Designing and redesigning international manufacturing networks

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Agenda

Designing international manufacturing networks

- At what level should we look?
- How can we map networks at an appropriate level?
- Are there generic network structures?

Redesigning international manufacturing networks

- What happens in a network when plant roles and responsibilities change?
- How does offshoring and backshoring impact the network balance?

Concluding remarks

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IMN at the Company level

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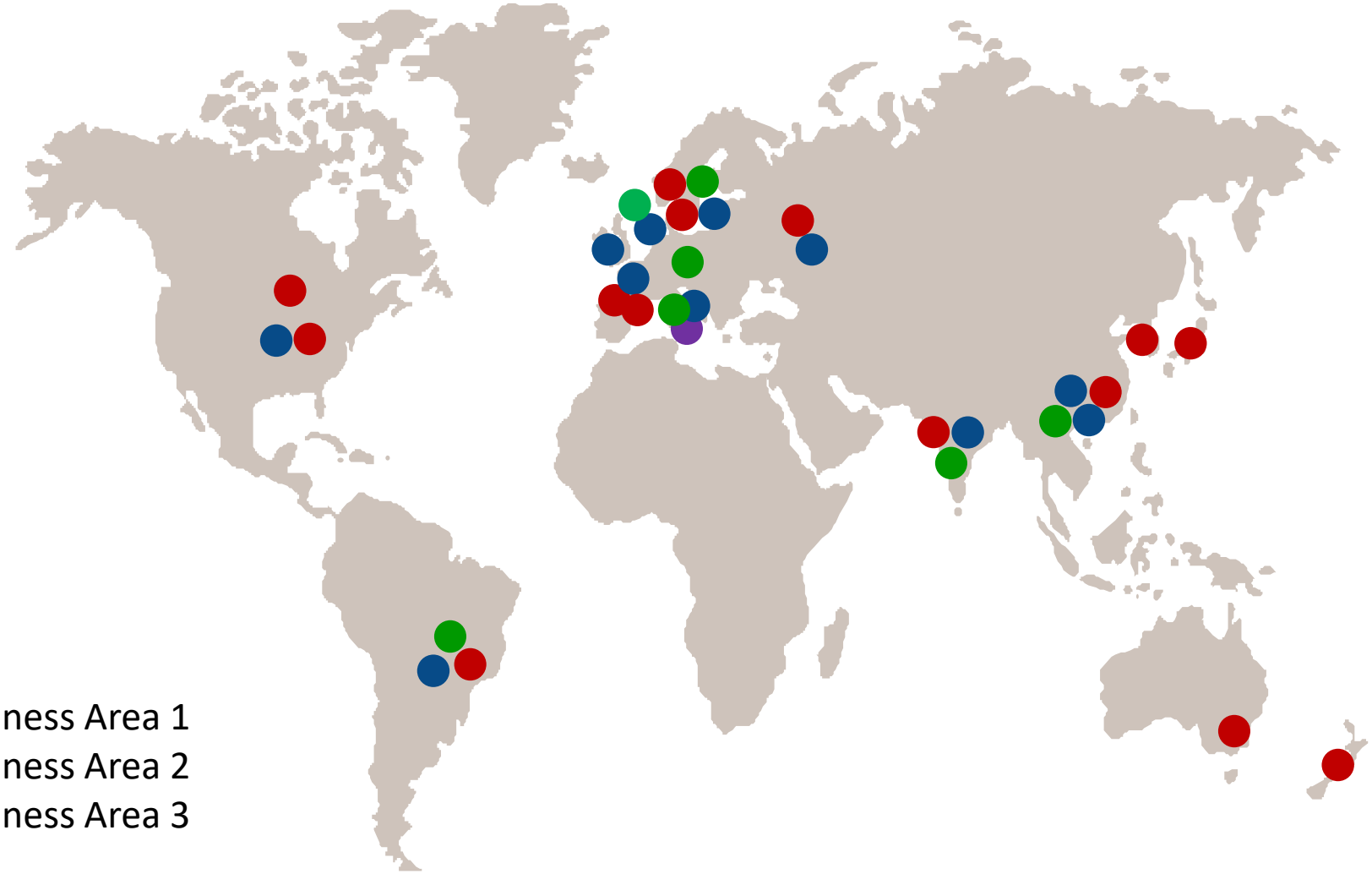
IMN at the Business Area level



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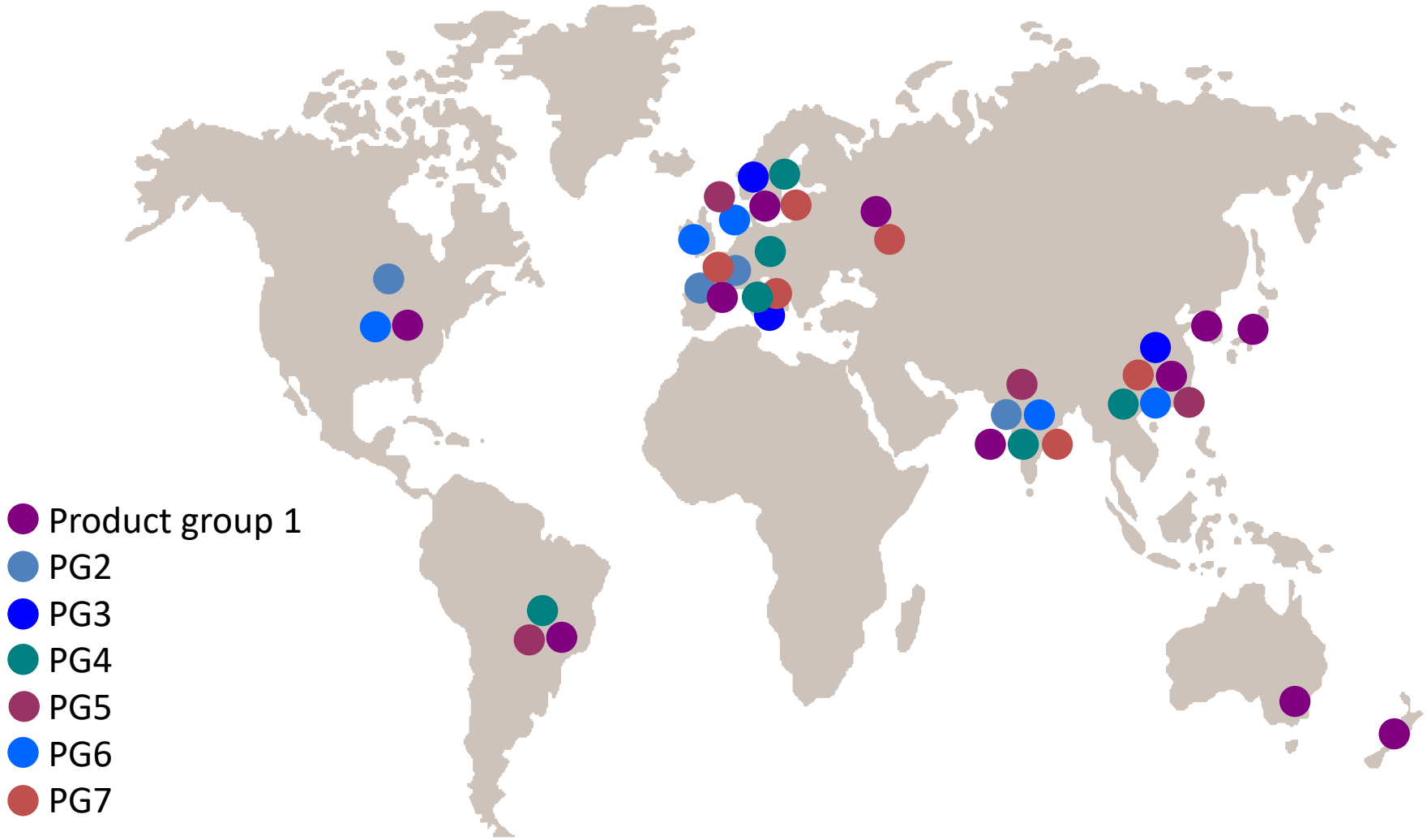
IMN at the Product Group level



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IMN for one specific Product Group

PG4

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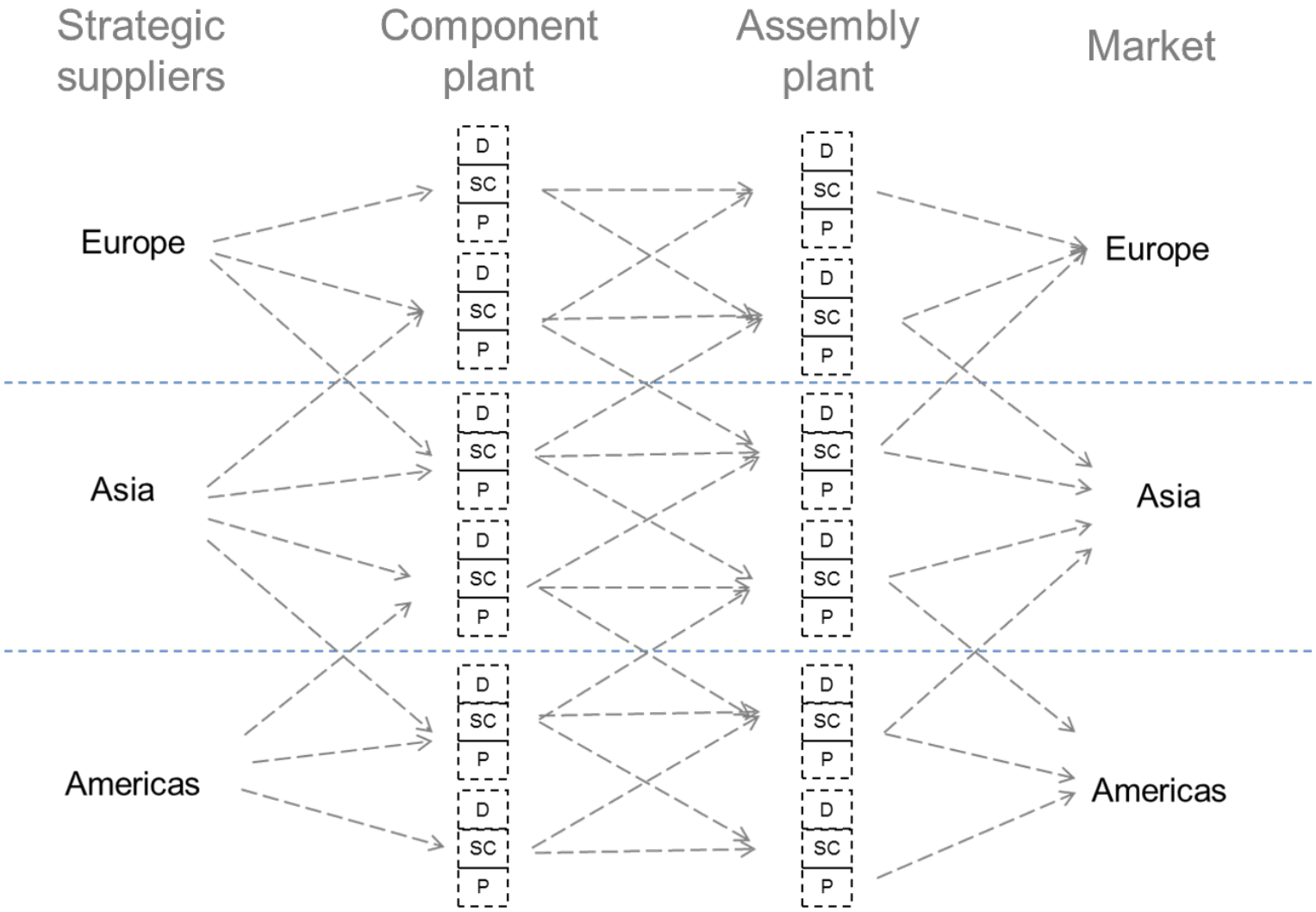
Network mapping model – Product Group level



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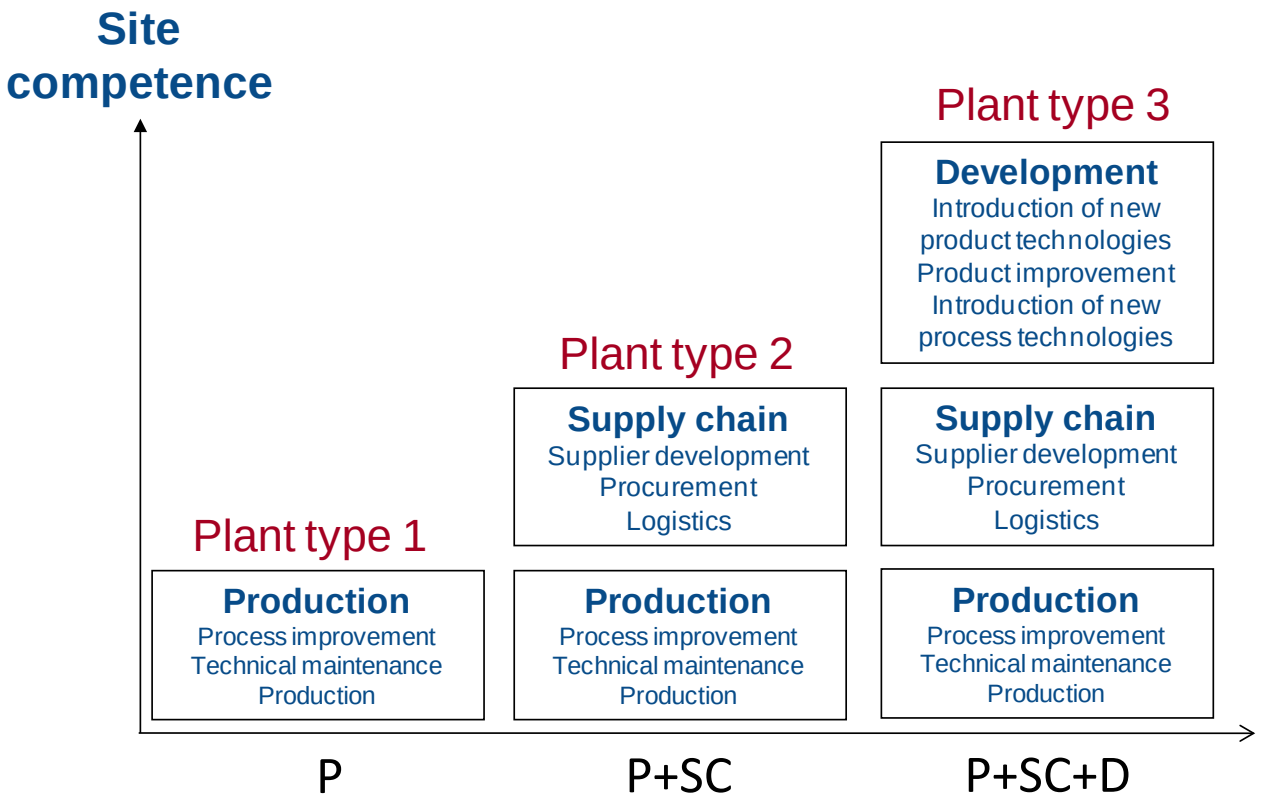
P, SC, D = …

Competence Bundles

- Development (D)
  - Product improvement
  - New product technologies
  - New process technologies
- Supply Chain (SC)
  - Logistics
  - Procurement
  - Supplier development
- Production (P)
  - Production
  - Technical maintenance
  - Process improvement

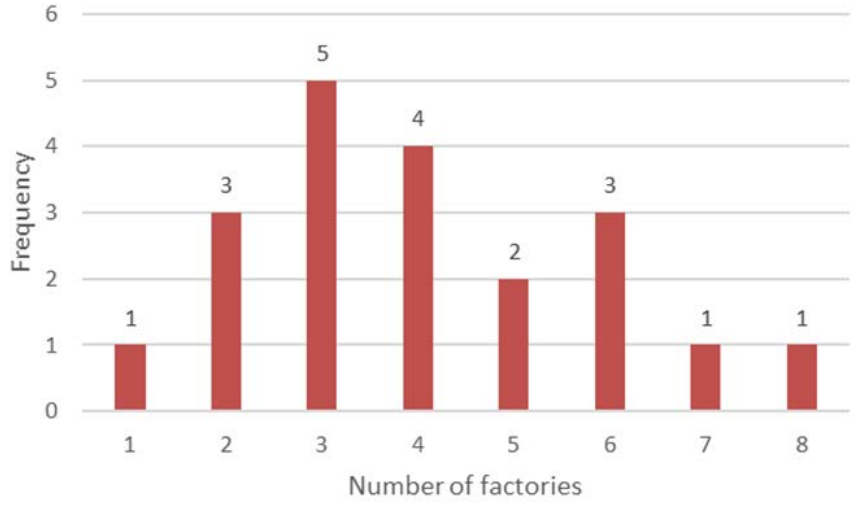
Plant Types



(Source: Feldmann & Olhager, 2013, ”Plant roles: Bundles of competences and their relationships with site location factors and performance”, *IJOPM*)

Research on Product Group IMN design

- 5 companies
- 20 product groups
- 1-8 plants involved in a product group network
- Plant operations:
  - component plant
  - assembly plant
  - ”integrated plant” = component mfg + assembly



(Source: Olhager & Feldmann, 2018, ”A taxonomy of international manufacturing networks”, *PP&C*)

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20 Product Group networks

	Company 1	Company 2	Company 3	Company 4	Company 5
# Networks in study	4	5	4	5	2
# Plants in networks (range)	3-8	3-6	4-5	1-7	2-3
Total # plants involved in these networks	13	10	12	11	3
# Plants in Europe	5	4	6	6	2
# Plants in Americas	2	3	2	2	1
# Plants in Asia	6	3	4	3	0

(Source: Olhager & Feldmann, 2018, ”A taxonomy of international manufacturing networks”, *PP&C*)

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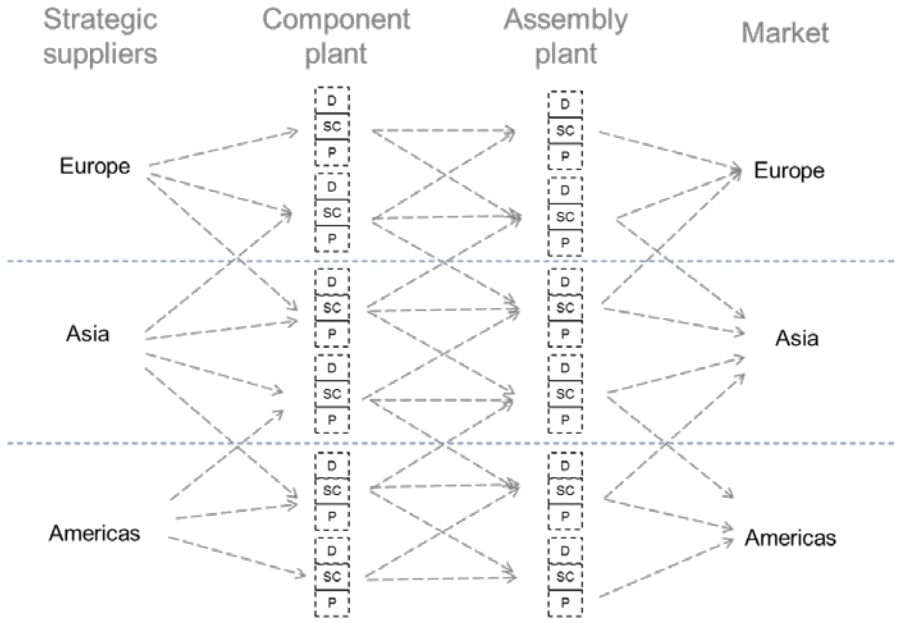
Data collection

Decision category	Measurement
Factory characteristics	Factory role; Site competences and responsibilities (production, supply chain, and development); Capacity; Size; Specialisation; Production process type; Proprietary vs. standard equipment; Automation level
Geographical dispersion	Location of factories; Links between factories
Horizontal coordination	Coordination mechanisms between production, purchasing, R&D, and product and process development.
Vertical coordination	Number of successive stages in the internal network; Make/buy decisions; Location and characteristics of strategic suppliers



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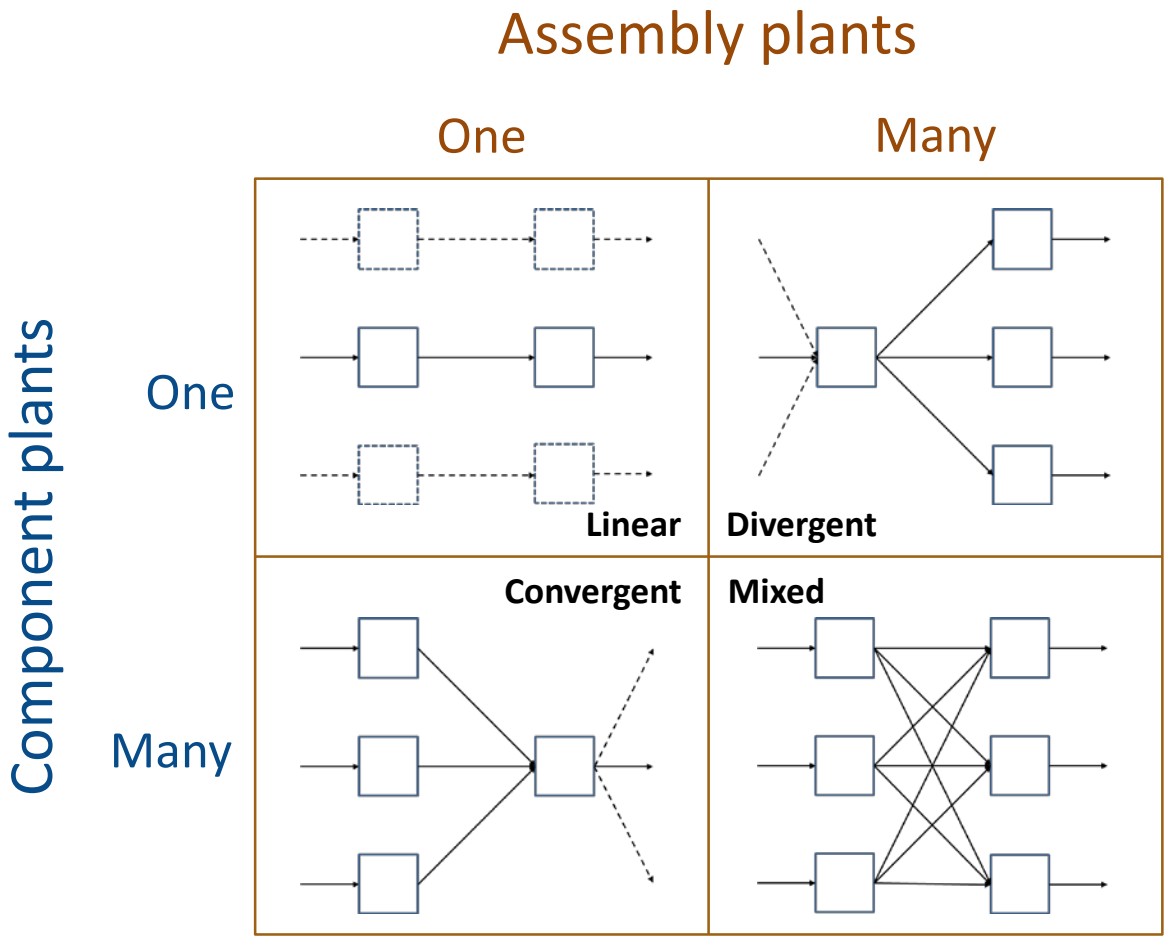
Four network types



(Source: Olhager & Feldmann, 2018, ”A taxonomy of international manufacturing networks”, *PP&C*)

Managerial challenges

Component plants \ Assembly plants	One	Many
One	*Degree of standardization across sub-networks, Distribution of R&D responsibilities* **Linear**	*Location of new assembly factories (for capacity and/or new markets)* **Divergent**
Many	**Convergent** *R&D coordination, Material flow synchronization*	**Mixed** *Balancing the network through expansion, consolidation and relocations*

(Source: Olhager & Feldmann, 2018, "A taxonomy of international manufacturing networks", *PP&C*)

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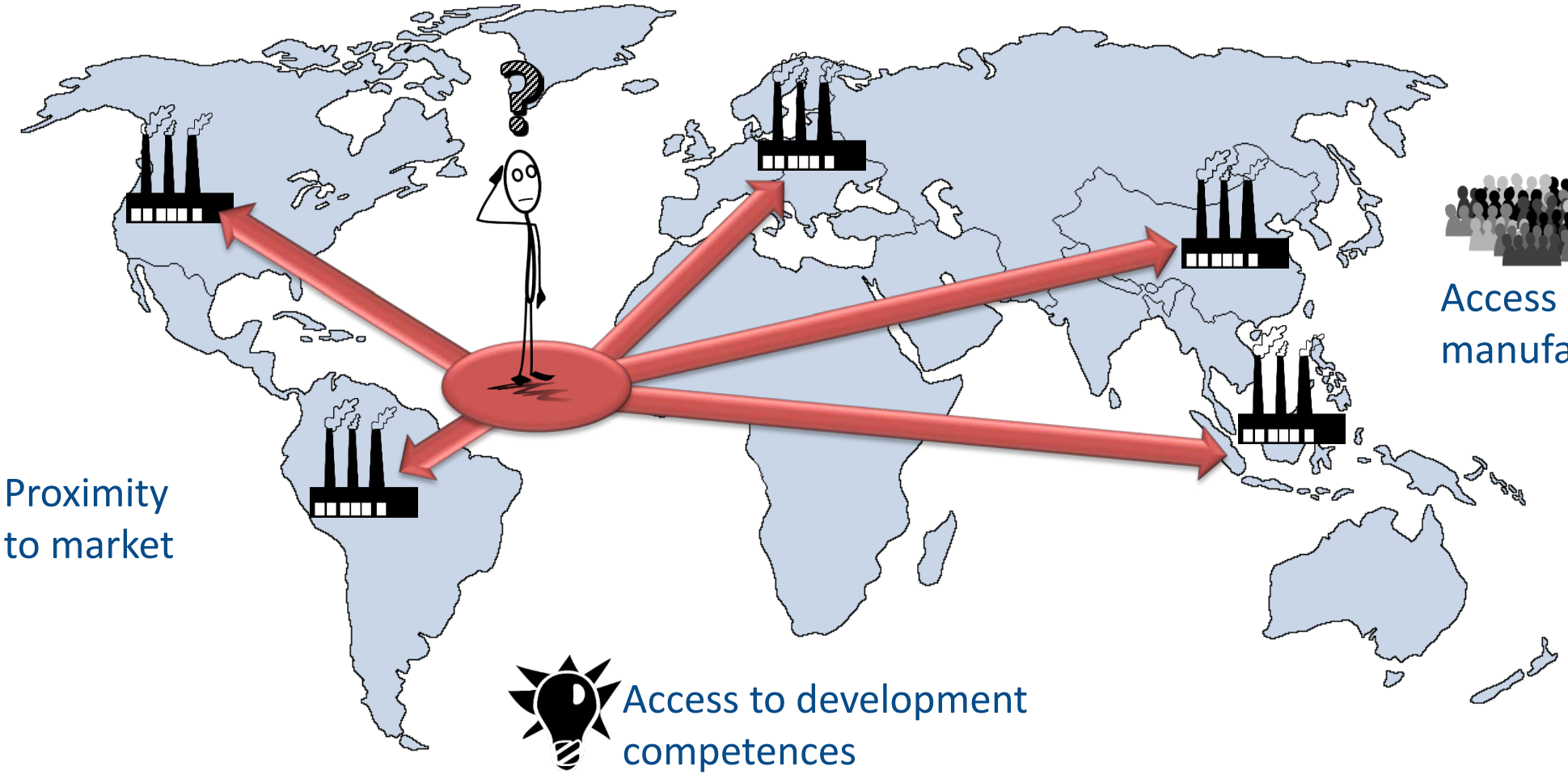
Manufacturing location and relocation



Access to low-cost manufacturing

Proximity to market

Access to development competences

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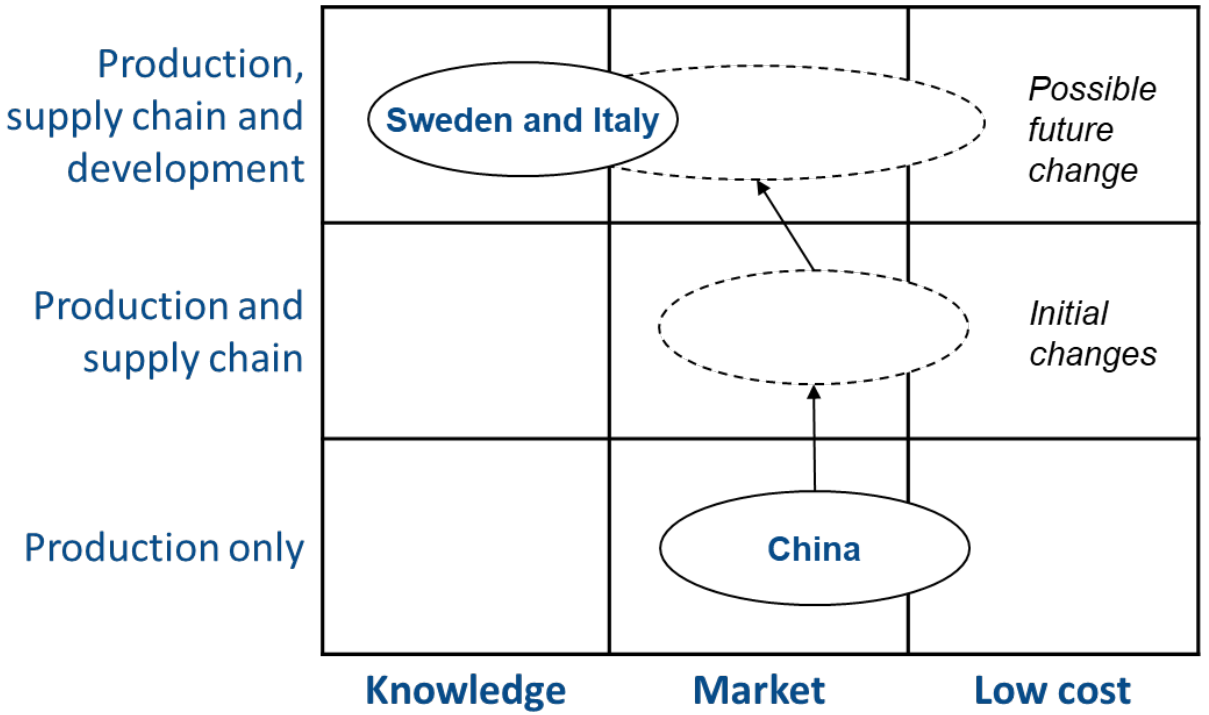
Case example

Background: Management of a MNC found it increasingly difficult to supply US customers from Europe

Action: Supply US from China, by adding competencies and responsibilities to the China plant



(Source: Feldmann, Olhager, Fleet, Shi, 2013, ”Linking networks and plant roles: the impact of changing a plant role”, *IJPR*)

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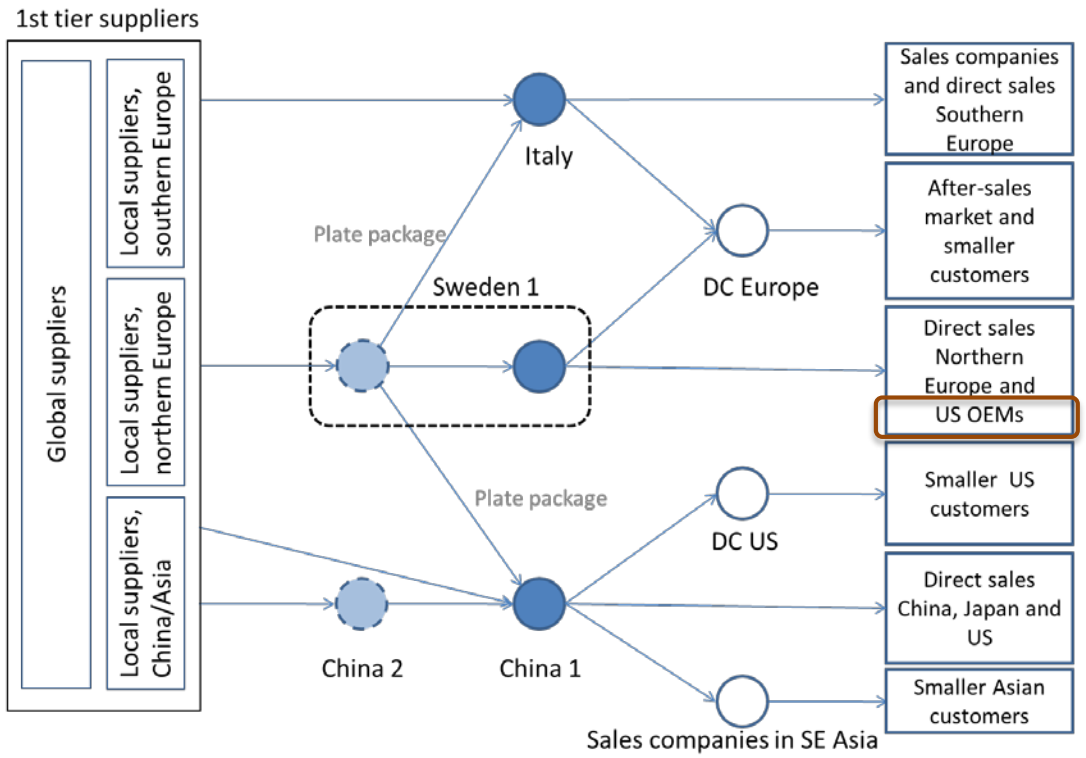
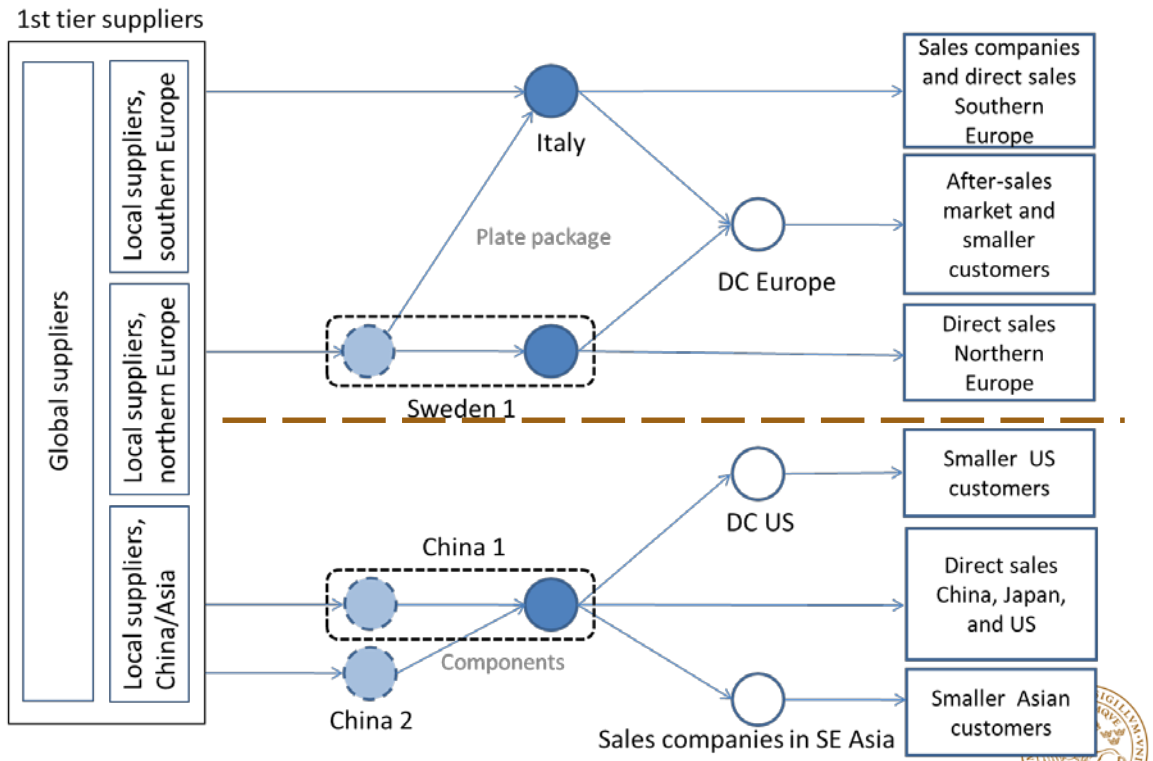
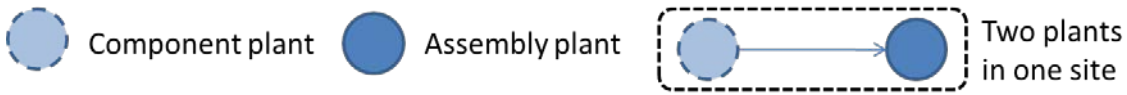
”Sub-network”: Small products in the product group

Before …



After …





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”Sub-network”: Large products in the product group

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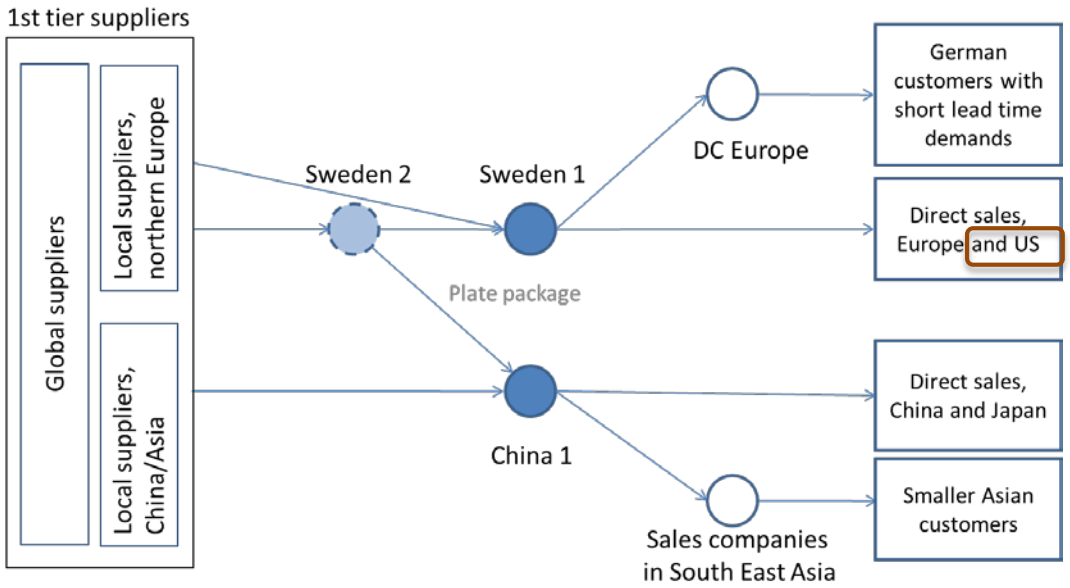

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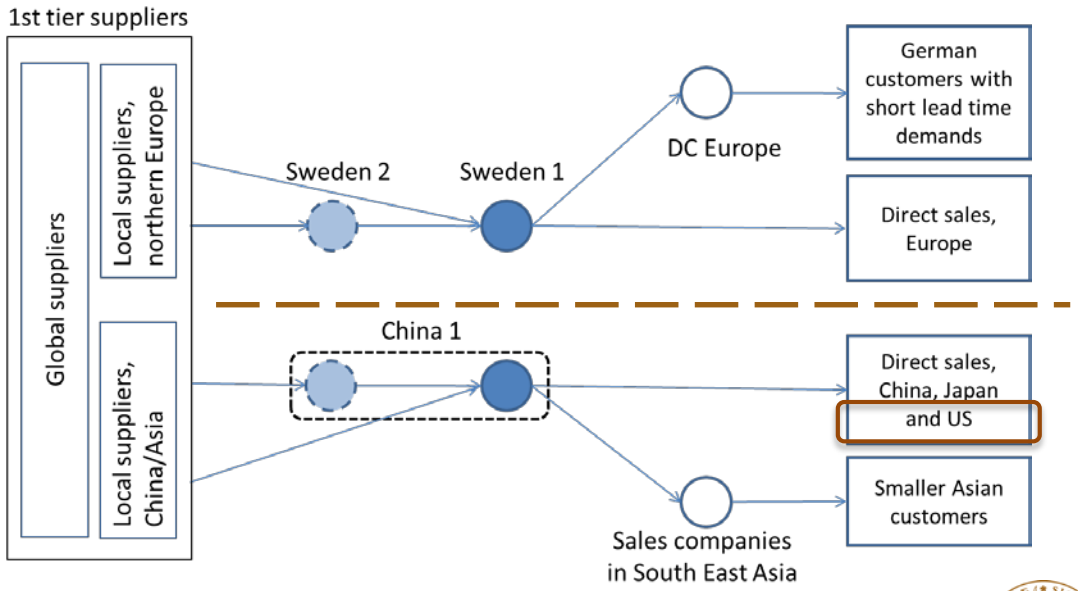

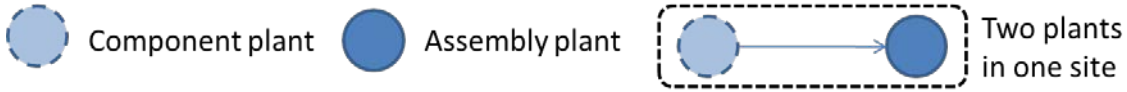

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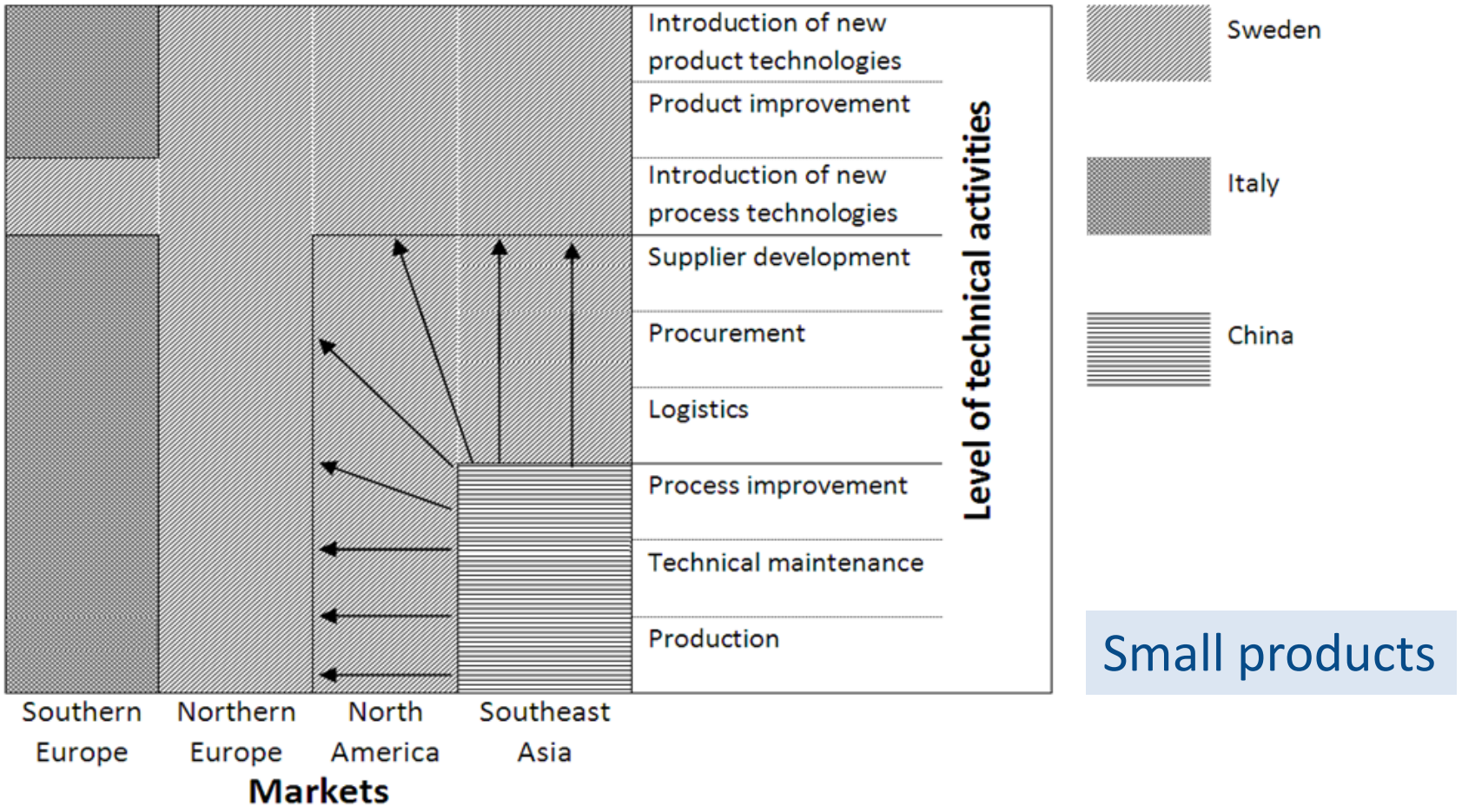
Model for mapping global responsibilities and illustrating plant role changes



Small products

(Source: Feldmann, Olhager, Fleet, Shi, 2013, ”Linking networks and plant roles: the impact of changing a plant role”, *IJPR*)

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So …

- … changing the *plant role* of one plant affects the *network balance*
- … plant role changes cannot be taken in isolation, but are *network decisions*
- … from the Swedish perspective, the plant role change was a case of *offshoring*
- … what about *backshoring*?
  - i.e. bring manufacturing back to Sweden

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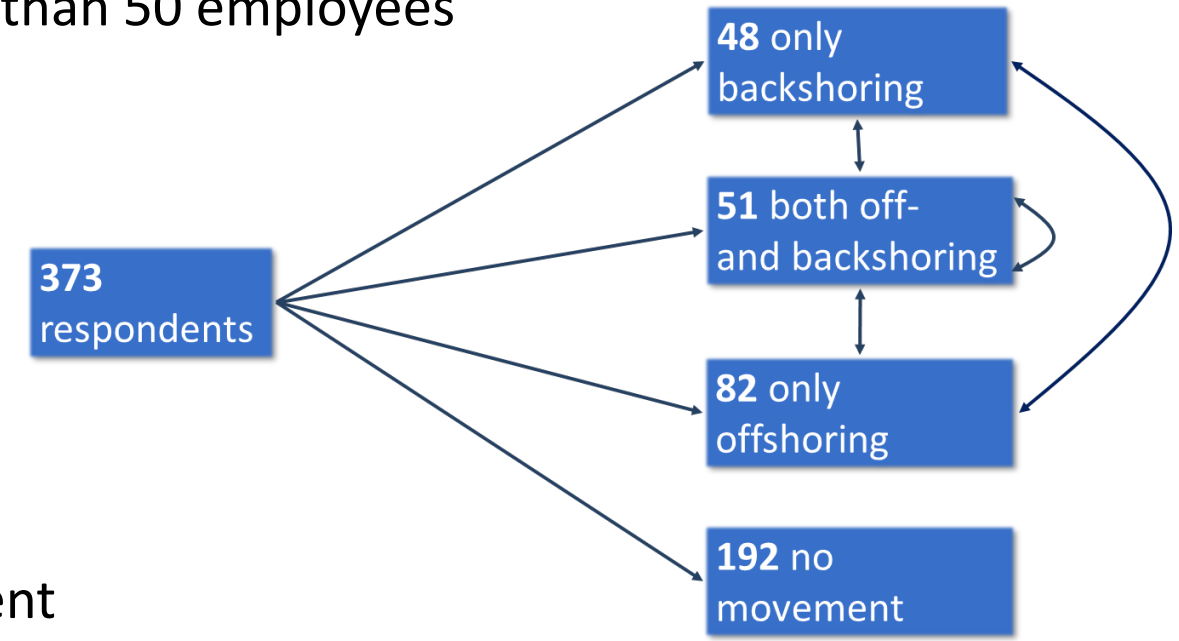
Survey on manufacturing relocation from and to Sweden between 2010-2015

- Data collection: September-October 2015
- Targets: All Swedish plants with more than 50 employees
  - 1637 plants
  - Industry code (SIC) 10-33
- Responses: 373
  - 22.8 % response rate
- Survey design
  - Unit of analysis: the plant
  - 229 items questions per respondent
  - **Same set of questions for offshoring and backshoring**



[Source: (1) Johansson & Olhager, 2018, Manufacturing relocation through offshoring and backshoring: the case of Sweden, *JMTM*; (2) Johansson & Olhager, 2018, Comparing offshoring and backshoring: The role of manufacturing site location factors and their impact on post-relocation performance, *IJPE*, and works in progress]

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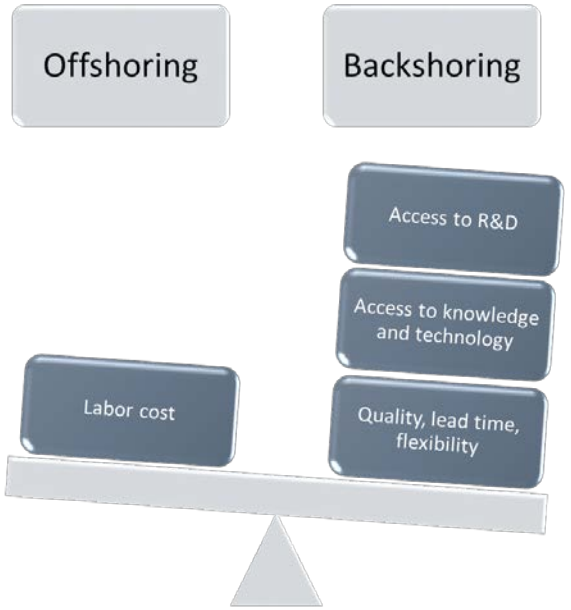
Key results

- Still more offshoring than backshoring, approximately 1:0.6
  - ”better” ratio in Sweden than in other countries! But still a net outflow!
- All industries off- and backshore
  - Low-tech < Medium-low tech < Medium-high tech & High-tech
- All plant sizes off- and backshore
  - Small plants move less, while large both off- and backshore
- Plants in large networks move more frequently
  - both internally and externally
- Distinctly different drivers for off- and backshoring
  - One driver for offshoring = labour cost
  - Many drivers for backshoring!



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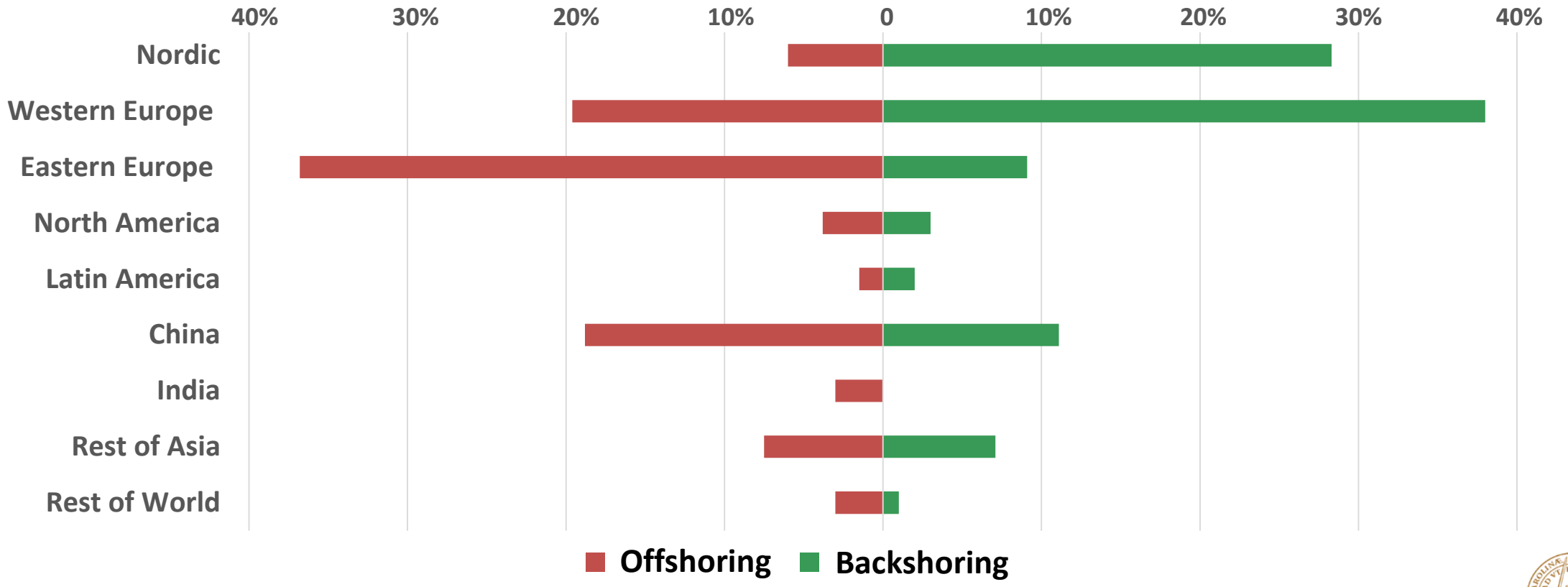
To where & From where?



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Relocations and innovations at the focal plant

To what extent are you pursuing manufacturing related innovations?

(Scale: 1 = Not at all; 2 = Small extent, 3 = Moderate extent; 4 = Large extent; 5 = Very large extent)

Type of innovation	Offshorers	Bi-directional movers	Backshorers	Non-movers
N =	82	51	48	192
Digitalization	2.79[d]	2.81[e]	3.28[c,d,e]	2.82[c]
New high-tech materials	2.37	2.56	2.66[c]	2.27[c]
New process technologies	2.55[c,d]	2.49[b]	3.09[a,b,d]	2.21[a,c]
Automation & robotization	3.17[c]	3.23	3.64[c]	3.31

a: difference is significant at the 0.001 level; b: difference is significant at the 0.01 level; c,d,e: difference is significant at the 0.05 level.

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Concluding remarks

- All practitioners strive for a balanced manufacturing networks!
- Who should be doing what, where, with how much capacity, and for which product group?
  - Who = Rightsourcing
  - What = Component mfg and/or assembly (+R&D)
  - Where = Rightshoring
  - How much capacity = Rightsizing (wrt investments and innovations)
- A change in any of these dimensions affects the balance of the network!
- Thus, all dimensions should be considered simultaneously!

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