



Industry 4.0: new challenges for work and qualification

Workshop „Technology and Work
from a TA perspective”

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The logo for the Austrian Academy of Sciences (ÖAW) consists of the letters 'ÖAW' in a white, serif font. The 'Ö' has two dots above it. The logo is flanked by two horizontal white lines, one above and one below.

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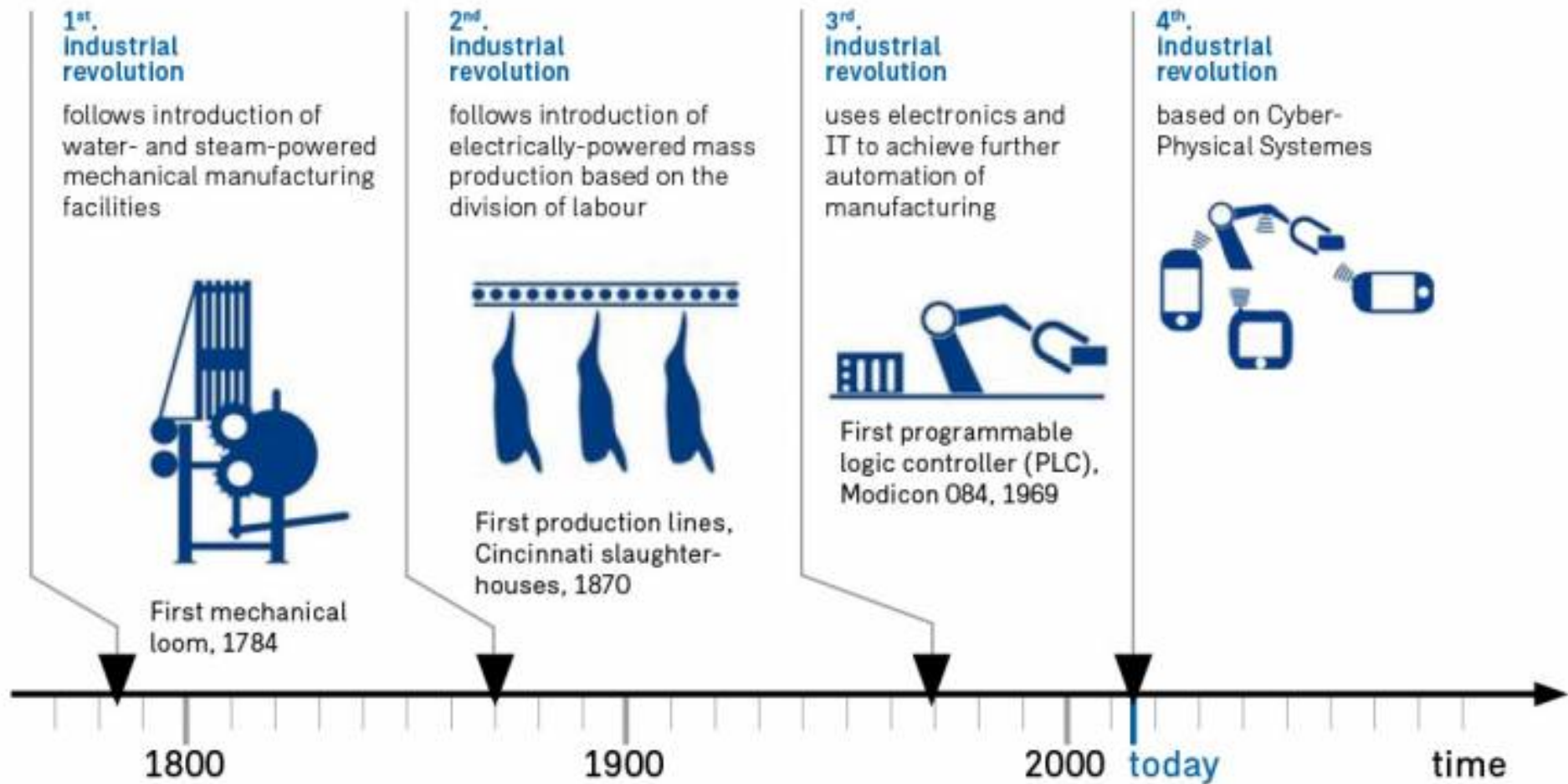


Overview

- Background
- Industry 4.0
- Impact on society: first assessments
- Focus on employment, work & qualifications
- Policy options

Industry 4.0

- Vision of a novel stage of industrial production
 - Digital integration throughout the value chain
 - Largely self-controlled, sensor-steered, self-optimising
 - Communication between humans, machines, parts, products (Cyber-physical systems)
 - Industrial Internet of things and services
- Far-reaching expectations
 - Increased productivity, flexibility, resource efficiency; competitiveness, reindustrialisation, reshoring




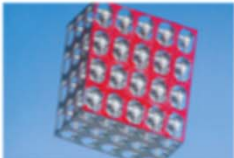


Source: DFKI (2011)

Technological drivers

- Performance increase in processors, memories and sensors
- Autonomous systems (adaptive industrial robots, software agents)
- Identification of objects, machines and people using (RFID) etc.
- Expansion of the Internet of Services, Internet of Things and Services
- Mobile communication between smart objects, machines and people
- Cloud computing and Big Data analytics
- New mobile interfaces and augmented reality applications
- Virtual design and digital modelling
- 3D printing and other decentralized production technologies

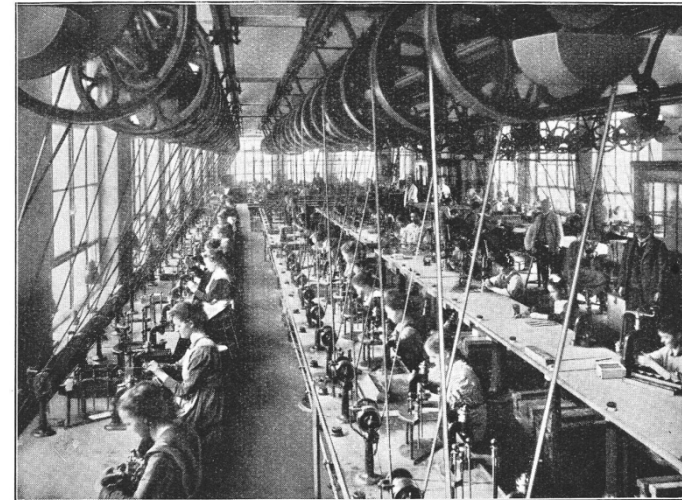
The paradigm change in manufacturing

	Mechanisation	High volume prod.	Automation	Intelligence
Chronology	18. century	19. century	20. century	21. century
Production system	Manufactory	Taylorism	Toyota System	Learning Factory
Production structure	Factory system	Focussing	Modularisation	Virtualisation
Product structure	Individual parts	Standardisation	Complexity	Adaptive variability
Flexibility vs. Productivity	Ratio ≈ 1	Ratio $\ll 1$	Ratio < 1	Ratio ≈ 1 (adaptable)
Worker	All-rounder	Specialist	Flexible	Self organizing
Markets	Regional product	Globalization	Regionalization	Localization
Resource efficiency	Extensive use	Intensive use	Careful use of res.	Recycling
				

Source: Bleicher, F. (2014). Industry 4.0: A Vision Affects Manufacturing in Austria , *Bridges vol. 42, Dec.*

Key fields of impact

- Employment
- Work organisation
- Education and training
- Health and wellbeing
- Use of resources
- Economy and competition
- Safety and security
- Technical standards
- Regulation



Employment

- Impact on volume of employment: uncertain
 - Contradictory projections, many determinants (e.g. extent of automation, success in marketing I 4.0 components, external factors, eg. at product level, materials, demography, global)
- Changing structure of employment
 - Increase of higher skilled jobs, new skill groups
- Challenges
 - Solutions for redundant workforce (if “jobless growth”)
 - Realising opportunities to improve job quality

Impacts on work organisation

- Various patterns of work organisation possible (design decisions)
 - Between „polarisation“ and „swarm organisation“ (skill upgrading)
- Flexible man-machine cooperation
 - Centrality or substitution of humans?
- Massive change with effects on skills, flexibility, working time, hierarchy,
- Challenges
 - Anticipatory, socially compatible design decisions
 - Balanced automation- and implementation concept
 - Attractive task profiles in man-machine cooperation

Trend towards “blended workforce”

- “Combines a variety of employees on different contracts, including permanent full-time staff, part-time, temporary workers, contractors and freelancers”
- Can encourage diversity but first of all provides leeway to employers
- Industry 4.0 adds robots and logic of global value chain (“crowd organisation”)
- Increased substitutability, further de-limitation of work

Impacts on vocational education and training

- New skill and training demands
 - IT skills; systemic thinking; interdisciplinary collaboration
 - Meta-cognitive key qualifications; readiness for lifelong learning;
 - New technical and social skills; new occupations (e.g. data-scientist; system security engineer)
- Challenges
 - Adequate skills for implementation and operation
 - Problem aggravation among low- and unskilled workers
 - Permanent further education (on-the-job/workplace-near)
 - Qualification pressure (especially for older employees)

Towards more concrete qualification demands

- General skill profiles dominate, differentiation missing
 - By sector, user vs. producer, system vs. component supplier, etc.
- Starting from major technical characteristics (Pfeiffer 2015)
 1. *data @production* (data-based networking of physical objects)
 - CPS, real-time parts-/service tracking, big data analytics, anticipatory maintenance, personalised products, self-controlled production
 2. *nextGen.production* (lightweight robots, drones, 3-D printer, etc.)
 3. *body&mind* (wearables, smart gloves, quantify-me apps)
 4. *socialmedia @prod* (shift doodle, KVP apps, etc.)

Impacts of industry 4.0 on skill demands

Change dimension	Magnitude of change	Nature of change / skill demands
1. data@production	High	Disruptive; formal qualification in dealing with data; ability to relate offline and online; upgrading in industrial and logistic core
2. <i>nextGen.production</i>	Medium	For skilled workers: incremental learning of machine control possible; partially new procedures; increased complexity
3. <i>body&mind</i>	Medium	Depending on design decisions; risk of downgrading in full automation scenario
4. <i>socialmedia @prod</i>	Low	Comparatively unproblematic; learning by doing

Qualification: policy options

1. Framework conditions

Prioritisation, sensitisation, coordination, regulation to promote qualification for industry 4.0

2. Education and training system

Institutional reforms for improved access and mobility, dualisation, focusing I 4.0 promotion on medium qualification segments

3. Qualification contents

Basic digital skills for all, adaptation of technical and extra-technical qualifications (e.g. multi-disciplinary, social, communicative), new occ.

4. Company level

Improving company level VET for Industry 4.0, promoting a culture of innovation, participation and skill transfer



Thank you for your attention!

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