UNIVERSITÀ DEGLI STUDI DI MILANO

ROMA TRE UNIVERSITÀ DEGLI STUDI

Workshop on
"The economic impact of CERN colliders:
technological spillovers, from LHC to HL-LHC and beyond"

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Intercontinental Hotel, BERLIN

A new survey of CERN suppliers: a Bayesian Network Analysis (BNA)

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Motivation and Research Hypotheses

*Does CERN stimulate innovation and economic performance of firms through its procurement activity? In what way?*

H1: the technological level and the volume of orders shape the relationship between CERN and its suppliers

H2: more structured types of relationships positively influence CERN suppliers' innovation outcomes

H3: innovation outcomes of CERN supplier firms are expected to positively impact on their economic performance

H4: innovation spillovers are not only confined to CERN (first-tier) suppliers, but they spread along the supply chain
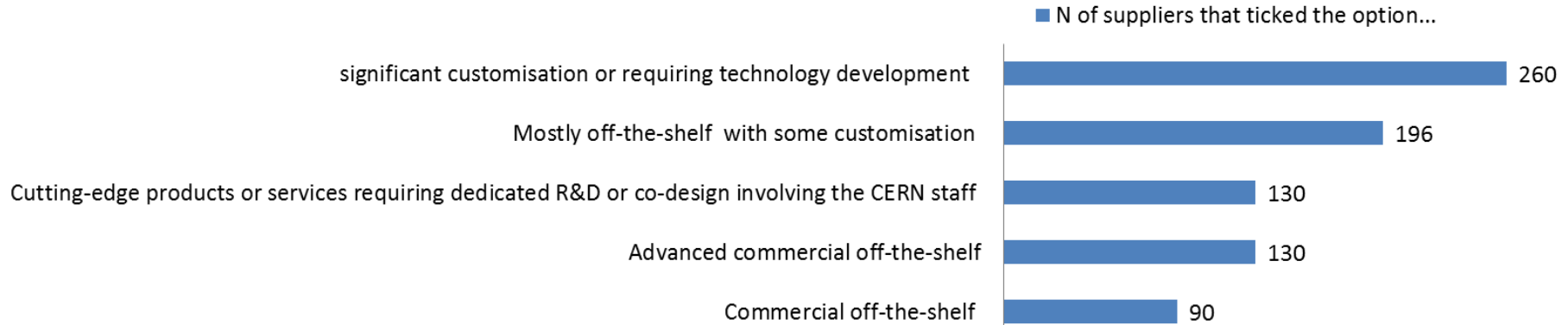
Conceptual model
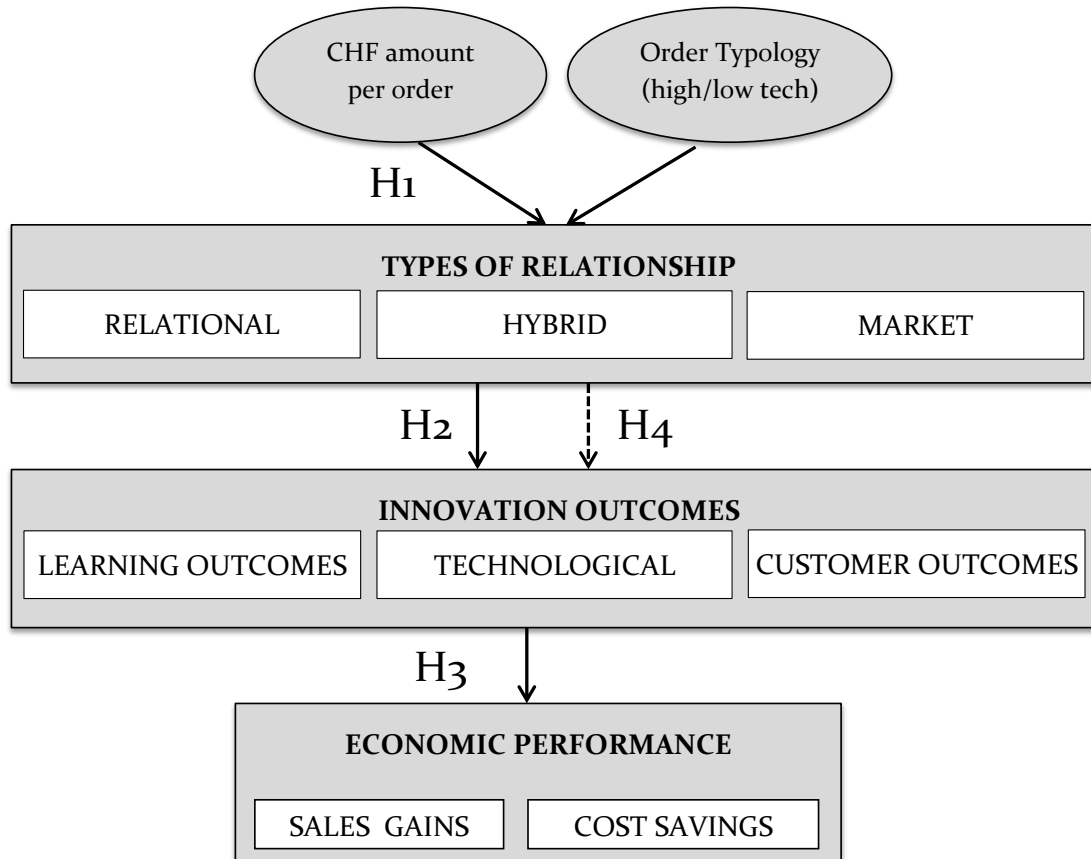
Survey

- To all CERN suppliers which received at least 1 order > 10,000 CHF between 1995 and 2015
- 5 languages on-line survey
- Multiple-choice questions, 5 point Likert scale *(strongly disagree, ..., strongly agree)*

Population	Sample (as of end April 2017)
4,204 suppliers from 47 countries	538 (**13%**) suppliers from 31 countries
33,414 orders	6,679 (**20%**) orders
4,318 Million CHF of expenditure	732 (**17%**) Million CHF of expenditure

Sample (1)
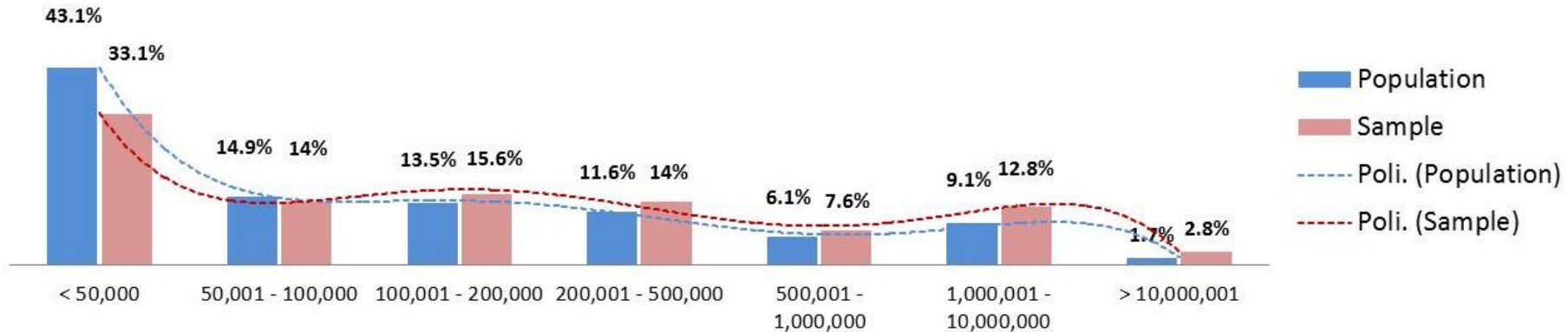

N of respondent suppliers
- < 10
- 10 - 25
- 25 - 50
- 50 - 100
- 100 - 157
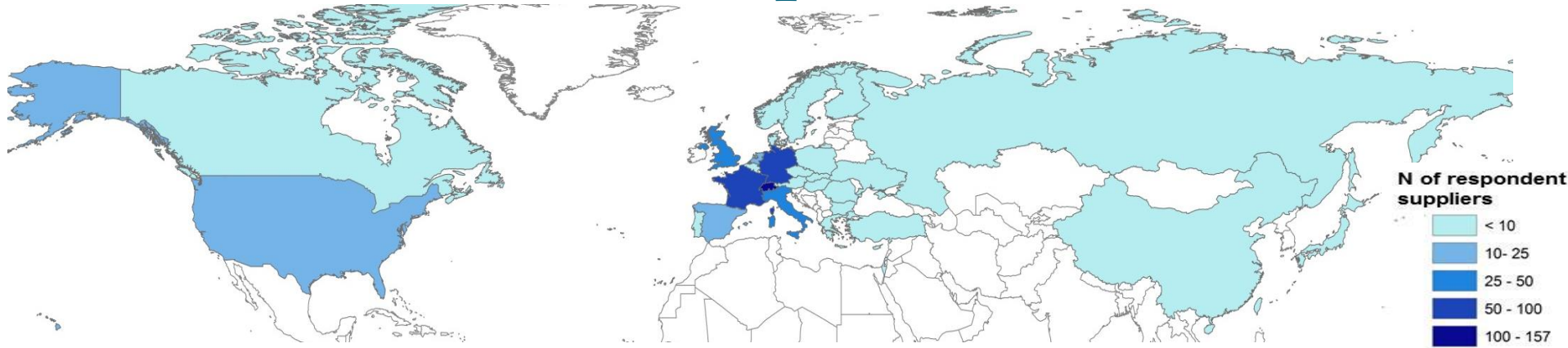
What was the **INNOVATION LEVEL OF PRODUCTS AND SERVICES** supplied to CERN? (Tick at most 2 options)

■ N of suppliers that ticked the option...

significant customisation or requiring technology development	260
Mostly off-the-shelf with some customisation	196
Cutting-edge products or services requiring dedicated R&D or co-design involving the CERN staff	130
Advanced commercial off-the-shelf	130
Commercial off-the-shelf	90

Sample (2)

Distribution of suppliers by cumulative amount (CHF) of orders received

| Indicator	Volume of orders (CHF) POPULATION	Volume of orders (CHF) SAMPLE
Min	10 Thousand	10 Thousand
Mean	1.0 Million	1.3 Million
Median	67 Thousand	118 Thousand
Max	237 Million	173 Million
SD	7.6 Million	8.2 Million

Methodology of analysis

Bayesian Network Analysis (BNA):

- **Conditional probability distributions** to find multiple relationships and dependences among variables

- **Hierarchical arrangement** of variables via a directed acyclic graph

- **Causal mechanisms** are revealed

- Find **unexpected relationships** between variables

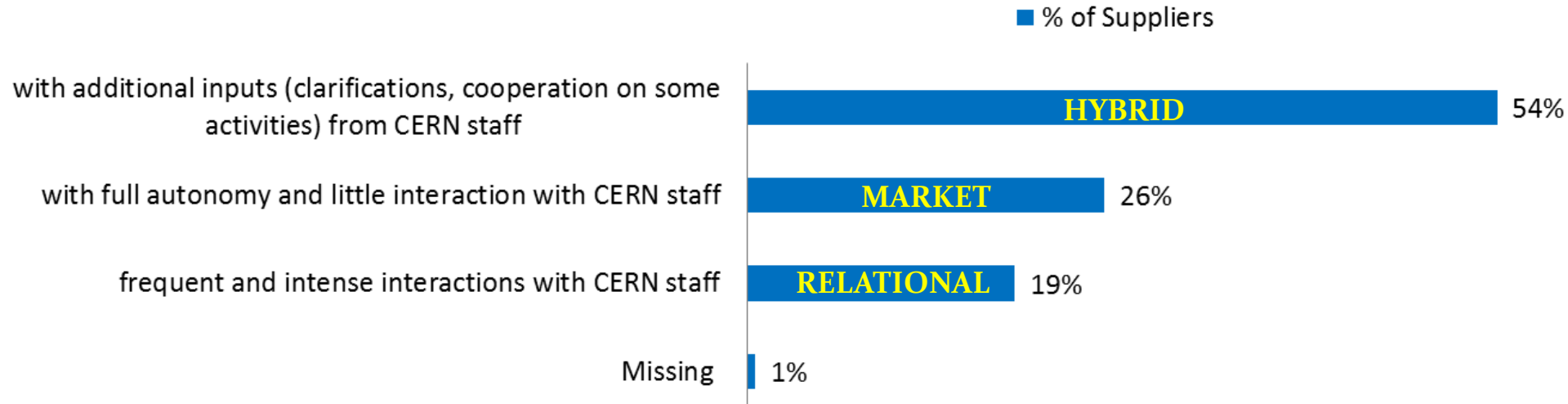+ **Econometric analysis** to test the robustness of results
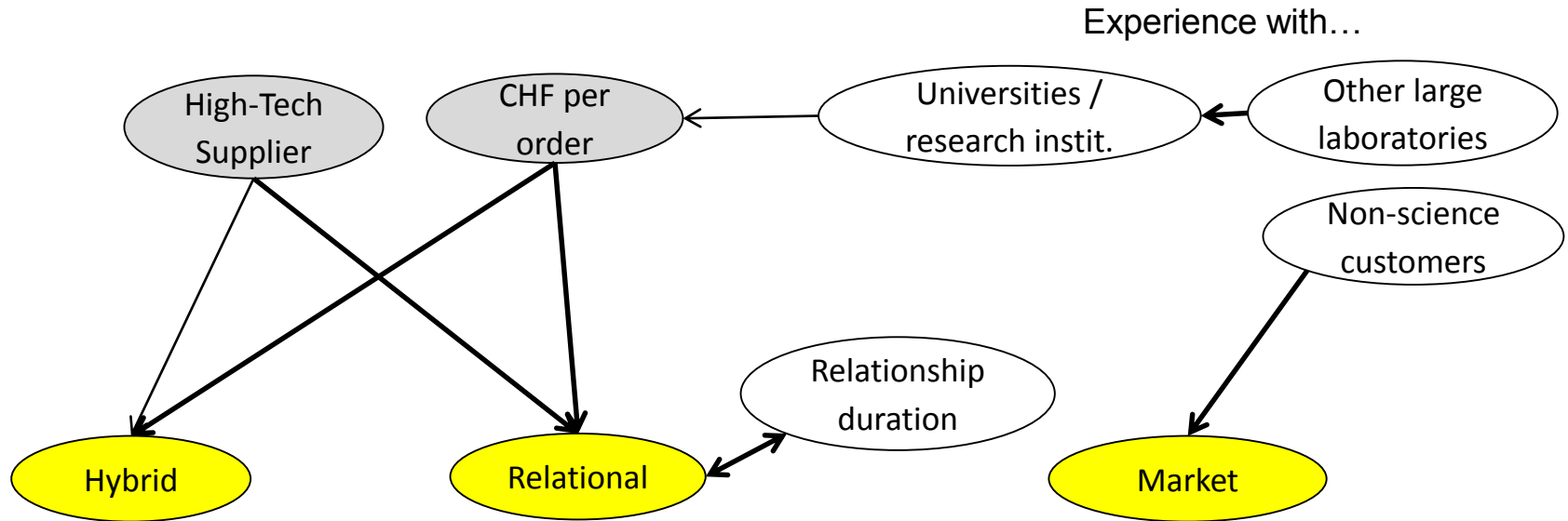
Bayesian Network
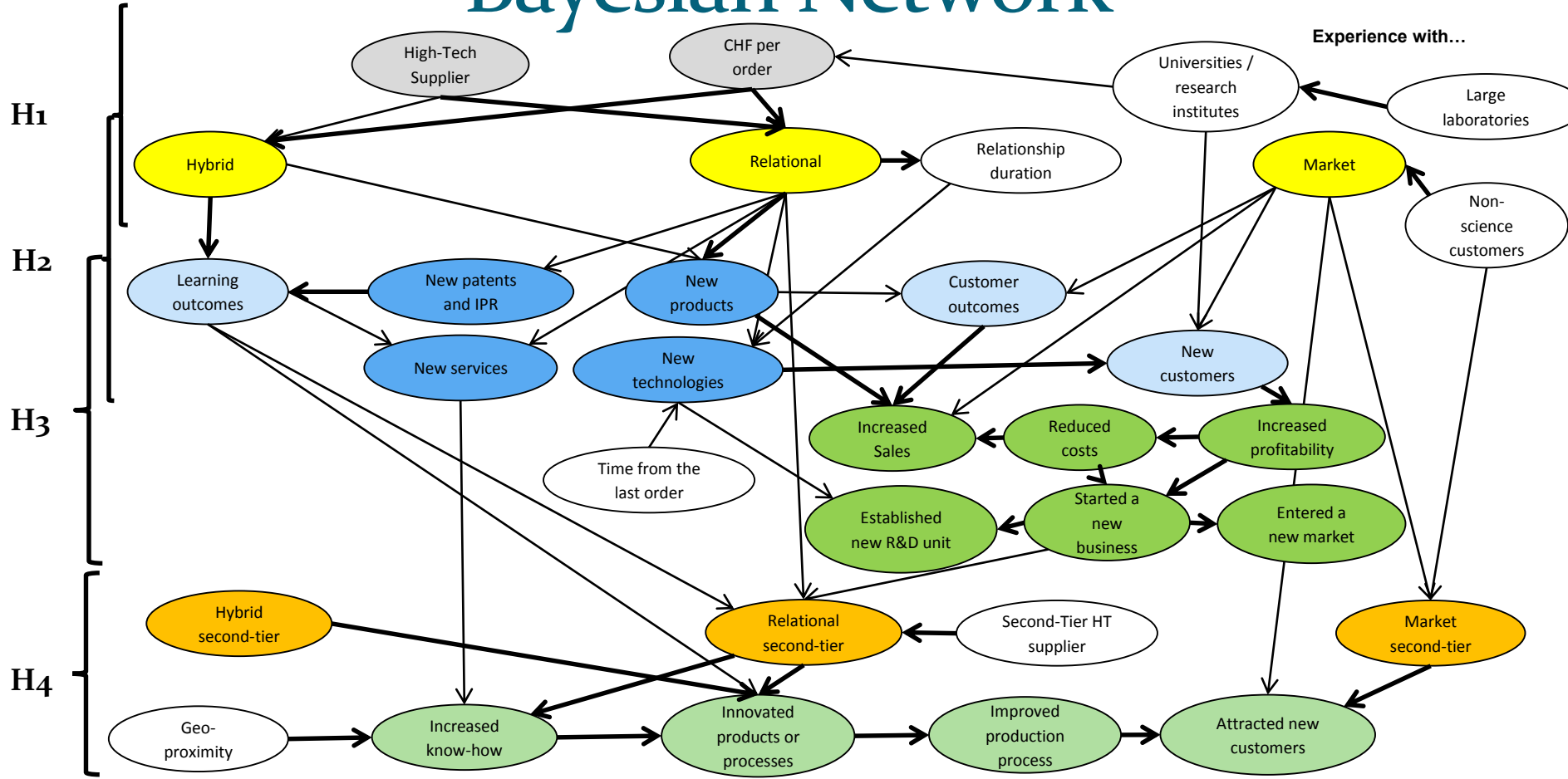
Testing H1: CERN-supplier relationship

H1: the technological level and the volume of orders shape the relationship between CERN and its suppliers

Testing H1: CERN-supplier relationship

Experience with…

Market: full autonomy and little interaction with CERN staff
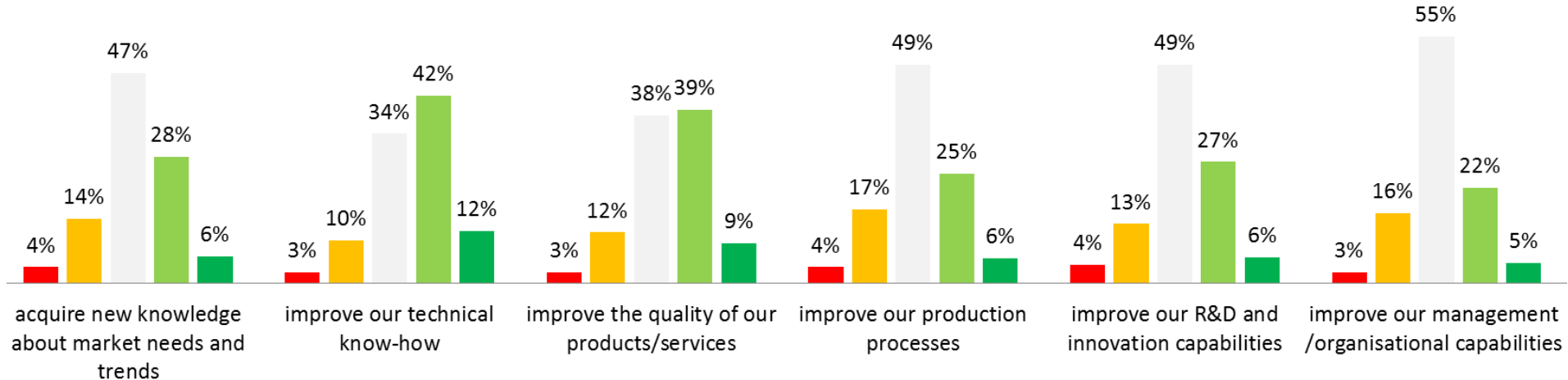**Hybrid**: additional inputs (clarifications, cooperation on some activities) from CERN staff
Relational: frequent and intense interactions with CERN staff

Testing H2: innovation outcomes

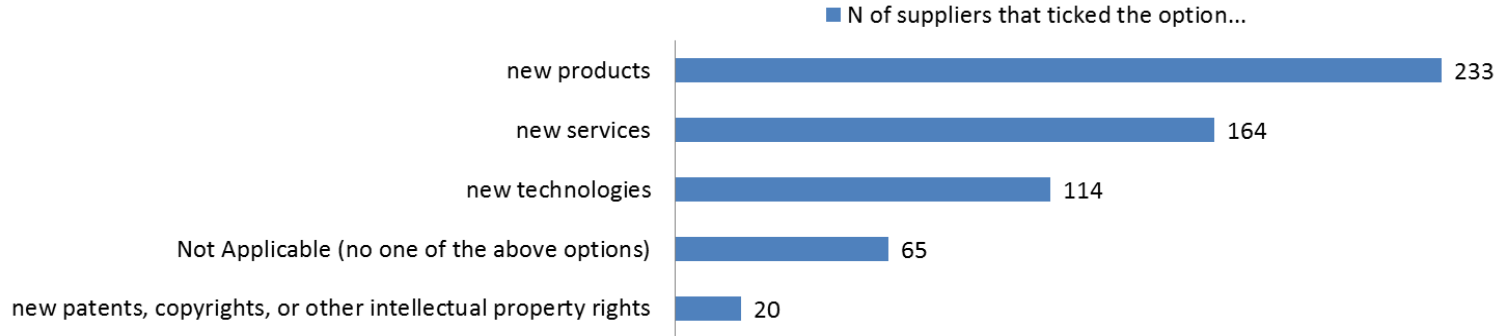**H2**: more structured types of relationships positively influence CERN suppliers' innovation outcomes

CERN RELATED **LEARNING BENEFITS** . Thanks to CERN, we were able to...

■ Strongly disagree ■ Disagree ■ Neutral ■ Agree ■ Strongly Agree

acquire new knowledge about market needs and trends: 4%, 14%, 47%, 28%, 6%

improve our technical know-how: 3%, 10%, 34%, 42%, 12%

improve the quality of our products/services: 3%, 12%, 38%, 39%, 9%

improve our production processes: 4%, 17%, 49%, 25%, 6%

improve our R&D and innovation capabilities: 4%, 13%, 49%, 27%, 6%

improve our management /organisational capabilities: 3%, 16%, 55%, 22%, 5%
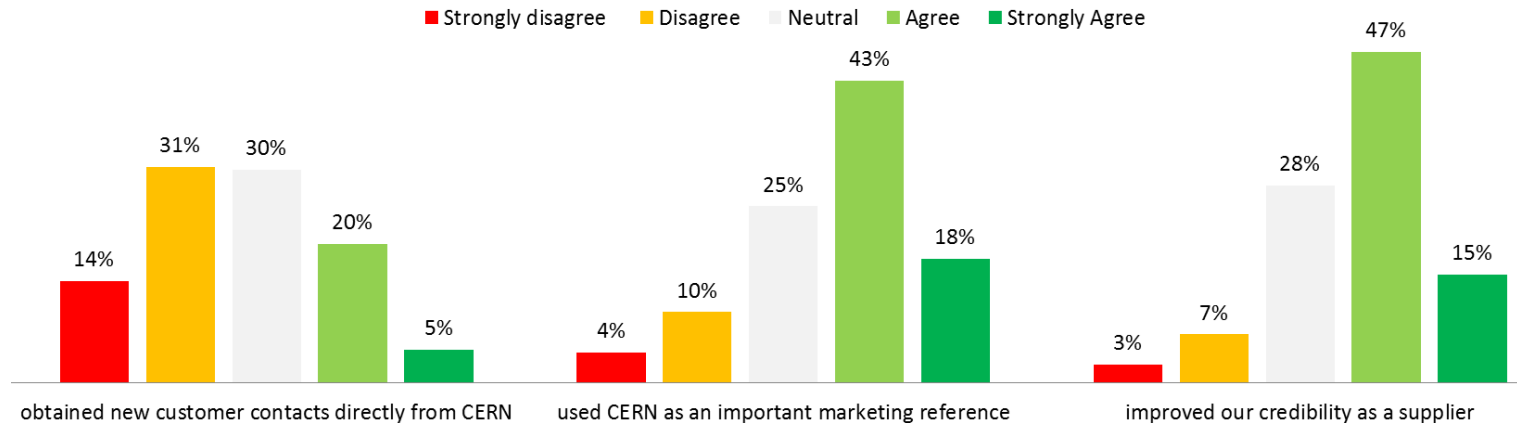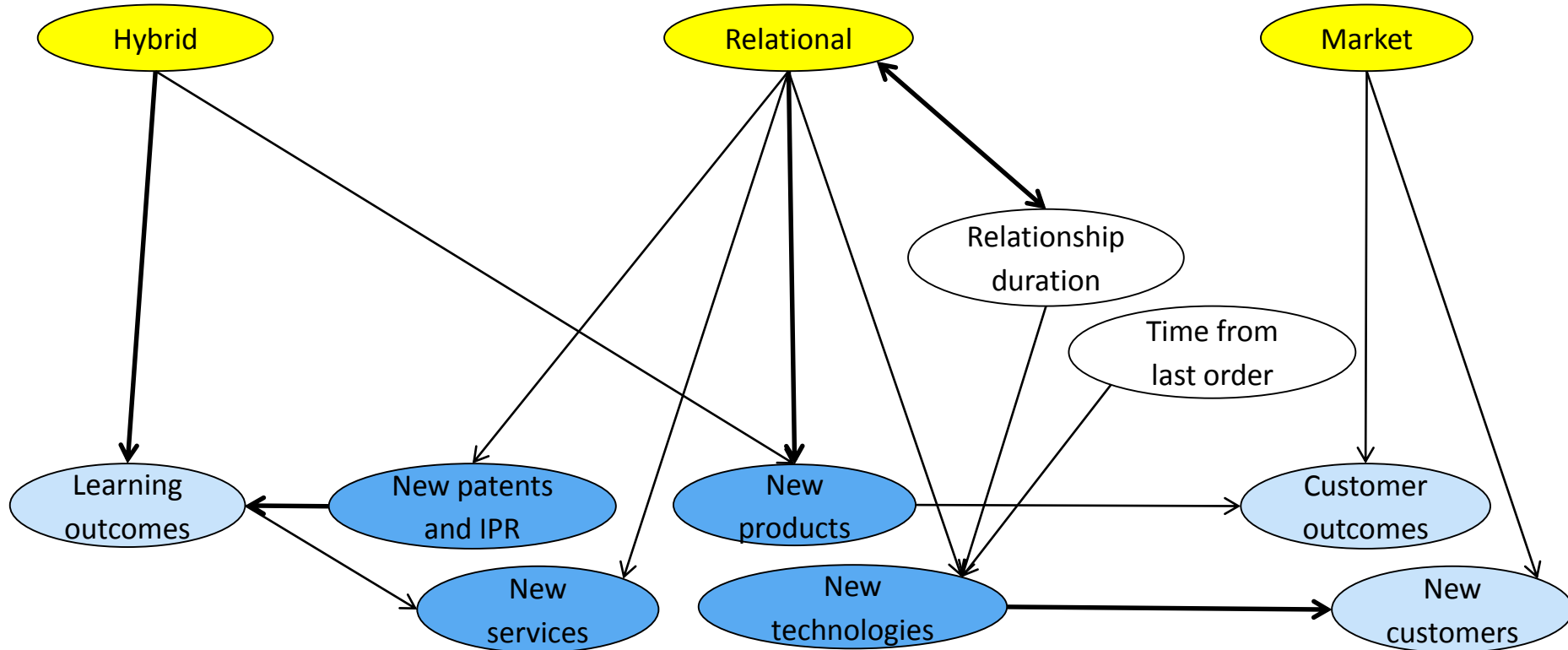
Testing H2: innovation outcomes *(cont.)*

As a results of new knowledge acquired and improvements, we were able to develop **TECHNOLOGICAL OUTCOMES**. Specifically ...

■ N of suppliers that ticked the option...

new products	233
new services	164
new technologies	114
Not Applicable (no one of the above options)	65
new patents, copyrights, or other intellectual property rights	20

CERN RELATED **CUSTOMER BENEFITS**. Because of the relationship with CERN, we...

■ Strongly disagree ■ Disagree ■ Neutral ■ Agree ■ Strongly Agree

|	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
obtained new customer contacts directly from CERN	14%	31%	30%	20%	5%
used CERN as an important marketing reference	4%	10%	25%	43%	18%
improved our credibility as a supplier	3%	7%	28%	47%	15%

Testing H2: innovation outcomes *(cont.)*

Testing H3: economic performance

H3: innovation outcomes in CERN supplier firms are expected to positively impact on their economic performance
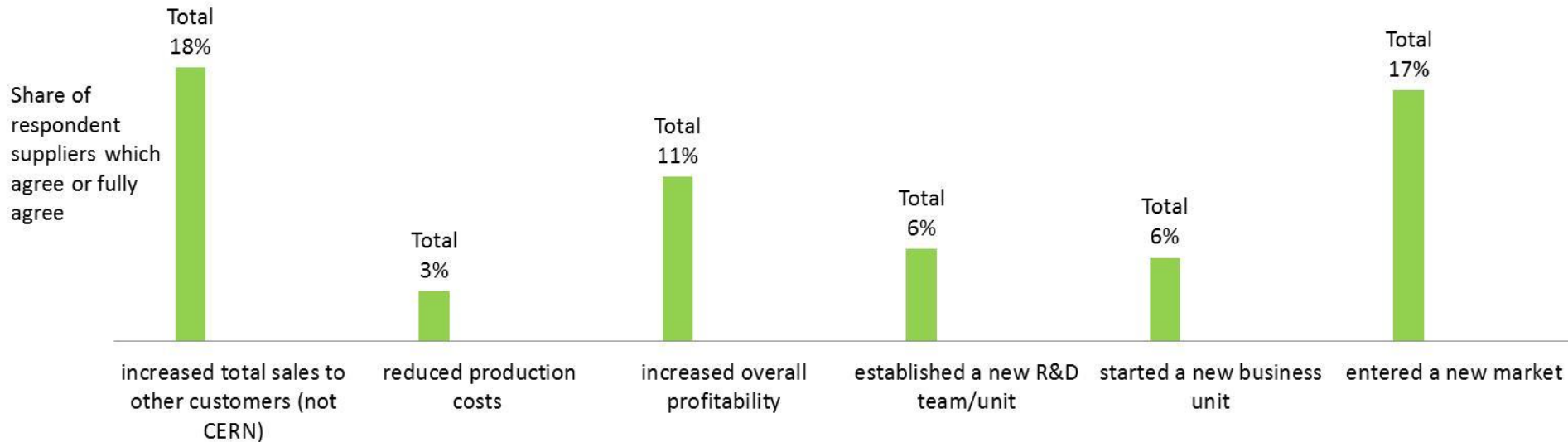
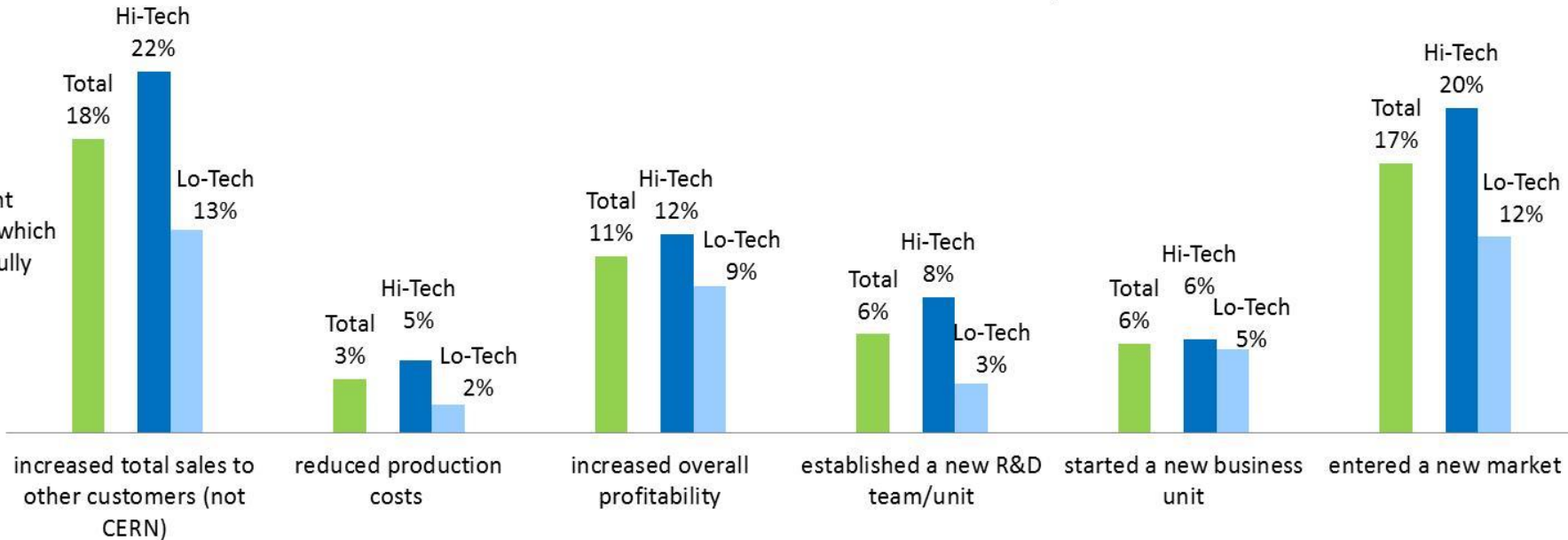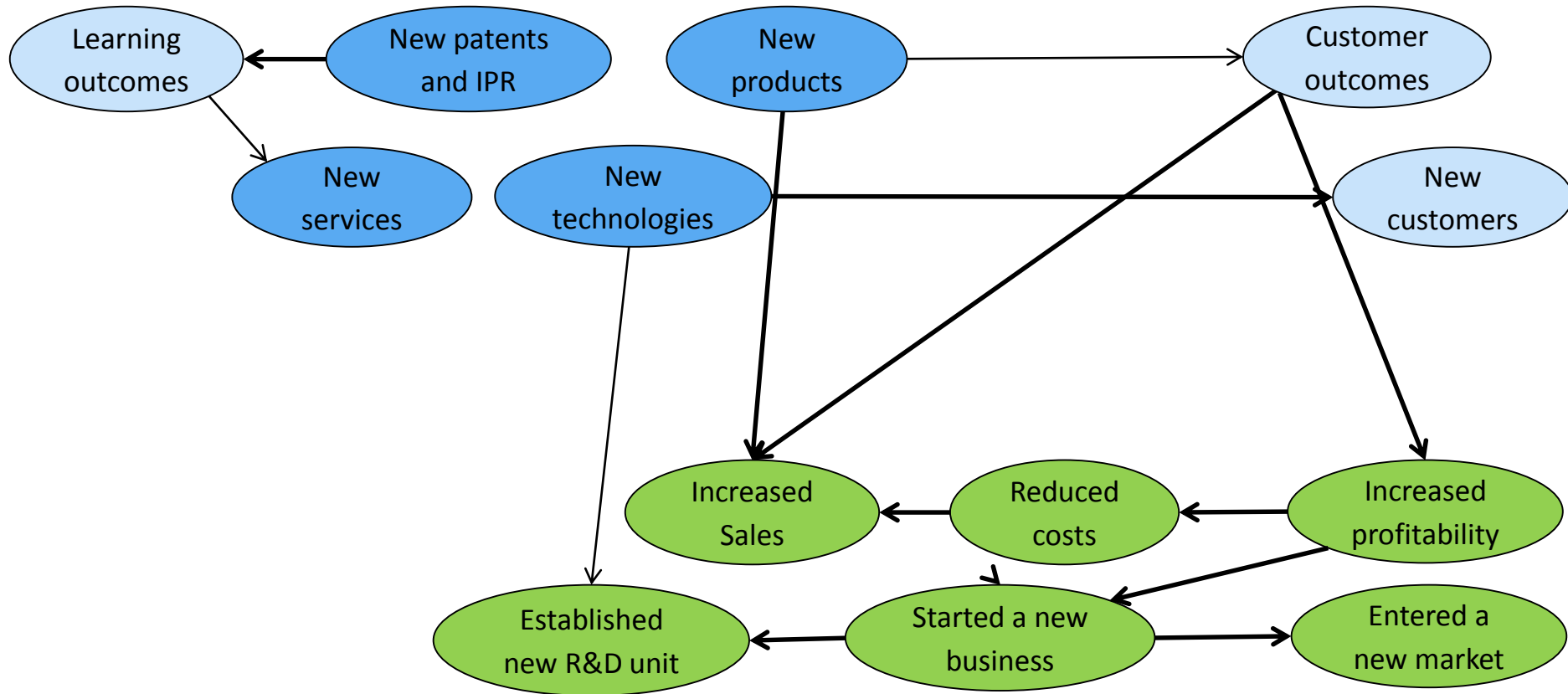**ECONOMIC PERFORMANCE.** Because of the work with CERN, we …

Testing H3: economic performance

H3: innovation outcomes in CERN supplier firms are expected to positively impact on their economic performance

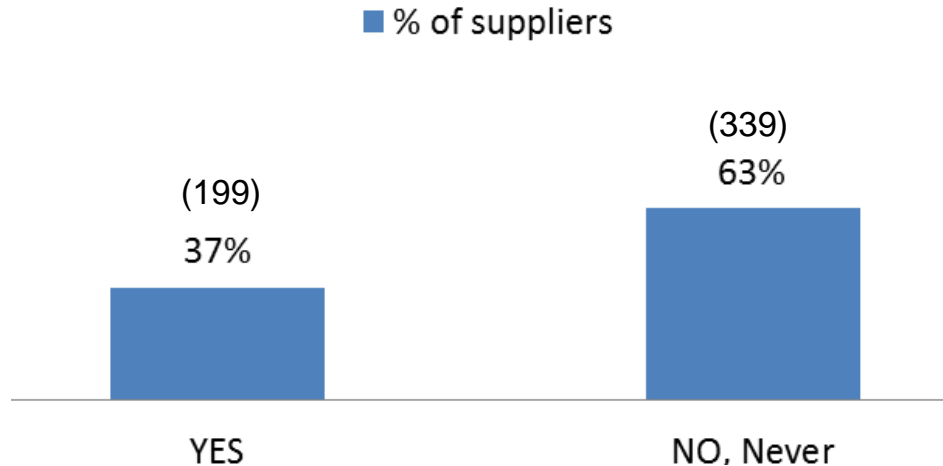**ECONOMIC PERFORMANCE.** Because of the work with CERN, we ...

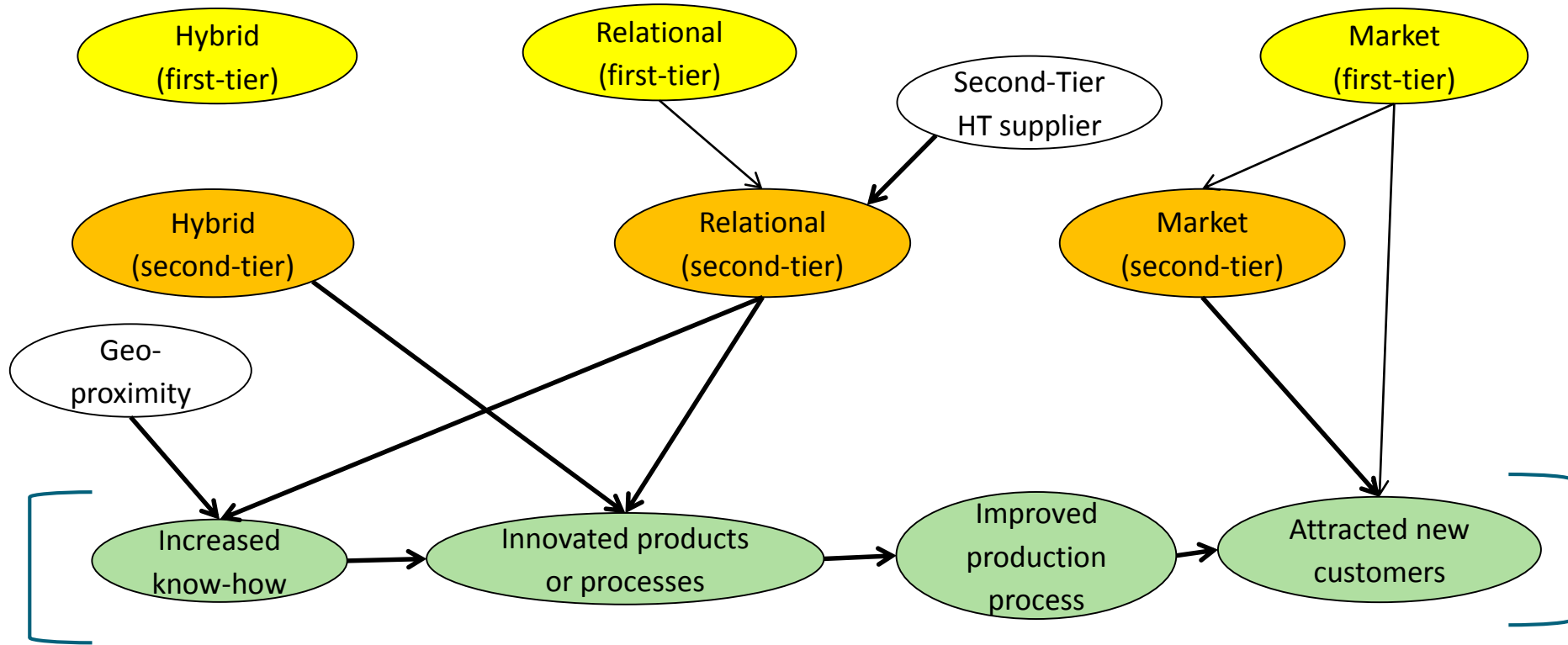# Testing H3: economic performance *(cont.)*

Testing H4: spillovers to value chain

H4: innovation spillovers are not only confined to CERN (first-tier) suppliers, but they spread along the supply chain

In order to carry out the CERN project(s), has your company ever mobilised any subcontractor?

Testing H4: spillovers to value chain *(cont.)*

Potential innovation outcomes as perceived by CERN suppliers

Conclusions

- This study provides empirical evidence about the **various types of benefits** accruing to companies involved in a procurement relationship with CERN:
  - o   Technological benefits
  - o   Learning benefits   Economic performance
  - o   Market benefits

- **Key mechanisms** which explain the type and size of benefits enjoyed are:
  - o   The way how CERN interacts with its suppliers
  - o   The type and volume of orders