

How the digital transformation impacts the labour market – Experiences from Germany

**How to govern the country better -
An example of good practice for employment policy**

**CERGE-EI, Prague
11th April 2018**

Dr. Florian Lehmer

Working Group 'Work in the Digitized World'



- The working group exists since October 2015
- 31 members from 11 research departments/groups
- About 4-5 meetings per year
- The aim of the working group is
 - to promote the exchange of information within and outside the IAB,
 - to discuss research approaches, projects ideas and results in order to provide good policy advice,
 - to establish new data sources so that new projects can be initiated.

Agenda



- Current state of digitisation
- Impact on employment growth
- Impact on employment structure
- Further consequences for the labour market
- Key areas of policy action

Digitalisation and employment

What are we talking about?



Quelle: <https://www.youtube.com/watch?v=7d59O6cfaM0>

The digital transformation is moving forward at a tremendous pace



Areas of development

- Machine learning, algorithms, artificial intelligence (AI)
- Mobile robots, soft robotics, cloud robotics, cloud computing
- Internet of Things (IoT), Cyber-physical (autonomous) production systems
- Assistance systems, remote maintenance

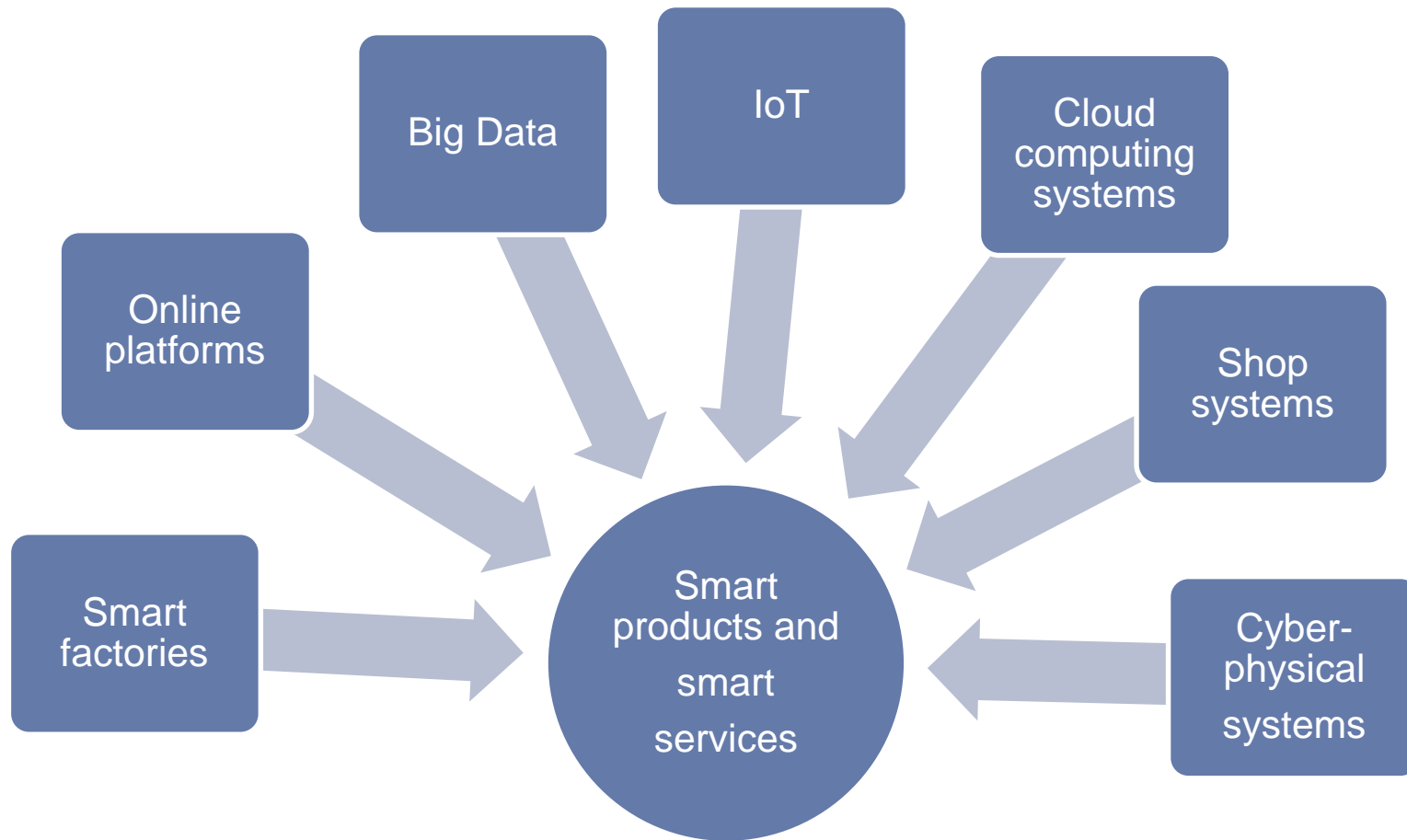
... create radically new possibilities of networking within firms/between firms/ between firms and customers.

... change the roles of producers and consumers (prosumers).

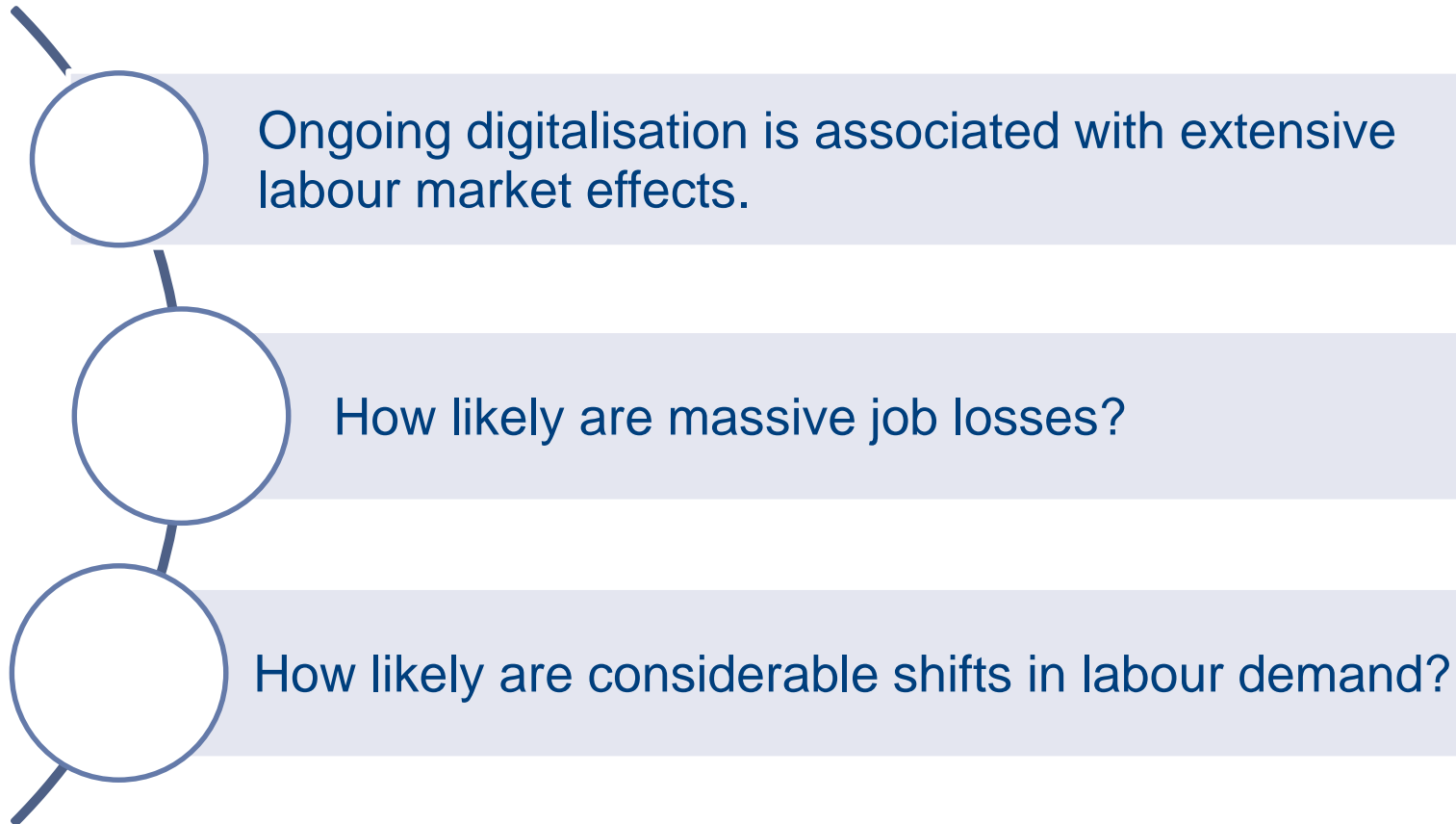
... create dynamic interactions between new digital structures and humans (learning systems).

... substitute human work/ tasks by technology.

... and is not restricted to the manufacturing industry!



Starting point and research questions



- Representative survey conducted in April/May 2016
- 2.032 CATI-based interviews (21% response rate) with establishments registered at the Federal Employment Agency in 2014
- Only establishments with at least 1 employee subject to social security contributions
- Service providers (67%) and producing establishments (33%)
- Stratification by
 - region (East/West)
 - establishment size (4 categories)
 - sector (5 categories)
- About 50 observations in each cell
- Weighted observations (stratification weights)

Content of questionnaire

- Relevance of “new” digital technologies (including 4.0 technologies)
- Degree of automation of work equipment
- Changes in labor demand (skills, tasks, competencies)
- Background characteristics (sales, profits, etc.)
- Information was gathered for the presence (2016), past (2011) and future (2021)
- We mostly asked production managers or management

Categorization of work equipment into technology categories

Production equipment (p)	Electronic office and communication equipment (d)
<p>1. manually controlled (k_1^p) e.g. drilling machine, motor vehicles or X-ray machine → humans are largely involved in work process</p>	<p>1. not IT-supported (k_1^d) e.g. telephones, fax and copy machines → humans are largely involved in work process</p>
<p>2. indirectly controlled (k_2^p) e.g. CnC machines, industrial robots or process engineering systems → humans are only indirectly involved in work process</p>	<p>2. IT-supported (k_2^d) e.g. computers, terminals, electronic checkout systems or CAD-systems → humans are only indirectly involved in work process</p>
<p>3. self-controlled (k_3^p) e.g. production facilities up to Smart Factories, Cyber-Physical Systems and Internet of Things → work processes are largely performed automatically</p>	<p>3. IT-integrated (k_3^d) e.g. analytic tools for Big Data, Cloud Computing systems, internet platforms such as Amazon, shop systems or Online-Markets → work processes are largely performed automatically</p>

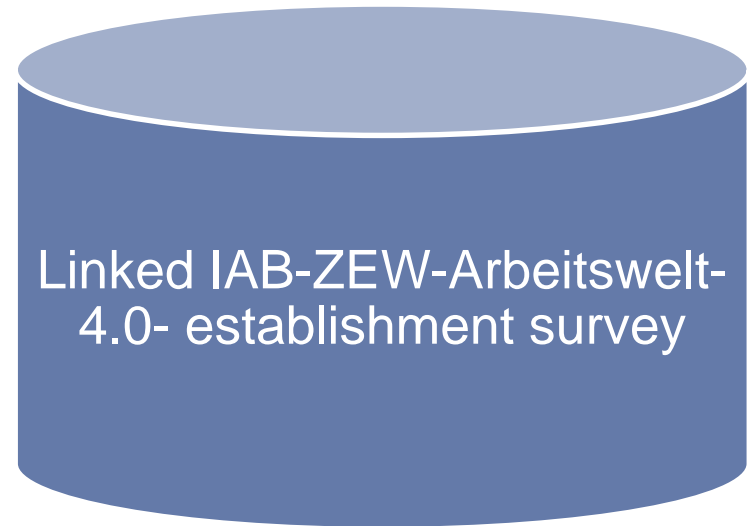
Degree of automation increases in classification

Self-controlled and IT-integrated technologies can be interpreted as 4.0 technologies

Construction of a linked employer-employee data set: IAB-ZEW "Arbeitswelt 4.0" establishment survey + employment histories (BeH)



Representative telephone survey of 2.032 establishments in Germany



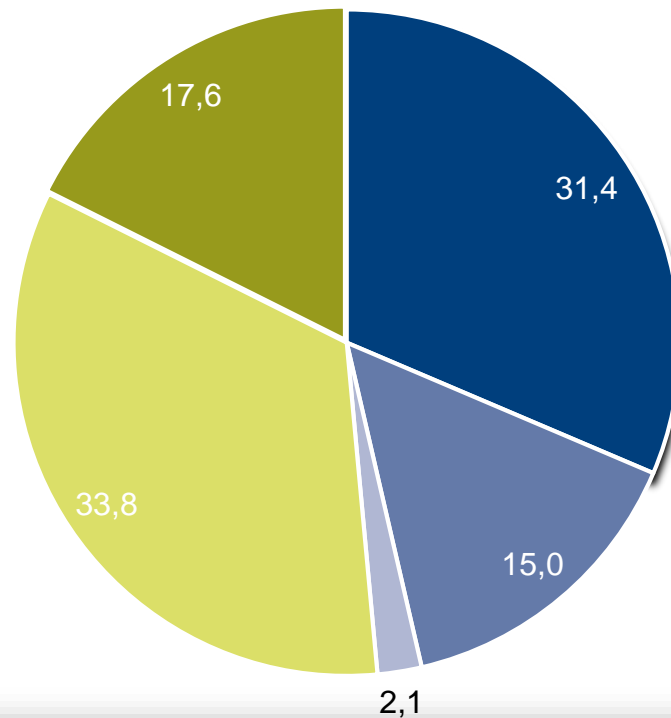
Employment biographies (2011-2015) of about 280.000 workers: Information on employment status, age, gender, education, occupation, sector, wages,...

Additional data sources:

- BERUFENET of the Federal Employment Agency: tasks data, 5 categories
- Establishment panel of the IAB: historic information on capital stock, investments, profits (imputation of missing information, construction of IVs)
- Establishment History Panel of the IAB (1999-2015)

Usage of new digital technologies in German firms

Responses in 2016 (in percent)



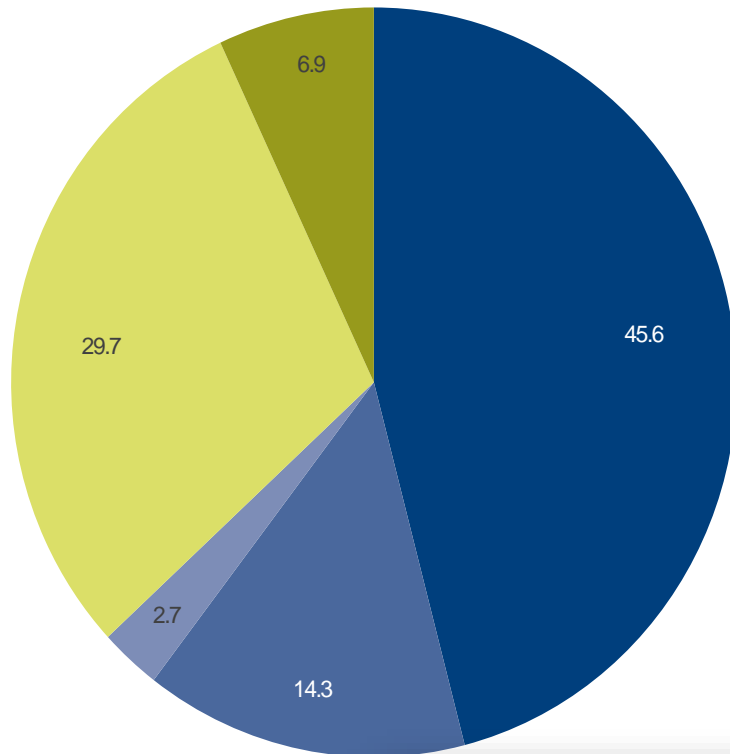
- So far we have not implemented such technologies
- We are already dealing with the implementation of such technologies
- We are planning to buy such technologies
- We are already using such technologies
- The usage of such technologies is an important element of our business plan

Source: IAB-ZEW-establishment survey „work 4.0“, own calculations

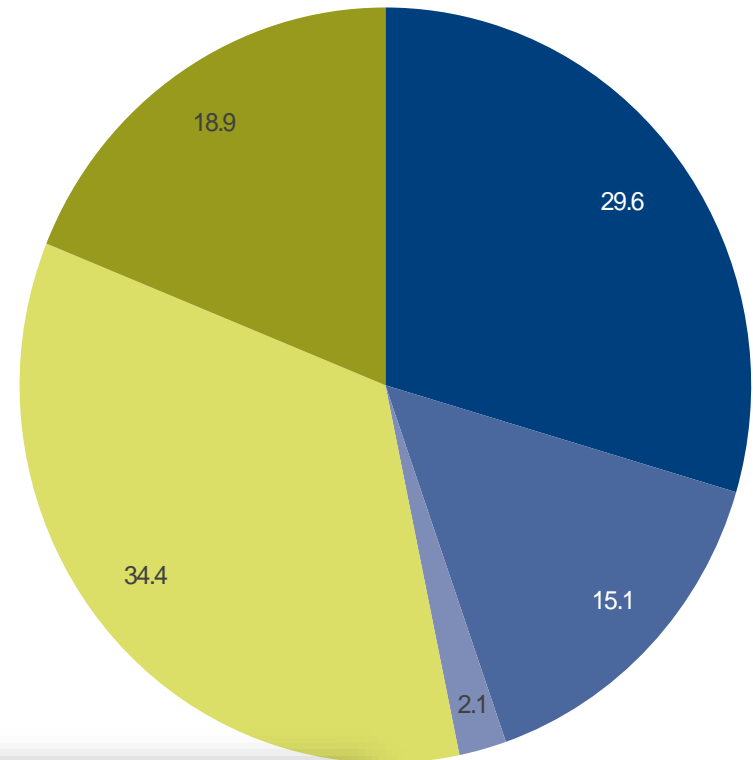
Usage of new digital technologies in German firms

Responses in 2016 (in percent)

Producers



Service Providers



- So far we have not implemented such technologies
- We are already dealing with the implementation of such technologies
- We are planning to buy such technologies
- We are already using such technologies
- The usage of such technologies is an important element of our business plan

Agenda



- Current state of digitisation
- Impact on employment growth
- Impact on employment structure
- Further consequences for the labour market
- Key areas of policy action

The Phantom Menace?

FUTURE TENSE

THE CITIZEN'S GUIDE TO THE FUTURE.

APRIL 28 2016 9:00 AM

Slate

FROM SLATE, NEW AMERICA, AND ASU

Killer Robots? Lost Jobs?

The threats that artificial intelligence researchers actually worry about.

  
362 239 28

By Cecilia Tilli



Elon Musk, Stephen Hawking, and Bill Gates .

Photo illustration by Sofya Levina. Images by Mike Windle/Thinkstock, Bryan Bedder/Thinkstock, and Joshua Lott/Getty Images.

EUROGRAB
President Trump has declared war on the press. [Help us fight back.](#)

Headlines in newspapers, magazines and blogs



- “Robots And Computers Could Take Half Our Jobs Within the Next 20 Years” <http://theeconomiccollapseblog.com/>
- “Robots Could Put Humans Out of Work by 2045” <https://singularityhub.com>
- “White House Predicts Robots May Take Over Many Jobs That Pay \$20 Per Hour” <https://www.huffingtonpost.com/>
- “Robot Serves Up 360 Hamburgers Per Hour” <https://singularityhub.com/>
- “Why the Highest-Paid Doctors Are the Most Vulnerable to Automation” www.slate.com/
- “Robot Receptionist in Tokyo Department Store.” www.bbc.com/

Theoretical impacts of new digital technologies on employment

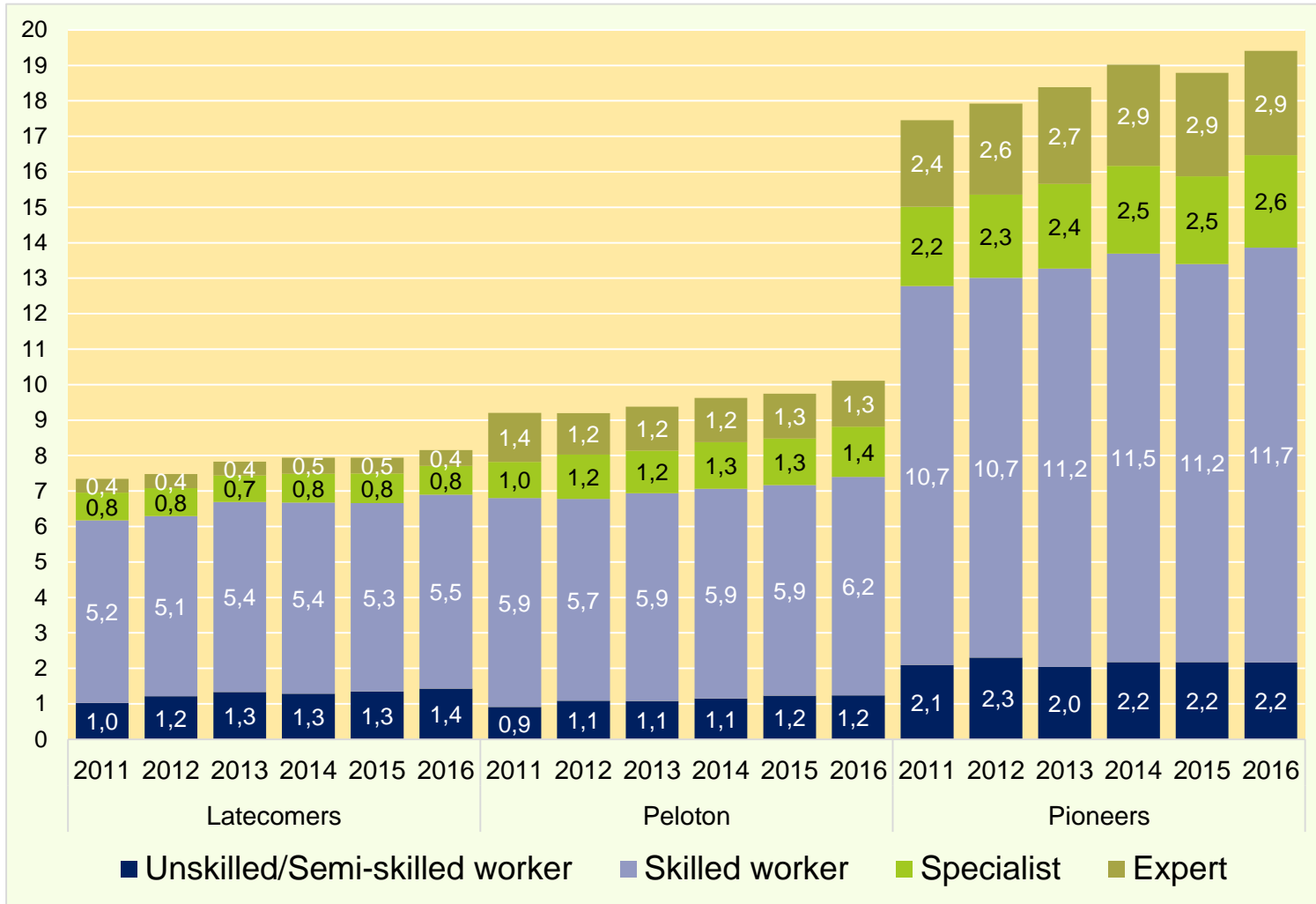


- Productivity ↑
 - Jobs are substituted → employment ↓
 - Product prices ↓, product demand ↑ → employment ↑
- Supply of new products and services ↑
 - Old products are losing market share → employment ↓
 - New products are gaining → need for investments ↑ → employment ↑
- Offshoring: employment ↓ vs. Reshoring: employment ↑

→ Net effect ???

Effects of the investments in new digital technologies on employment at the establishment level

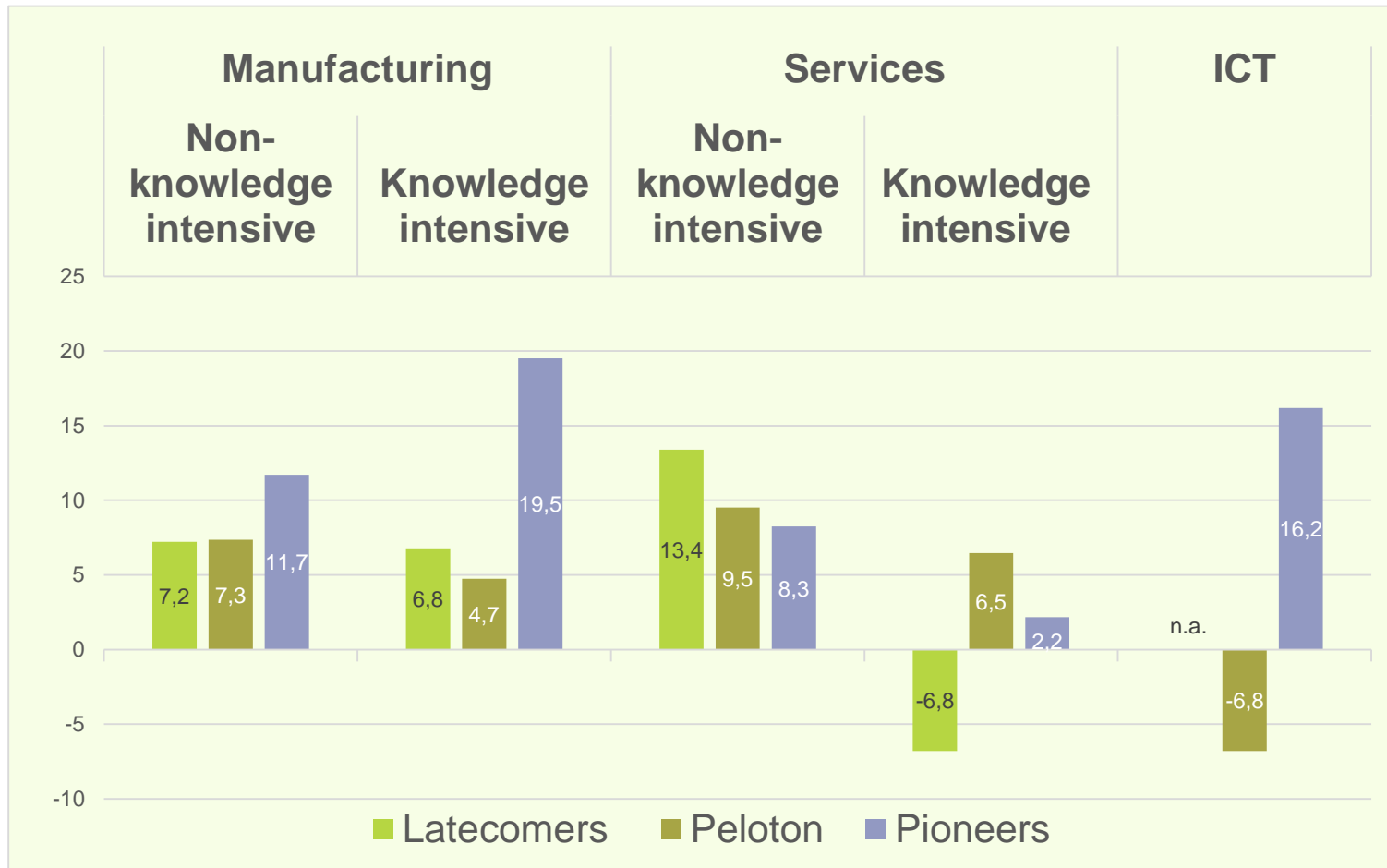
Average employment levels for digital latecomers, the peloton and digital pioneer firms
2011-2016, in absolute numbers



Source: Linked IAB-ZEW-establishment survey „work 4.0“, own calculations

... sector-specific results

Average employment growth for digital latecomers, the peloton and digital pioneer firms
2011-2016, in percent



Source: Linked IAB-ZEW-establishment survey „work 4.0“, own calculations

Expectations

(derived from BIBB-IAB Qualification and Occupational Field Projections)



- Increases in productivity, value added and wage totals
- Structural change accelerates from manufacturing to services
- Labour flows between sectors and occupations are much larger than the changes in the number of persons employed
 - Until 2025, about **1,500,000 jobs** will be lost, but **1,500,000 jobs** will be created
 - Occupations normally will not disappear completely, but occupations will change; new occupations emerge
- Employment gains for highly-skilled workers, losses for skilled and low-skilled workers

Future demand for tasks?

Impact of ...

- ... technological developments (digitalisation/ automation)
- ... globalisation (offshoring)
- ... change of product demand

Which factors determine the future demand for tasks?

Results from the tasks literature (see Autor, Levy, Murnane, 2003):

- High substitutability for manual and routine tasks
- Low substitutability for
 - Interactive tasks
 - Knowledge-intensive tasks
 - Creative tasks

Results from the tasks literature



Tasks	Content	Example	Substitution potential
Analytical non-routine tasks	e.g. research, analysis, evaluation, planning, designing, constructing, negotiating, coordination, teaching, marketing etc.	Lawyer Economist Manager Engineer Teacher	low
Interactive non-routine tasks			
Manual non-routine tasks	e.g. repairing, renovating, personal servicing, hosting	Caretaker Beautician Security Guard	medium
Cognitive routine tasks	e.g. simple calculations, data analysis, machine operators	Clerk Secretary Machine Operator	high
Manual routine tasks			

Our expectations: employment trends for different tasks types



Tasks	Up to now	Future
Routine	-	--
Manual	--	--
Social intelligent	+	++
Creative intelligent	++	+++
Person-related/ interactive	++	++
Flexible	+	+++

What determines the impact of digitalisation?

- It seems unlikely that whole occupations disappear
- It is more likely that tasks within occupations are more or less prone to be substituted by computers or computer-controlled machines
- Which tasks belong to an occupation (in Germany)?
 - information from **BERUFENET** for Germany
 - Contains information for 3,900 occupations about:
 - which tasks are typically associated with each occupation
 - which equipment/appliances are commonly used
 - typical conditions at work
 - required training or regulations
- Substitution potential determined by technical feasibility and not cost, legal, ethical or other considerations

Example: Which tasks does a (typical) salesperson perform?



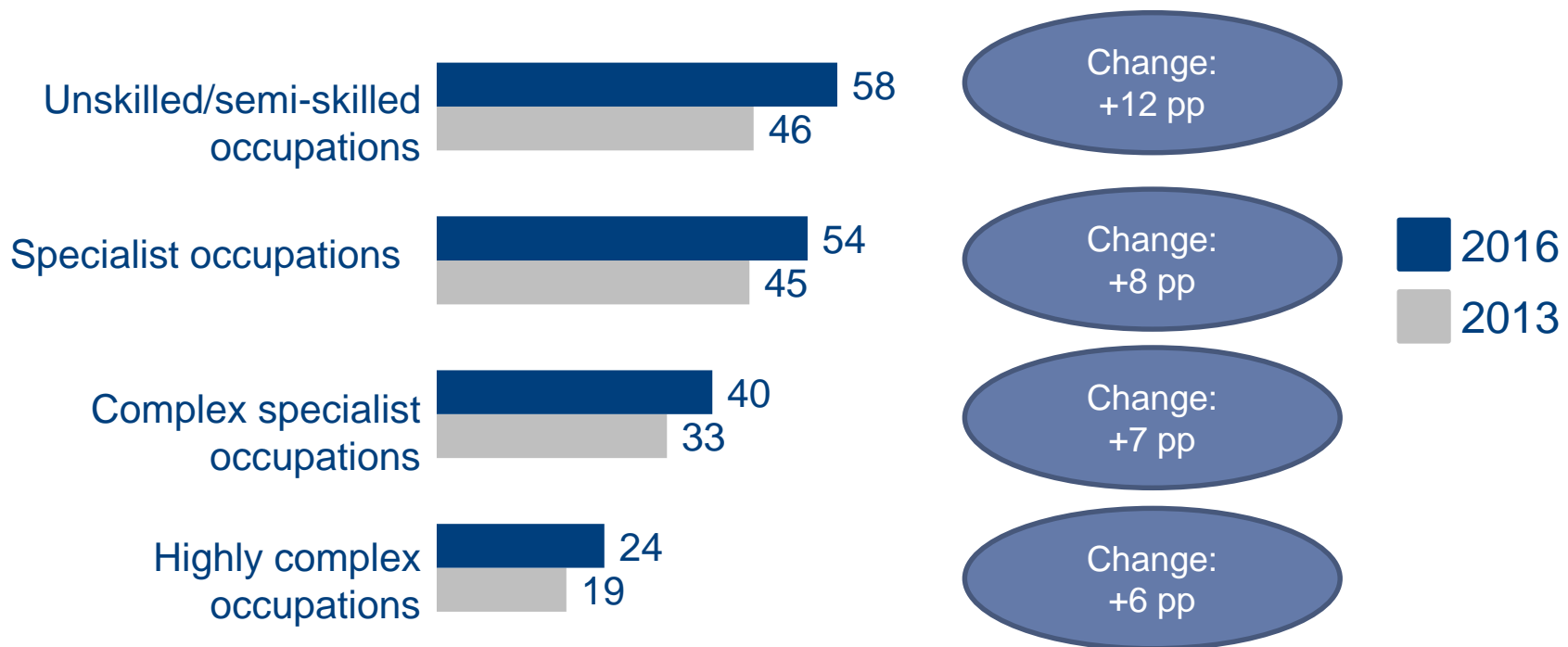
4 out of 6 tasks can be substituted \Rightarrow substitution potential of 66.6 %

And for any occupation ...
<http://job-futuromat.iab.de/>

Substitution potential in unskilled/ semi-skilled occupation has increased the most

Substitution potential by requirement level

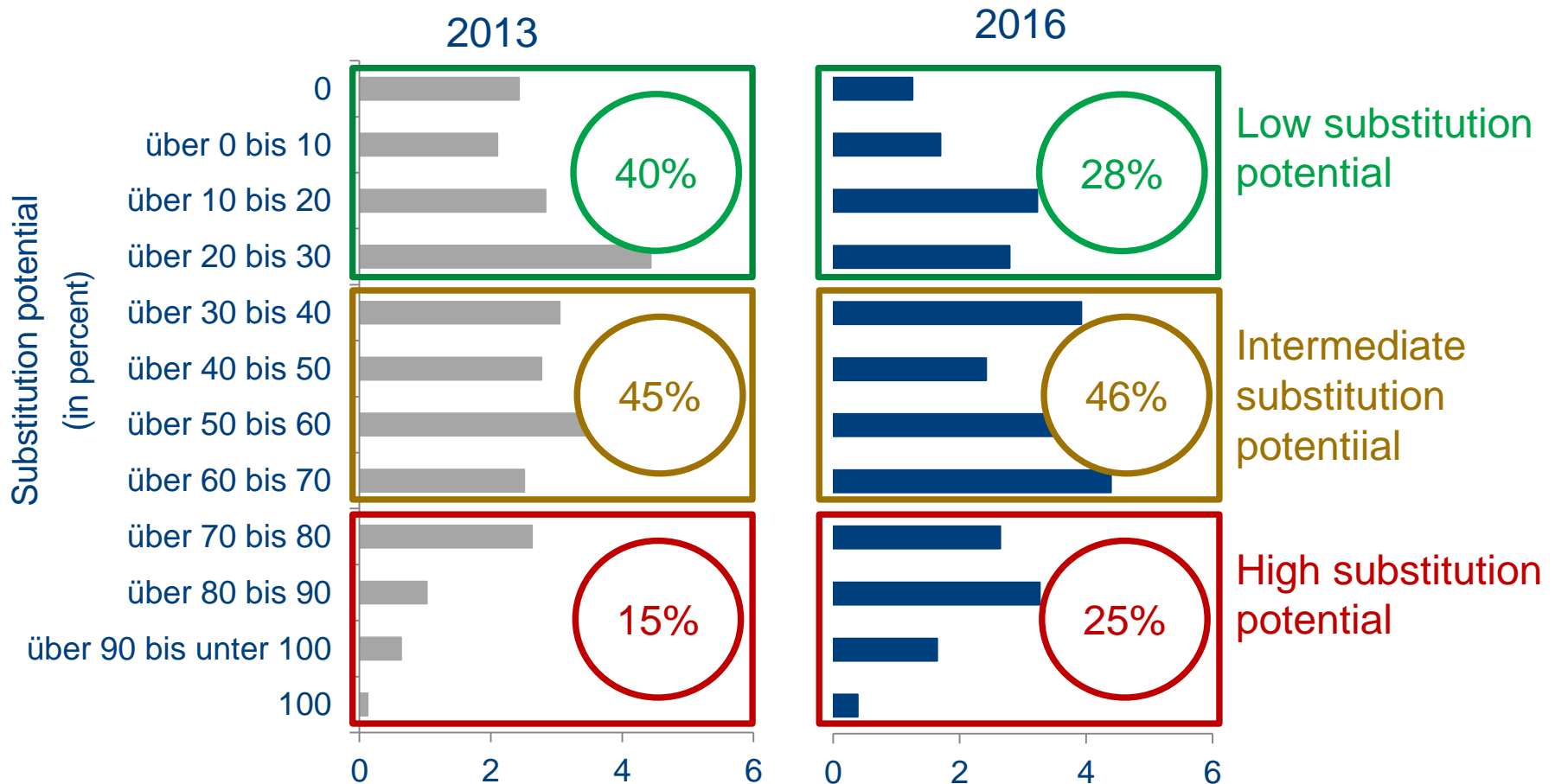
Proportion of tasks that could already be substituted by computers or computer-controlled machines today (in percent)



Quelle: Dengler/Matthes (2015, 2018), Berufenet (2013, 2016).

High substitution potential for 25 percent of employees in 2016

Impacts of substitution potential for employees subject to social contributions in Germany (in millions)



Quelle: Dengler/Matthes (2015, 2018), Berufenet (2013, 2016), Statistik der BA (2013,2016).

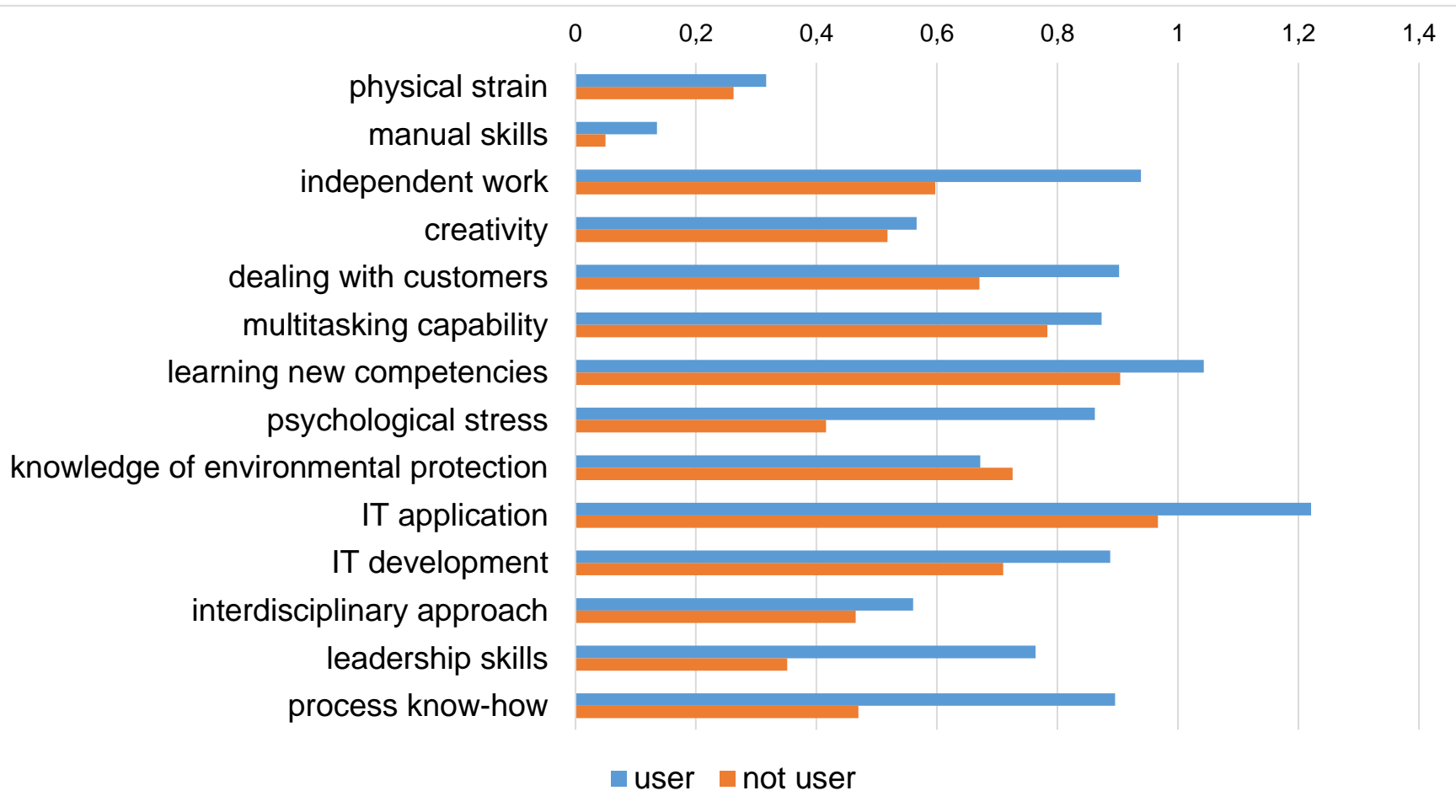
- Current state of digitisation
- Impact on employment growth
- Impact on employment structure
- Further consequences for the labour market
- Key areas of policy action

Further consequences for the labour market



- Removal of boundaries between work and leisure / mobile working
- Physically demanding or dangerous work can increasingly be executed by machines/ robots
- New forms of work (gig-/crowd-/cloud-/platform work): up to now, this is more of a marginal phenomenon in Germany (and therefore it has not yet been researched).

Further consequences for the labour market: Change of requirements in the last five years



Quelle: IAB-ZEW Arbeitswelt 4.0-Befragung, eigene Berechnungen

The impact of new digital technology investments on wages

- Individual fixed effects-regressions;
- Explained variable: log. of wage growth 2011 to 2016

Variable	All work-ers	Male Wor-kers	Female Workers	Low-skil-led Work-ers	Skilled workers	Highly-skilled workers
Dummy indicator: Wage growth effect of peloton firms vs. latecomers	0.0059**	0.0055**	0.0067	0.0307***	0.0064***	-0.0032
Dummy indicator: Wage growth effect of pioneers vs. latecomers	0.0072***	0.0077***	0.0061	0.0314***	0.0099***	-0.0104
N	180,473	129,086	51,387	7,546	134,444	38,483
R-squared	0.2885	0.3026	0.2660	0.3325	0.3480	0.1981
F	1182.71	950.08	336.80	64.58	1162.13	152.61

Notes: ***p<0.01, **p<0.05, *p<0.1

Source: 'IAB-ZEW Labour Market 4.0' establishment survey, BeH, BERUFENET, IAB Establishment Panel, own calculations

Policy areas



- Preventive labour market policy
- Skills development and adaptation
- Social security in the digital age
- Industrial relations and social dialogue in the digital age

Preventive labour market policy (1)



- Massive reduction in number of jobs is unlikely but large changes likely between and within sectors, occupations and skill levels.
- Current regional industrial structure has a large effect on the likely effects on the local labour market ⇒ **requires regional strategies**
- Labour market is likely to become (even) more dynamic
 - Problematic especially for long-term unemployed because requirements increase and human capital devaluates)
 - Risk of skills shortages increases

Preventive labour market policy (2)



⇒ **Need for more further trainings**

⇒ **Shorter intervals between trainings**

Politics: Support of further training activities of firms: independent high-quality qualification counselling for firms and individuals; contribution to the costs of training activities and work loss.

Special responsibility for disadvantaged population groups (low-qualified workers, workers in small firms, etc.)

Skills development and adaptation

- Higher qualification requirements for employees
 - Tasks and competencies more important:
 - Less routine and more creative tasks
 - Basic digital competences needed in many occupations
 - Ability to work in a team with integrated processes
- ⇒ Need for customised training requirements for different groups!
- ⇒ Digital competences
 - ⇒ Social competences
 - ⇒ Creative competences
 - ⇒ Language competences

Social security in the digital age

- Little is known yet about the interplay between digitalisation and demographic change
 - The likely losers: long-term unemployed and low-qualified employed persons
 - But: The digital transformation does not necessarily lower the wages of low-qualified workers (as long as they remain employed)
 - Rising inequality, distributional problems
- ⇒ Inclusion of new forms of work in social security systems
- ⇒ Government-sponsored employment possibilities (for persons who are left behind)

- ⇒ Adjustments in the digital transformation only works through a well working social partnership
- ⇒ Increase flexibility! But very sensitively! Both, firms and individuals must benefit (e.g., further training sabbaticals)
- ⇒ Special responsibility of employers and workers' organisations for further training programmes

Thank you!

Dr. Florian Lehmer

florian.lehmer@iab.de

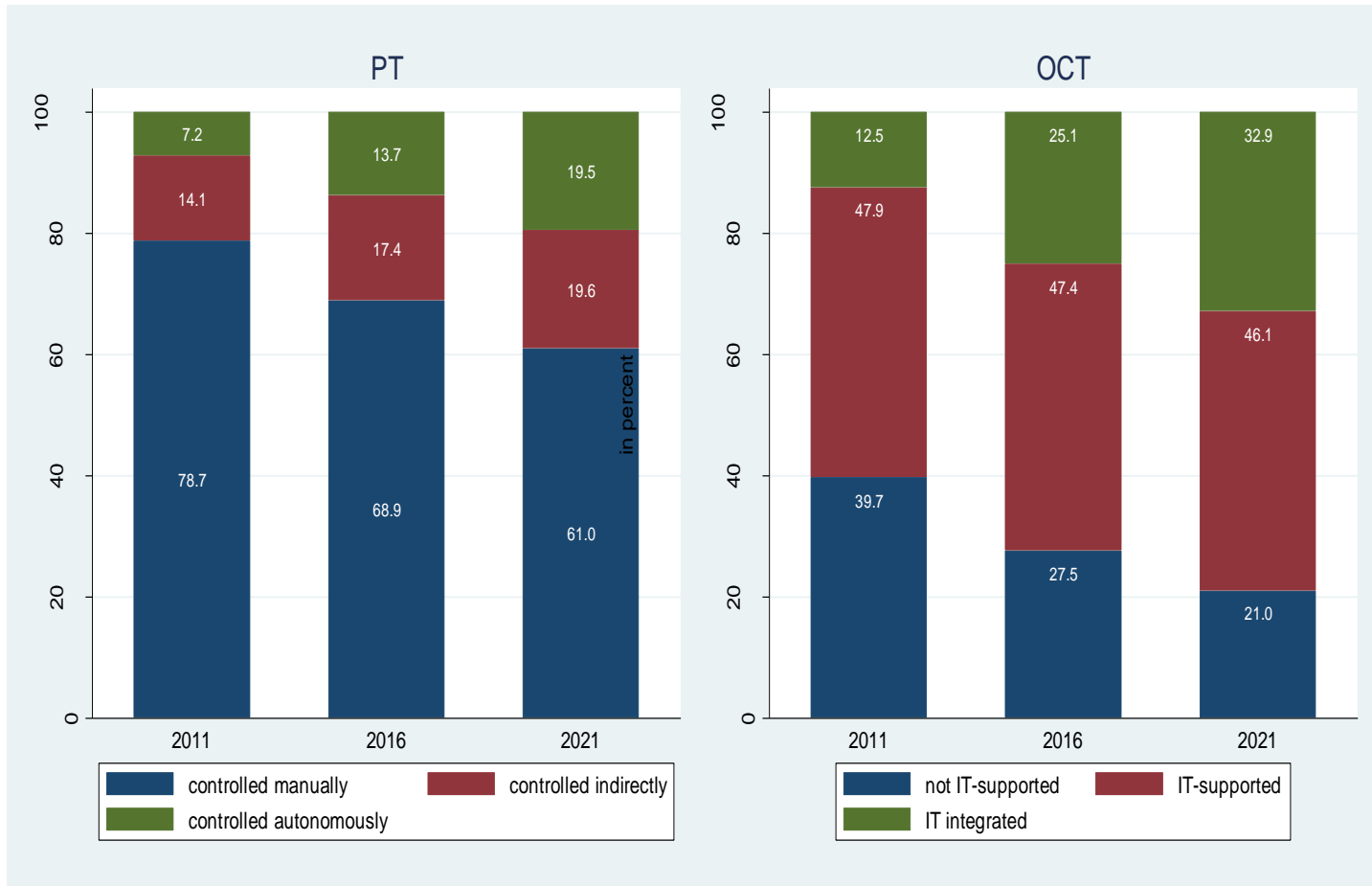
Phone +49 (0)911/179-5664

<http://www.iab.de/839/section.aspx/Bereichsnummer/10449690>

Group allocation

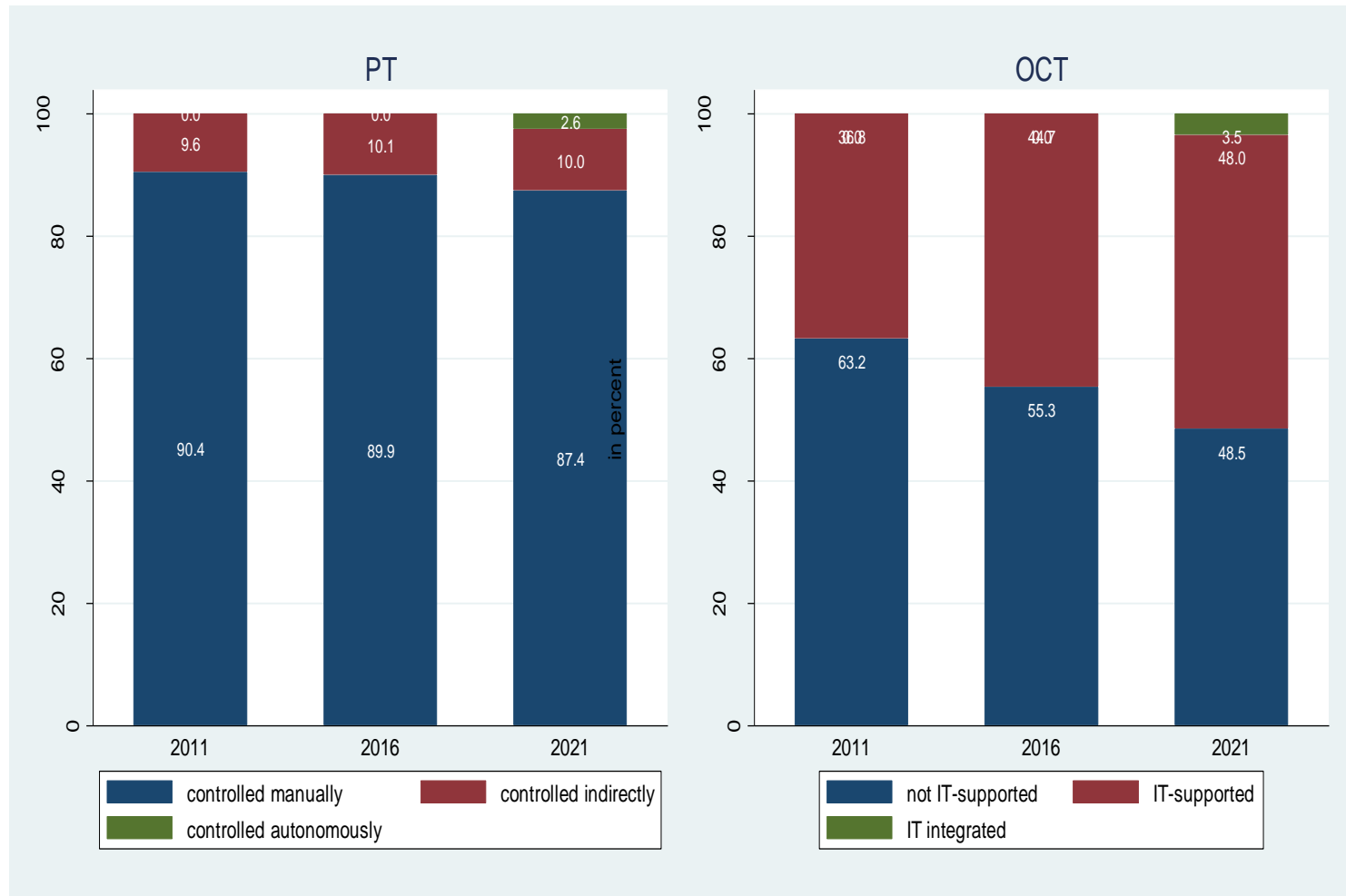
- Latecomer (280 establishments)
 - Do not use new digital technologies
 - Do not invest into new digital technologies between 2011 and 2016
- Pioneer (383 establishments)
 - Already use new digital technologies
 - Invest into new digital technologies between 2011 and 2016
- Main field (862 establishments)
 - Rest category

Technological level of work equipment for digital technology pioneers



- Increasing share of 4.0-technologies
- O & C equipment more automated than production equipment

Technological level of work equipment for digital technology latecomers



Technological level of work equipment for the main field

