counterfactual group); avoided costs approach	• Volume of procurement contracts that are likely to generate technological externalities • Estimation of a sales multiplier • Profitability measure (e.g. the EBITDA margin).
Development of new/improved products, services, or technologies	Incremental shadow profits	• Profitability measures (e.g. EBITDA) • Average costs (salaries, rents and utilities)
Patents	Marginal social value of the patent generated by a RDI infrastructure	• Number of patents that will be registered (applications or 'invention disclosures' should not be considered) • Average rate of usage of granted patents • The average number of references, the change in expected profits from the sale of innovations
Start-ups and spin-offs	Establishment of new firms or (and) an increase in the survival rate	• Number of start-ups and/or spin-offs expected to be created • Expected lifetime and survival rate of start-ups and spin-offs • Expected profit generated by start-up and spin-offs
Other knowledge spillovers	Incremental shadow profits; avoided costs approach; willingness-to-pay approach	• Number of potential beneficiaries; • Overall cost associated with the production/development of the knowledge/technology • Overall costs avoided given the exploitation/application of the new technology • Time saving from the new new/improved technology/products • Economic value of time saved.

Conceptual framework (1)
ARROW (1962) vs SOLOW (1997)

Continuos Learning	Discontinuos Innovation
«Learning is the product of experience. Learning can only take place through the attempt to solve a problem and therefore only takes place during activity[…] (L)earning associated with repetition of essentially the same problem is subject to sharply diminishing returns»	«A new theory that combines learning by doing (identifying it with the concept of "continuous improvement") with a separate process of discrete "innovations"»
Progress = Improvement (=Learning by doing)	**Progress = Innovation + Improvement**
 Arrow, "The economic implications of learning by doing." *The review of economic studies* (1962). Nobel Prize 1972	 Solow, *Learning from" learning by doing": lessons for economic growth.* Stanford University Press, 1997. Nobel Prize 1987

Conceptual framework (2)

- The analytical issues involved in estimating the technological impact of Ris include two aspects:
  1. how to identify and measure spillover effects
  2. how to value them
- If the R&D cost is fully internalized by the firm, and it is then repaid by the procurement contract, there is no identifiable first-round externality
- This does not bar second-round effects from occurring
- Innovation spilling over the scope of the initial procurement contract can be attributed to the knowledge acquired on the job
- A CBA of a RI should look at the social profits generated by the spillovers
- A possible approach is to look at the company's return on sales
- With j being the number of companies benefiting from technological spillovers over time $\mathcal{T}$, Π_{jt} their *incremental* shadow profits (i.e. profits at shadow prices) directly imputable to the spillover effect, and given the discount factor, the present value of technological learning externalities is expressed as:

$$TE = \sum_{j=1}^{J} \sum_{t=0}^{\mathcal{T}} \frac{1}{(1+SDR)^t} \cdot \Pi_{jt} = \sum_{j=1}^{J} \sum_{t=0}^{\mathcal{T}} \frac{1}{(1+SDR)^t} \cdot (\Delta r_{jt} - \Delta c_{jt})$$

- the last term is the difference between incremental revenues Dr and costs Dc for firm j over years 1,…t,… $\mathcal{T}$
- If costs decrease thanks to innovation, then profits increase

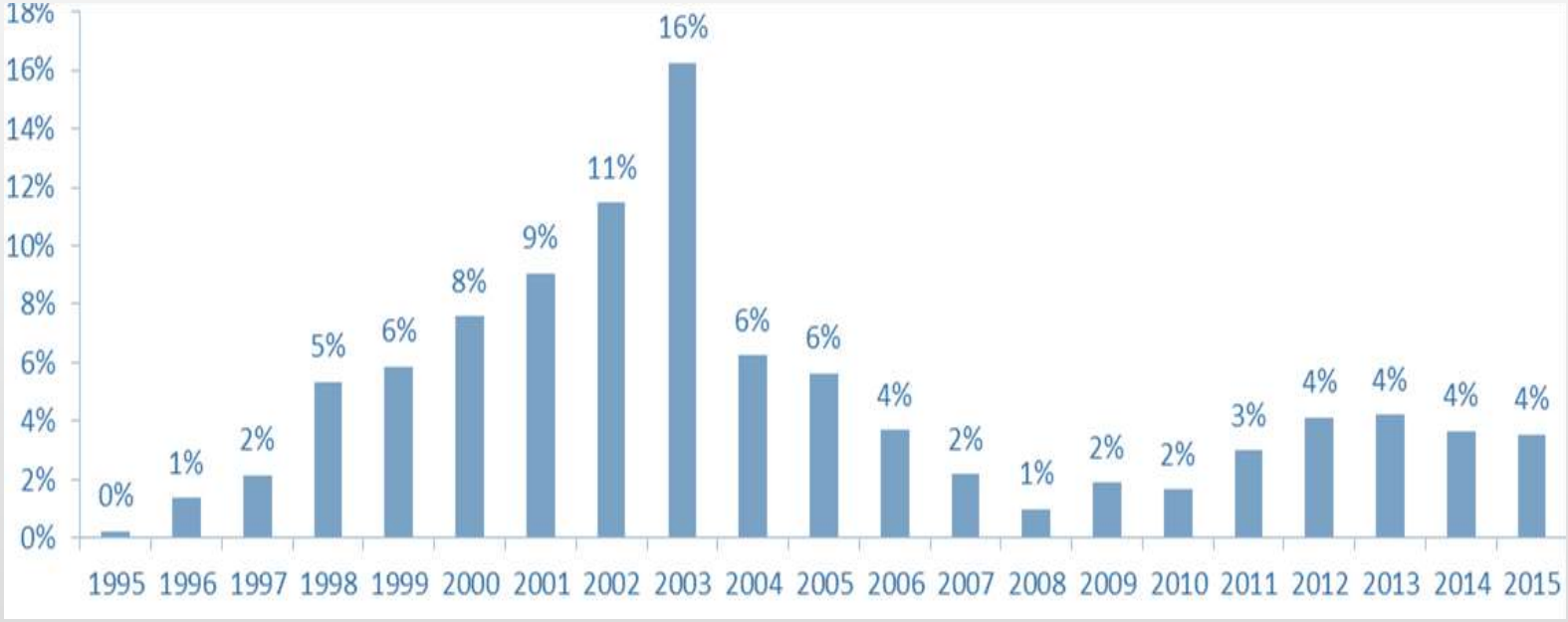
Procurement data (1)

CERN*

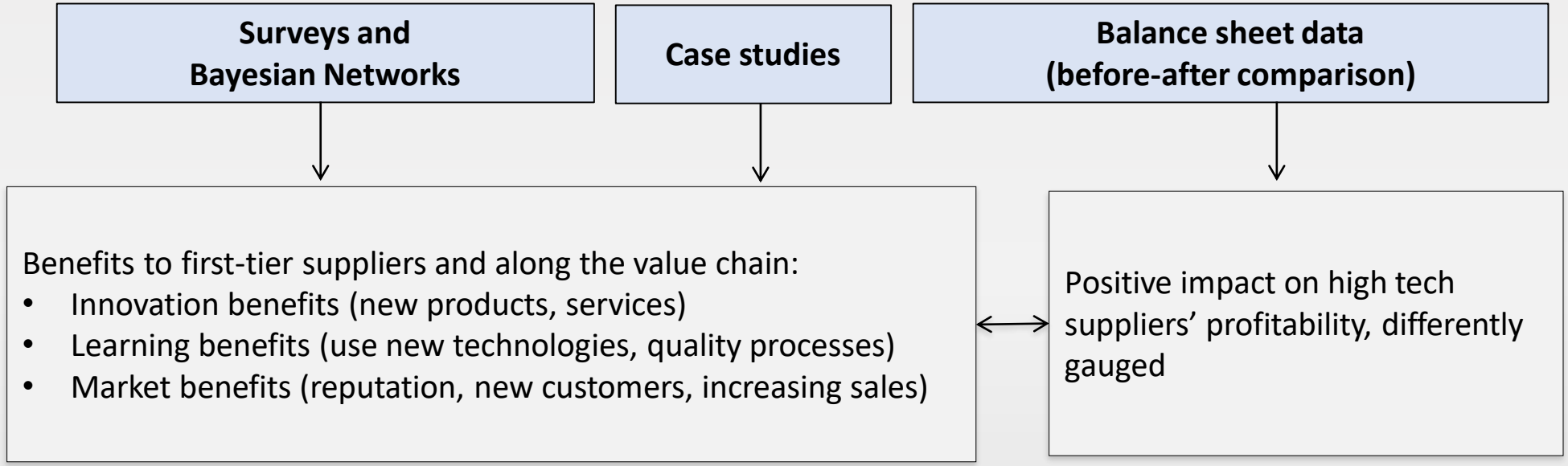
*Period: 1995 – 2015; Orders > 10,000 CHF (about 8,500 Euro)

4,204 suppliers from 47 countries
65% low tech; 35% high tech
33,414 orders
4.3 Billion CHF of expenditure

Volume of the orders by year %



Procurement data (2)
Different methods



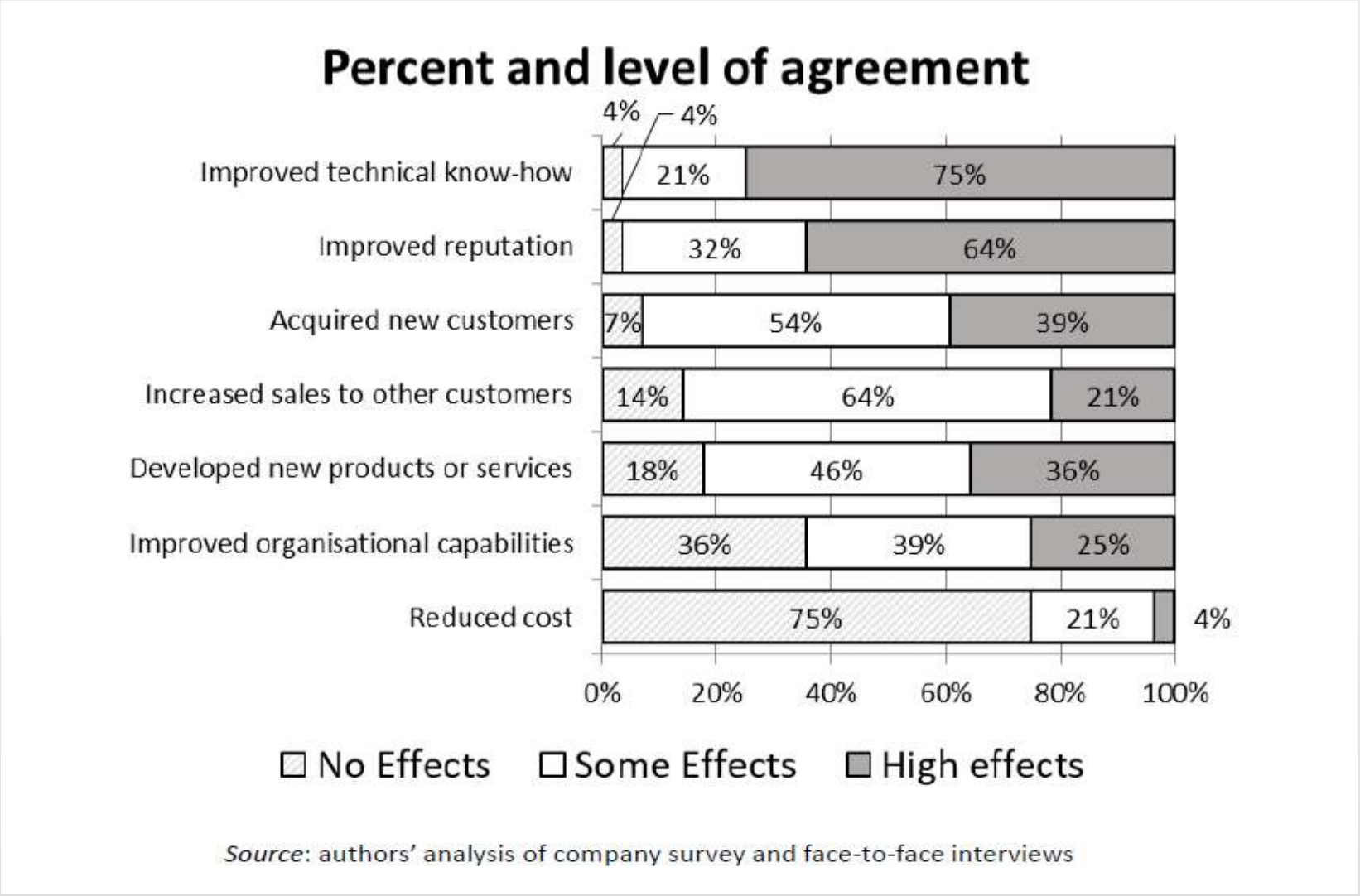
- **Key mechanisms:**
  The way how CERN interacts with its suppliers
  The type and volume of orders

Case studies (1)

- 28 illustrative case studies were assembled by CSIL and CERN (Sirtori et al 2019)
- Face-to-face conversations based on a semi-structured interview template
- Questions about:

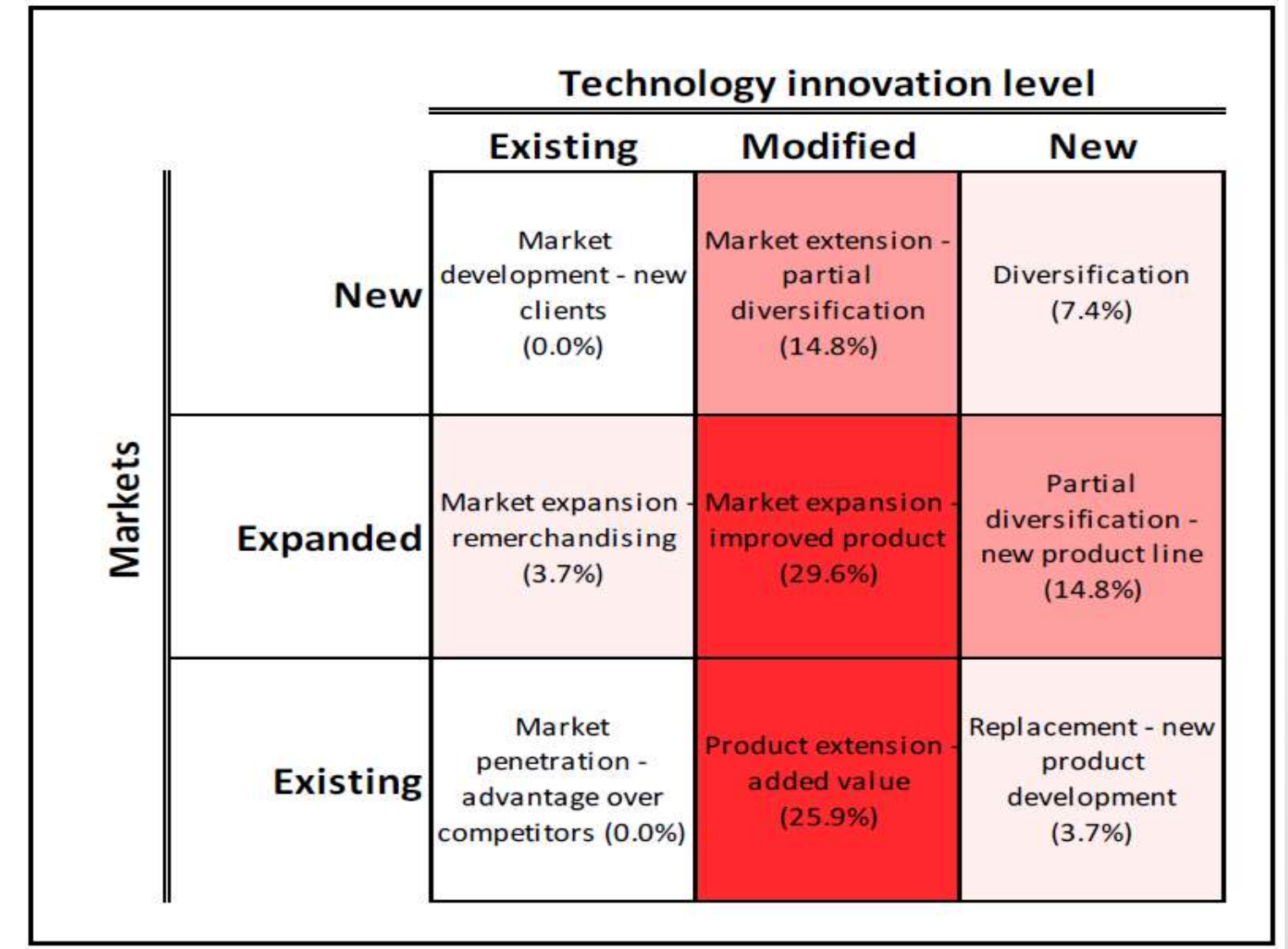
1. the company
2. collaboration with CERN
3. impact of this collaboration

Case studies (2)



Source: authors' analysis of company survey and face-to-face interviews

Case studies (3)



Notes: Percentage of the number of responses. Source: authors' elaboration on interviews

Case studies (4)

- Three main areas of business: magnet technology, nuclear technology, and service and assembly.
- Development of large superconducting magnets for research into high-energy physics and nuclear fusion

BILFINGER

YEAR OF FOUNDATION
1824

LOCATION
Würzburg, Germany

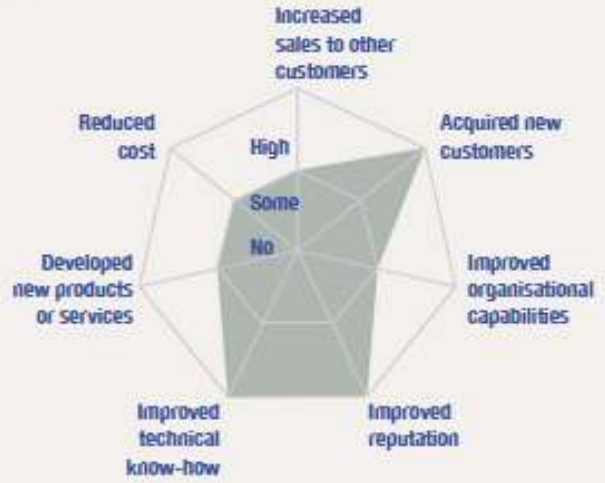
APPLICATION DOMAIN
Science, energy, specialized engineering

SIZE

Annual turnover

Employees

PERCEIVED BENEFITS GAINED THANKS TO CERN



CERN-RELATED MARKET OR INNOVATION BENEFITS FOR BILFINGER NOELL

MARKET				
	NEW	Market development (New clients)	Market extension through partial diversification	Diversification
	EXPANDED	Market expansion through re-merchandising	Market expansion through improved product	Partial diversification through new product line
	EXISTING	Market penetration through advantage over competitors	Product extension through added value	Replacement through new product development
		EXISTING	MODIFIED	NEW
		TECHNOLOGY INNOVATION LEVEL		

Survey data (1)

Organization	Method	Average values	Source
CERN	Survey of firms	3	Schmied (1977)
CERN	Survey	1.2	Schmied (1982)
CERN	Survey	3	Bianchi-Streit et al. (1984)
European Space Agency	Survey of firms	3	Brendle et al. (1980)
European Space Agency	Survey	1.5–1.6	Schmied (1982)
European Space Agency	Survey	4.5	Danish Agency for Science (2008)
NASA Space Programmes	Input–Output model	2.1	Bezdek and Wendling (1992)
National Institute of Nuclear Physics	Input–Output model	2–2.7	Salina (2006)
John Innes Centre, UK	**Input–Output model**	**3.03**	**DTZ (2009)**

Survey data (2)

- **Hypothesis 1:** The level of innovation and the value of orders shape the relationship between CERN and its suppliers. Specifically, the larger and the more innovative the order, the more likely the CERN and its suppliers are to establish relational governance as a remedy for contract incompleteness, agents' opportunism, and suboptimal investments on both sides.
- **Hypothesis 2:** The relational governance of procurement is positively related to innovation outcomes for the suppliers of largescale science centers.
- **Hypothesis 3:** Innovation and market penetration by the large-scale science centers' suppliers are likely to impact positively on their performance.
- **Hypothesis 4:** In the case of relational governance of procurement, the innovation and market outcomes are not confined solely to first-tier suppliers but spread to second-tier suppliers as well.

Survey data (3)

Bayesian networks

- Findings:
- This study (Florio et al 2018) provides empirical evidence about the various types of benefits accruing to companies involved in a procurement relationship with CERN:
  - Innovation benefits
  - Learning benefits
  - Market benefits
- Key mechanisms which explain the type and size of benefits enjoyed are:
  - The way how CERN interacts with its suppliers
  - The type and volume of orders
- Procurement relationships based solely on market and prices mechanisms are not creating and generating innovation and generate spillovers