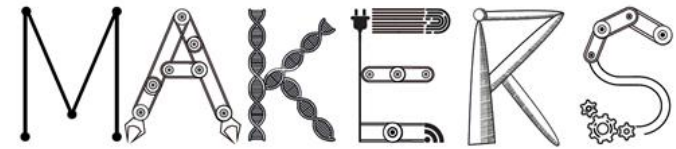




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# Industry 4.0 application and reshoring of manufacturing – evidence, limitations & policy implications

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EU industrial policy”, Brussels, January 25<sup>th</sup> 2018**

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- **Industry 4.0 and local value chains**
- **Trends in manufacturing backshoring**
- **Industry 4.0 enabling technologies and correlation with backshoring**
- **Key competences for Industry 4.0**
- **Conclusions for Industrial and Innovation Policy**

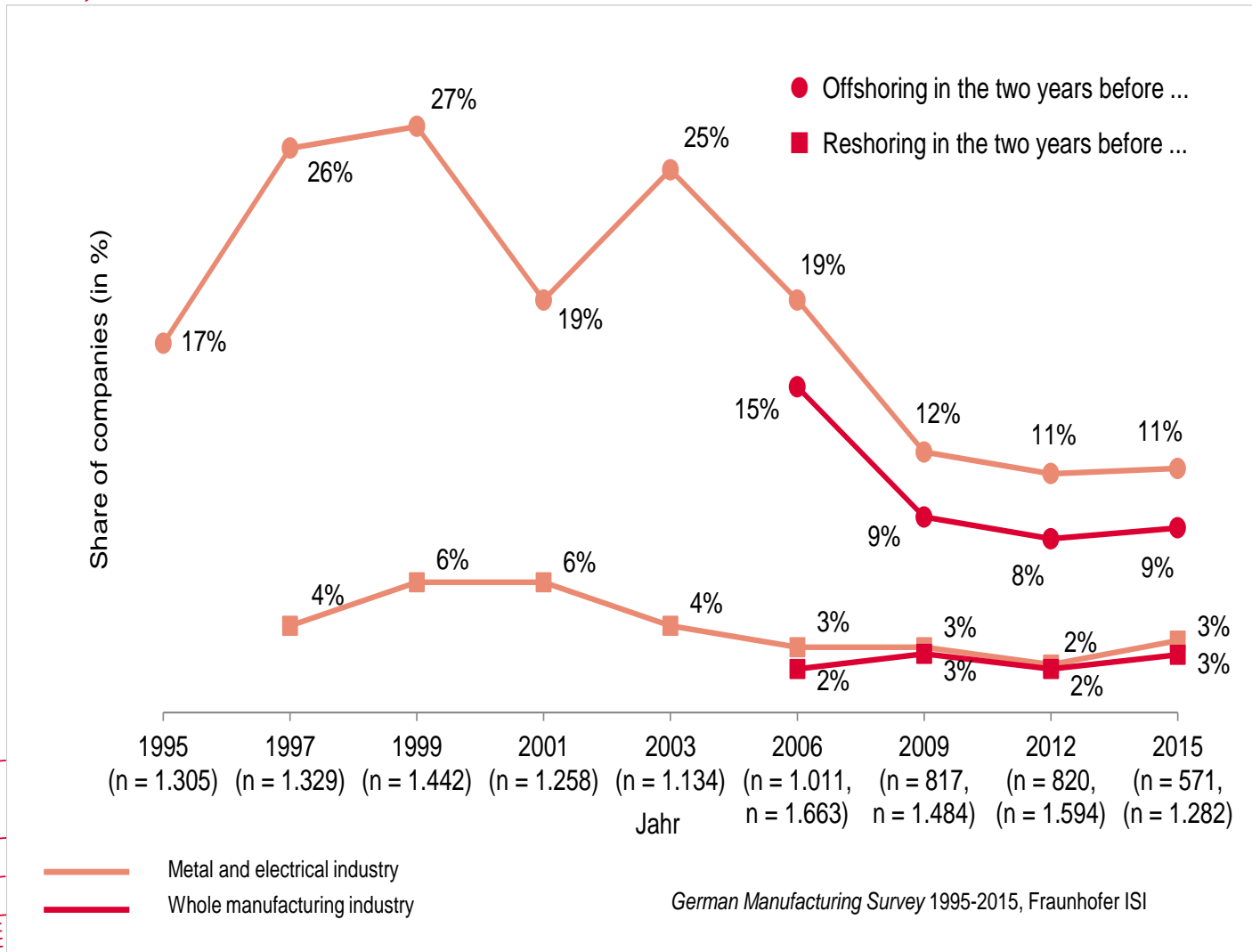


# Rise of local value chains and Industry 4.0?

- Transnationally highly fragmented value chains are typical for today's global economy, in particular for high-tech products (Brennan et al., 2015).
  - E.g. iPhone: Designed and commercialised in the US
  - Assembled in China, “Made in the world”
- But also disadvantages and risks of global supply chains show up: (e.g. Handfield, 1994; Holweg et al., 2011; Nassimbeni, 2006)
  - Long lead-times, low flexibility, instability in supply chains
  - Unsatisfactory quality standards of foreign suppliers
  - Cultural differences and communication problems
  - Rising labour costs
  - ⇒ Increasing awareness for the *back-/reshoring* of manufacturing
- Industry 4.0 / Smart Factory enables efficient and agile production systems
  - ⇒ Potentials to support back-/reshoring?
  - ⇒ Potentials to restore manufacturing and local value chains in EU countries?



# German evidence: Manufacturing offshoring and backshoring over time



- Offshoring stays on lowest level since mid 90s
- Backshoring stable (slightly upwards); for every 3<sup>rd</sup> offshoring company there is one backshoring
- Around 500 German manufacturing companies per year perform backshoring



# “Adjusted” shares of backshoring companies in European countries

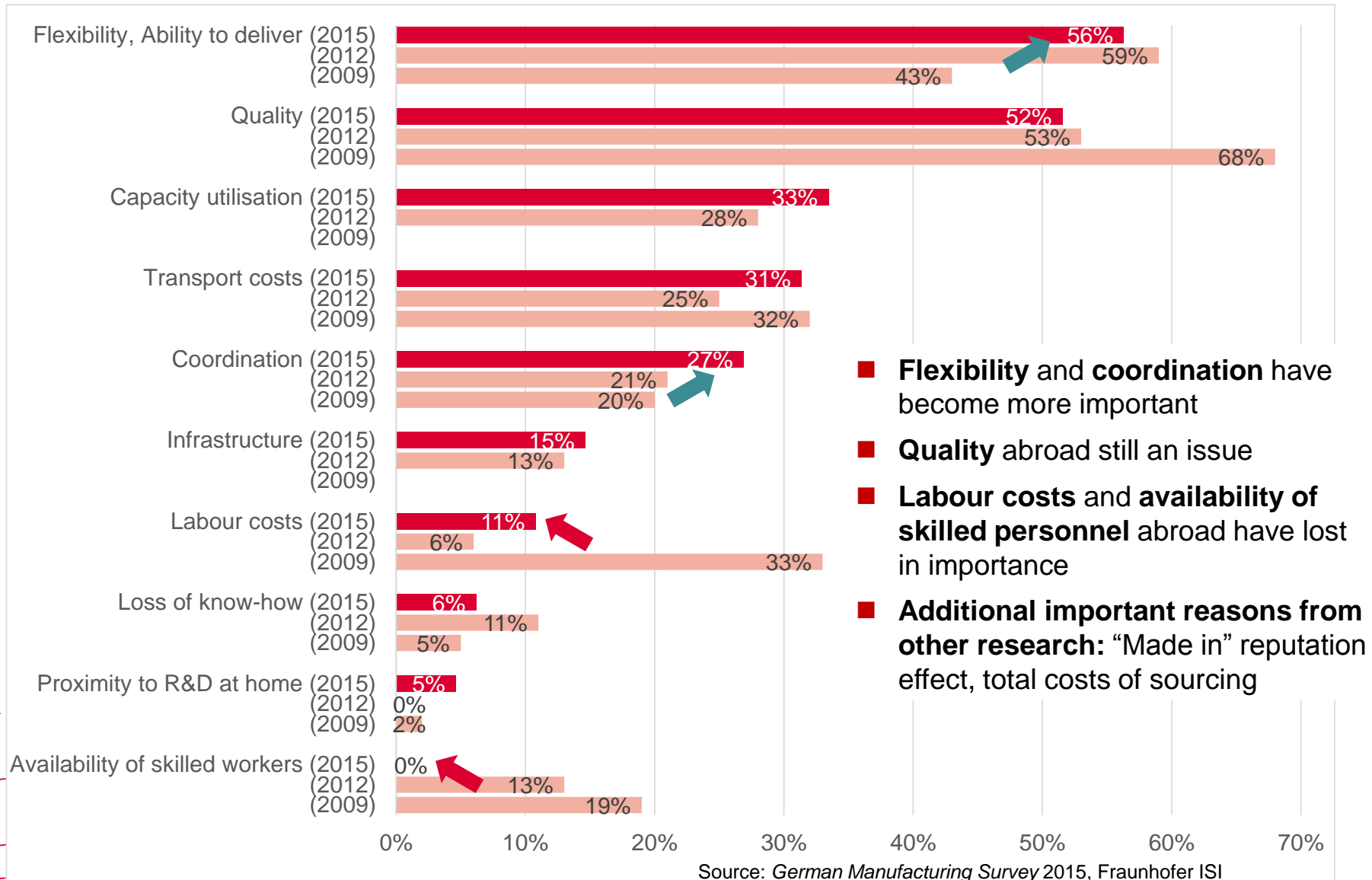
Country	Share of companies active in reshoring	Time-frame (years covered)	“Adjusted” share of companies active in reshoring over a 2 years period
Sweden	27,0%	6	9,0%
Ireland	13,0%	3	8,7%
Belgium	9,5%	3	6,3%
Slovakia	9,0%	3	6,0%
France	14,0%	5	5,6%
Denmark	13,0%	6	4,3%
Finland	13,0%	6	4,3%
DACH	4,0%	2	4,0%
Portugal	6,0%	3	4,0%
Netherlands	6,0%	3	4,0%
<b>Selected European countries (EMS survey)</b>	<b>4,0%</b>	<b>2</b>	<b>4,0%</b>
UK	13,0%	8	3,3%
Germany	3,0%	2	3,0%
Estonia	3,5%	3	2,3%
Lithuania	2,0%	3	1,3%
Bulgaria	2,0%	3	1,3%
Romania	1,0%	3	0,7%

- Issues: Different points in time, different economic conditions, different phases in the „offshoring and backshoring lifecycle”

Source: Kinkel et al. (2017): *Measuring reshoring trends in the EU and the US*, Deliverable 4.1 of the MAKERS project, Karlsruhe

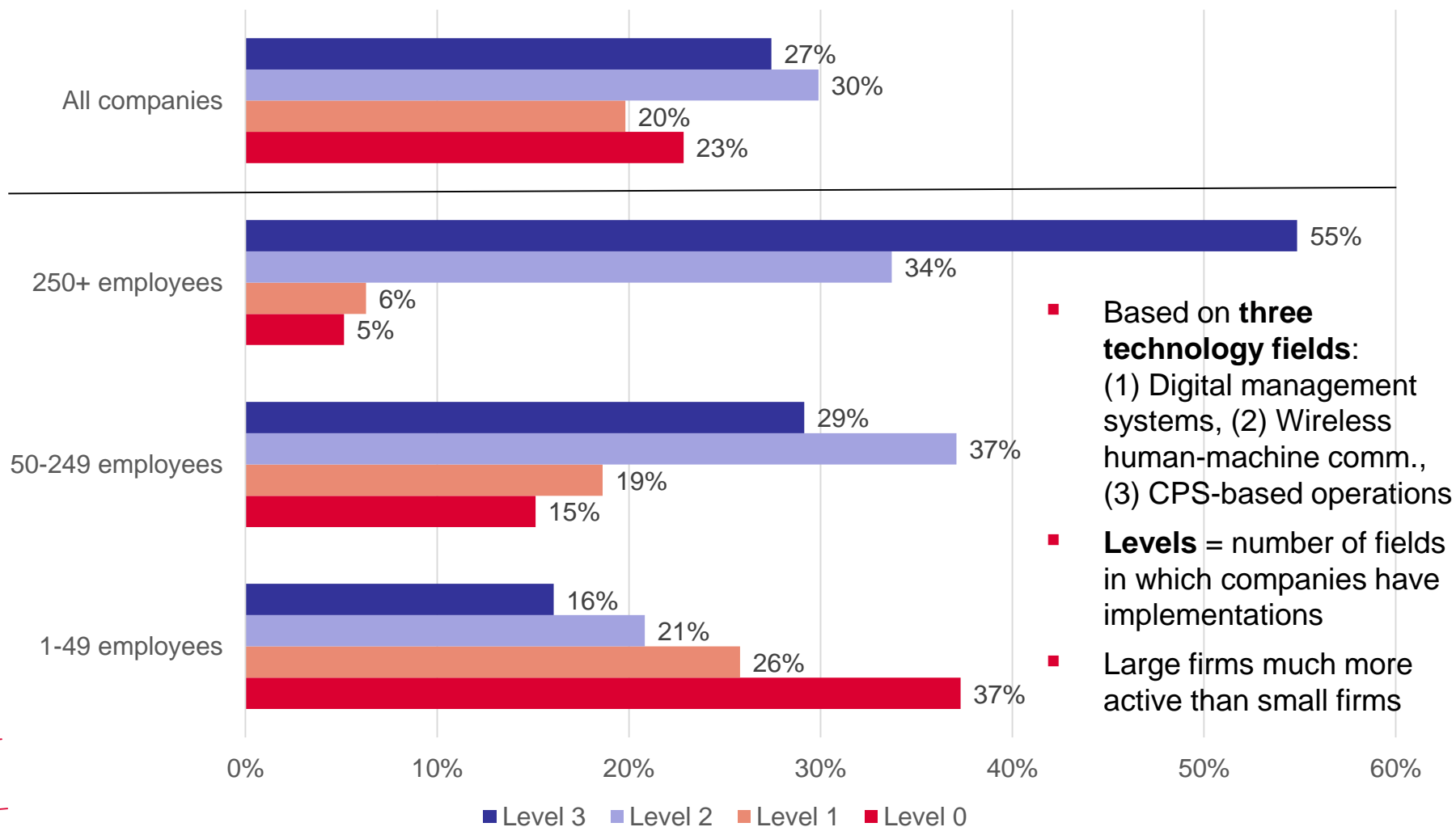


# Main motives for backshoring of manufacturing activities (German evidence)





# Industry 4.0 *enabling technologies* application levels – long ways to go





# Correlations of Industry 4.0 and backshoring

- **Significant positive correlation** between the **use of Industry 4.0 enabling technologies** and the **backshoring propensity** of German (also Austrian and Swiss) manufacturing companies
- “Advanced users” (level 3) of Industry 4.0 enabling technologies display on average a **10-times higher backshoring propensity** than "non-users" (level 0)

Two arguments:

- Use of I4.0 enabling technologies facilitate **increased automation and productivity** of the German factory site, making labour arbitrage of low-cost countries (LCC) less appealing and economies of scale more important
- Even more important: Use of I4.0 enabling technologies facilitate **increased flexibility and efficient production of individualized solutions**, providing incentives for firms to keep/reshore production close to their European customers (→ local value chains).

Cox & Snell: 0,055		Nagelkerkes: 0,230		Regression coefficient B	Sig.
Step 1	Ln #employees			,072	,673
	sec99_other manufacturing			-,038	,974
	sec24_metal & metal components			-,093	,938
	sec26_Data processing equipment, electronic and optical products			,691	,561
	sec27_electrical equipment			,439	,724
	sec28_machinery & equipment			-1,023	,415
	medium batch size			,329	,593
	large batch size			-,152	,850
	medium complex products			-,383	,532
	complex products			-,248	,730
	supplier company			-1,485	,004
	main competition factor: price/cost			,574	,310
	Ln import quota of inputs			-,143	,468
	Ln export quota of inputs			1,101	,004
	Ln share of unskilled workers			,137	,439
	I40-enabling-use-til-2013_level1			1,884	,095
	I40-enabling-use-til-2013_level2			1,932	,076
	I40-enabling-use-til-2013_level2			2,618	,016
	Constant			-8,946	,000





# Key competences for the digital integration

- Technical key competences:
  - Software development of modular applications (apps) and IT-based platforms
  - Integration with the programming of machine and plant controls
  - IT security and user-oriented IT design
- Non-technical competences:
  - Comprehensive understanding of customer problems and business models
  - Analysis of complex data and making sense as “smart data”
  - Interdisciplinary cooperation, particularly between engineers and IT specialists
- Agile development approach, early experimentation and testing, positive culture of error: "be brave and fail fast"

Source: Kinkel et al. (2016): *Digital-vernetztes Denken in der Produktion. Studie für die IMPULS-Stiftung des VDMA, Karlsruhe, November 2016*



# Conclusions for Industrial and Innovation Policy

- The advantages of cost-based offshoring to LCC have clearly diminished, however offshoring intensity is still higher than backshoring intensity
- Positive correlation between the adoption of I4.0 enabling technologies and backshoring
  - limited with respect to jobs directly created at the home base, as “new production” is more automated
  - Indirect effects through local purchase of equipment and infrastructure as well as local sourcing of inputs and services
- **What policy can do**
  - Support regional clusters and local value chains
  - Support local demand for innovative and more sustainable solutions (e.g. public procurement, “Made in” local value chains)
  - Support development and adoption (!) of smart and agile production systems (e.g. Industry 4.0, flexible and individualized manufacturing, additive manufacturing)
  - Support development of smart, data-driven services and business models for B2B
  - Support education, qualification and competence development of skilled personnel, limit bottlenecks



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# Questions?

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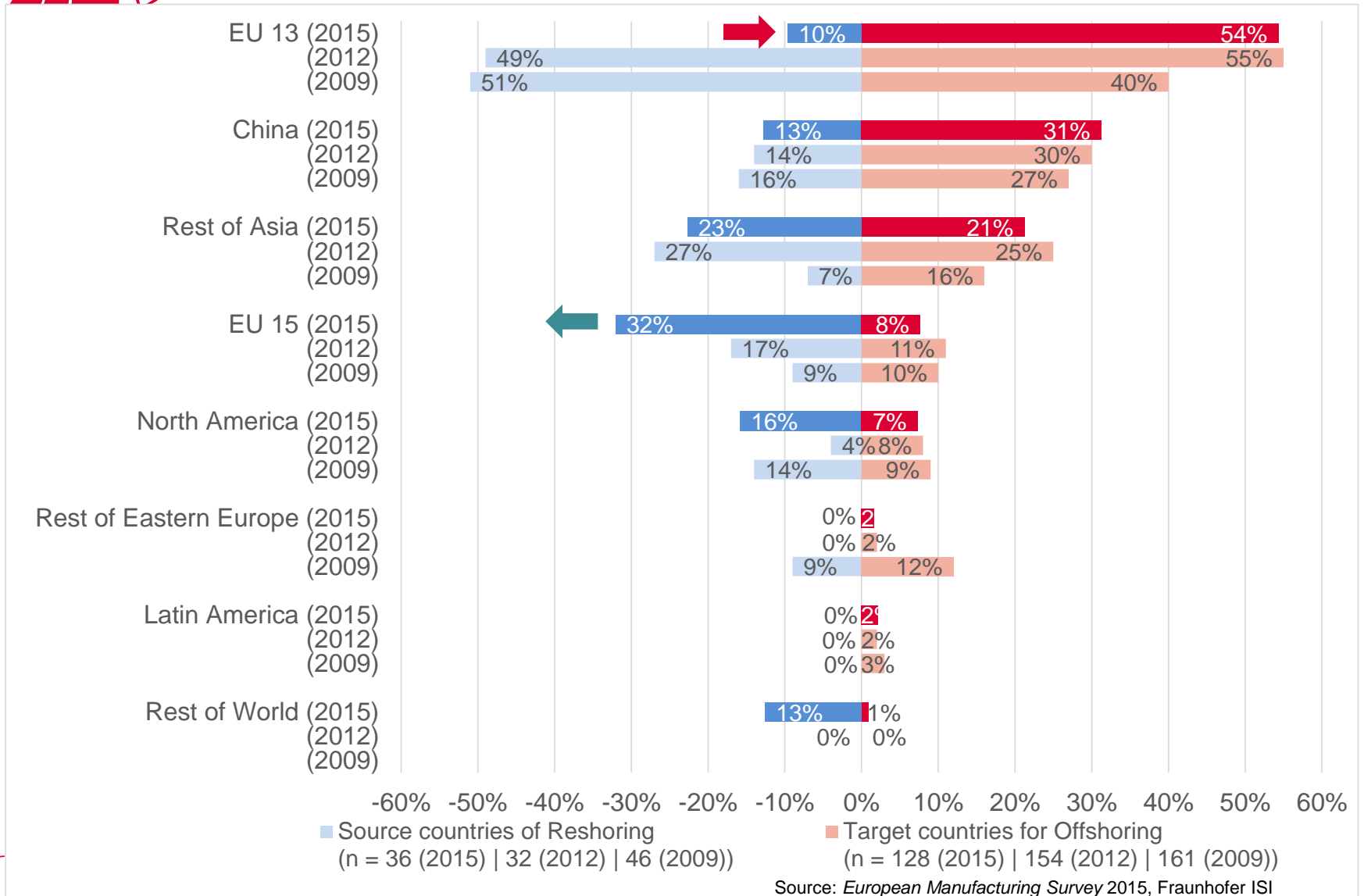
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# Target and source countries of manuf. offshoring and backshoring



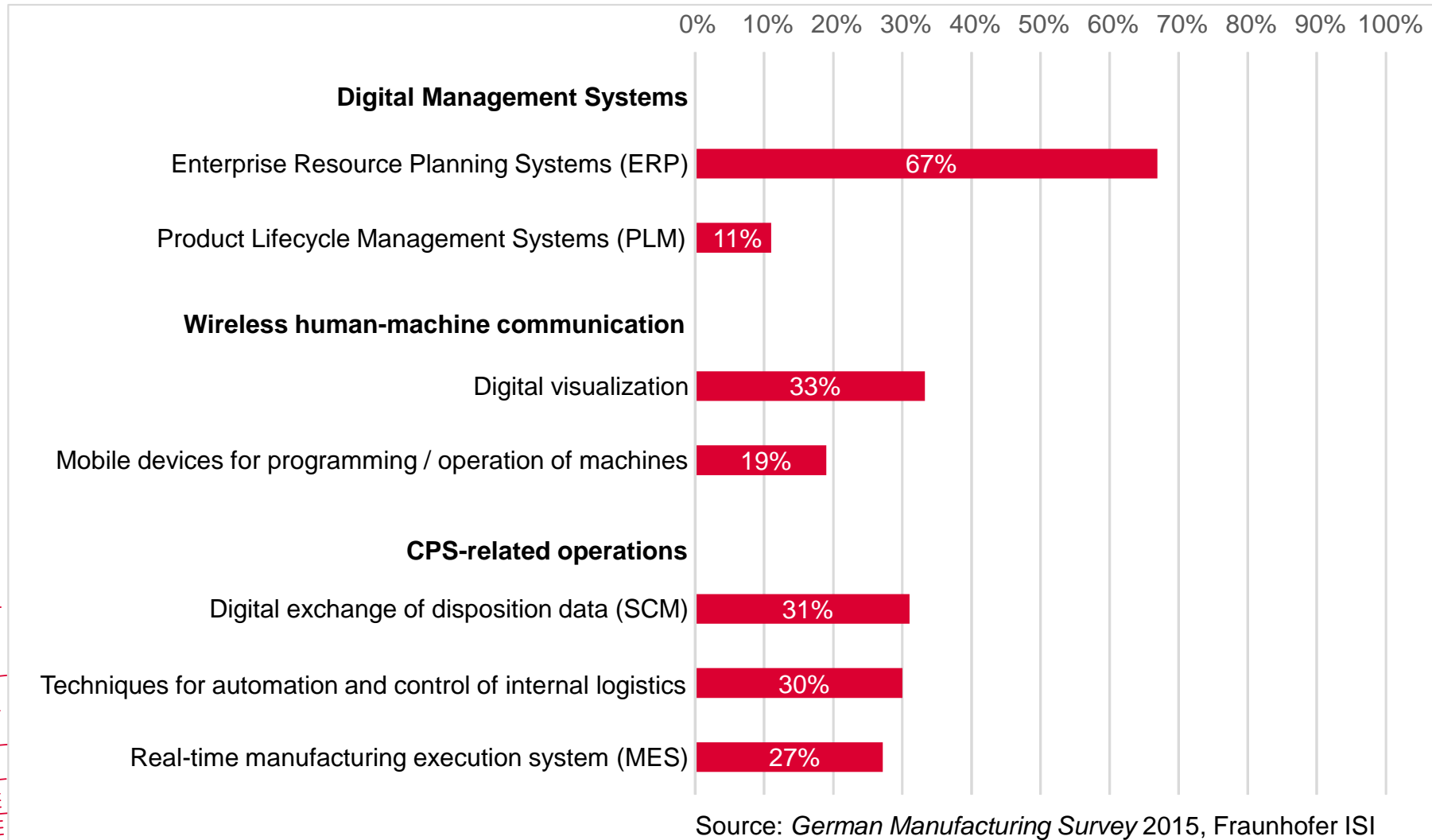


# Main motives for offshoring of production activities

Main motives for manufacturing relocations	Manufacturing relocation mid 2004 to mid 2006	Manufacturing relocation 2007 to mid 2009	Manufacturing relocation 2010 to mid 2012	Manufacturing relocation 2013 to mid 2015	Trend
Labour costs	80 %	77 %	71 %	75%	→
Access to new markets	27 %	28 %	28 %	27%	→
Vicinity to key customers	21 %	29 %	26 %	29%	→
Vicinity to to relocated production capacities	n.a.	16 %	23 %	20%	→
Access to raw materials	n.a.	n.a.	15 %	12%	→
Import restrictions	n.a.	n.a.	11 %	9%	→
Lack of skilled workers	n.a.	8 %	9 %	13%	(↗)
Taxes, levies, subsidies	11%	12%	5%	11%	→
Following competition	n.a.	n.a.	n.a.	10%	n.a.



# Use of Industry 4.0 enabling technologies in German manufacturing industry



Source: *German Manufacturing Survey 2015*, Fraunhofer ISI



# Logit model for offshoring propensity of companies

Cox & Snell: 0,077    Nagelkerkes: 0,168		Regression coefficient B	Sig.
Step 1	Ln #employees	,449	,000
	sec99_other manufacturing	-,435	,475
	sec24_metal & metal components	-,325	,617
	sec26_Data processing equipment, electronic and optical products	-,291	,706
	sec27_electrical equipment	1,094	,097
	sec28_machinery & equipment	,159	,808
	medium batch size	,377	,255
	large batch size	-,349	,472
	medium complex products	,039	,917
	complex products	,321	,451
	supplier company	,153	,573
	main competition factor: price/cost	,788	,012
	Ln import quota of inputs	,153	,213
	Ln export quota of inputs	,215	,107
	Ln share of unskilled workers	,121	,271
	I40-readyness-til-2013_level1	,323	,430
	I40-readyness-til-2013_level2	,463	,223
	I40-readyness-til-2013_level2	,250	,538
	Constant	-6,437	,000

- Large firms are more active in offshoring
- Companies with a focused price/cost leadership strategy are more active in offshoring
- No effects of **Industry 4.0 readiness** on offshoring propensity



# Logit model for backshoring propensity of companies

Cox & Snell: 0,055    Nagelkerkes: 0,230		Regression coefficient B	Sig.
Step 1	Ln #employees	,072	,673
	sec99_other manufacturing	-,038	,974
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	Constant	-8,946	,000

- Company size no factor for backshoring propensity
- Supplier companies are more reluctant to backshoring
- Export-intensive firms are more active in backshoring, to shorten their upstream value chains
- Positive effects of **use of Industry 4.0 enabling technologies** on backshoring propensity