



Challenges and solutions for training 4.0

“Competency Development for Lifelong Learning and Future of Jobs”

TPQI Conference

Bangkok, 31.07.2024

- **Approaches and methods for the identification of future skills requirements – “Skilled worker qualifications and competencies for the digitalised work of tomorrow”**
- **Results of the occupation screening**
- **Recommendations and recent initiatives / solutions**
- **CONDITION: Competence-retention for non-routine activities in digital work environments - studies based on the professions chemical- and pharmaceutical technician**
- **Questions/discussion**



Skilled worker qualifications and competencies for the digitalised work of tomorrow – occupation screening*



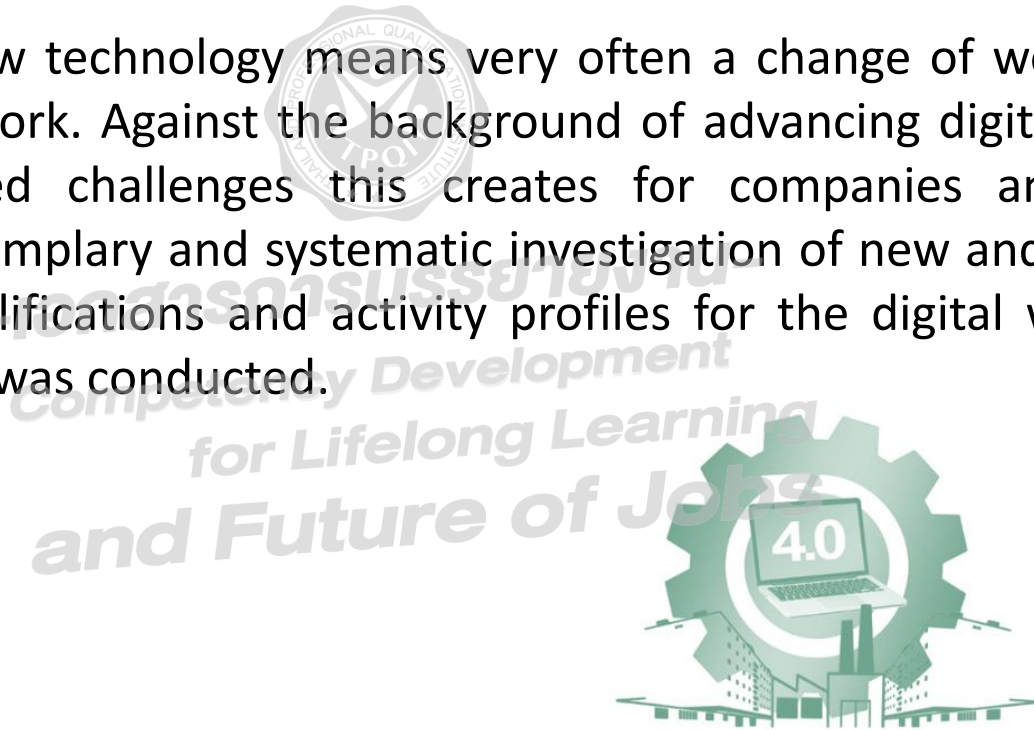
* This project is a joint initiative by the Federal Ministry of Education and Research (BMBF) and the Federal Institute for Vocational Education and Training (BIBB)

A different picture of skilled work ...



Why this project?

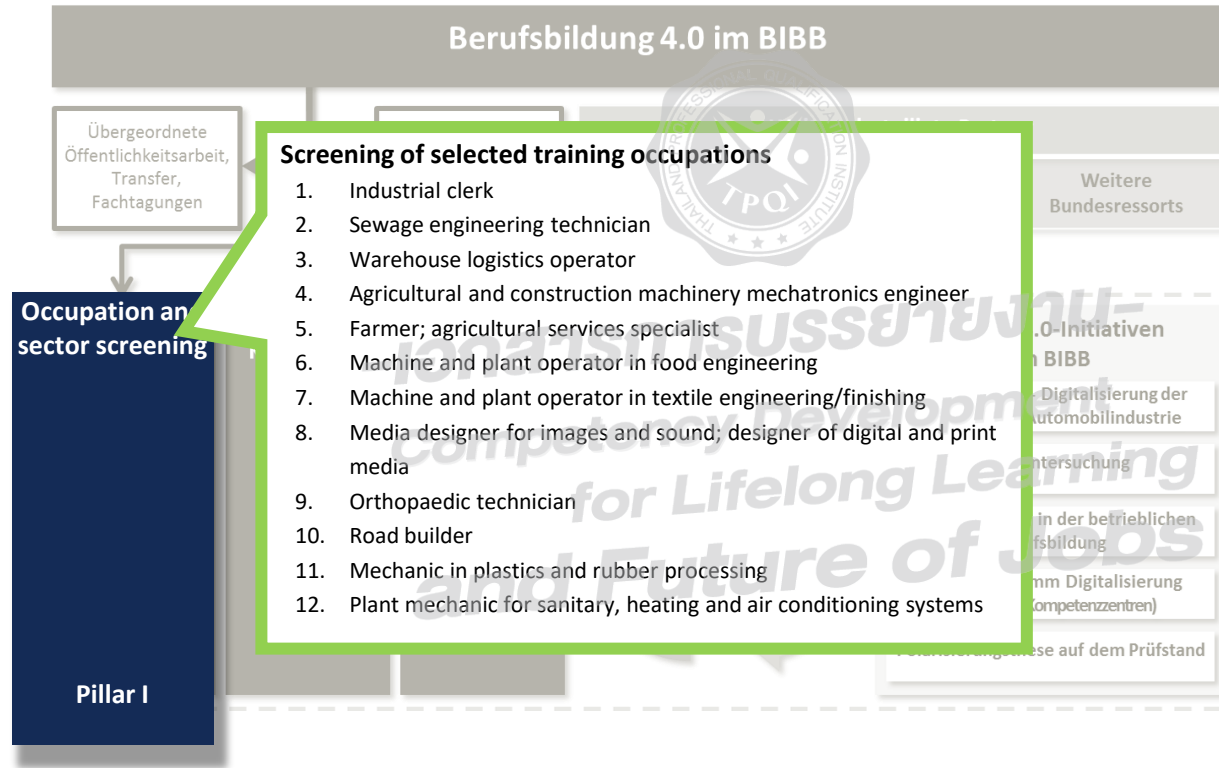
Introduction of new technology means very often a change of workplace and a change of work. Against the background of advancing digitalisation and the associated challenges this creates for companies and their employees this exemplary and systematic investigation of new and altered skilled worker qualifications and activity profiles for the digital world of work of tomorrow was conducted.



Research questions

- Which **digitalisation and networking approaches** are to be found in company practice?
- Which **activities or activity profiles** come about as a result of digitalisation in the occupations and sectors examined?
- Which **competences** are necessary for skilled workers?
- To what extent are these activities and competences **suited** to the existing **training occupations and advanced training**?

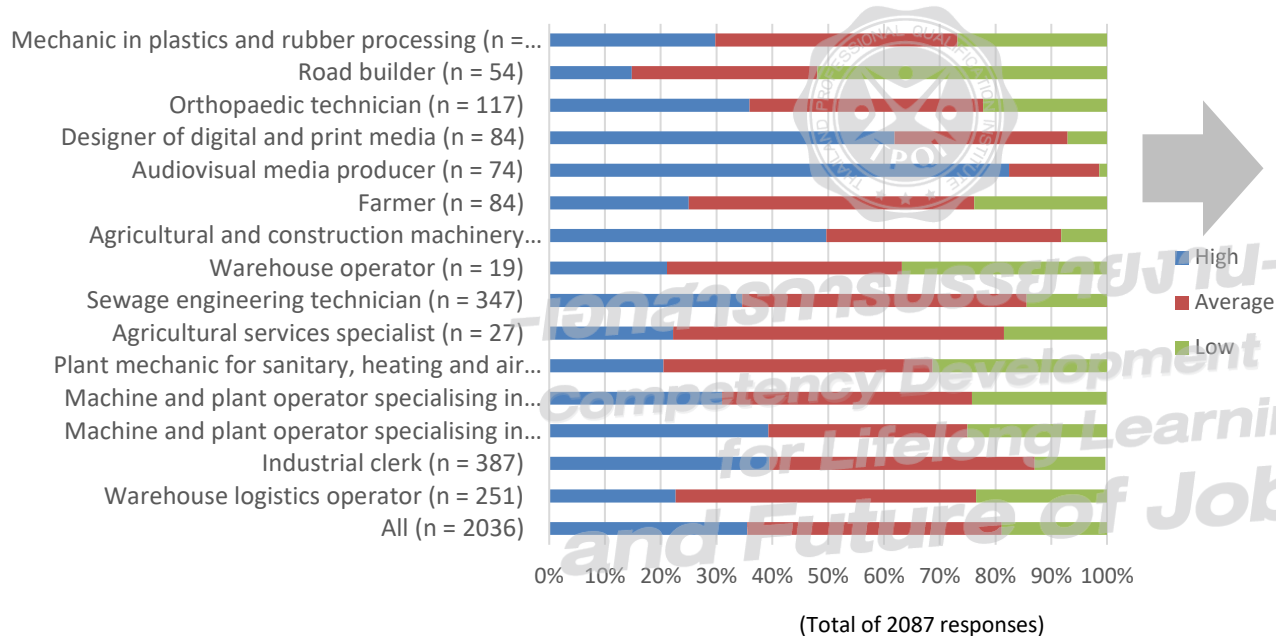
Selected occupations screened



Study design



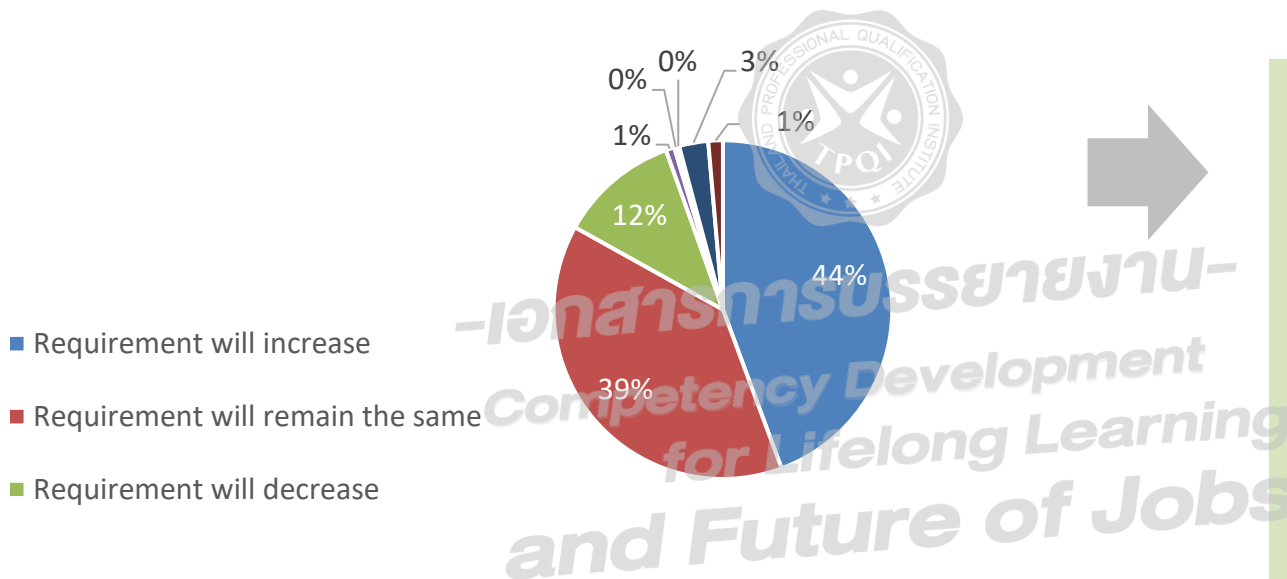
Impact of digitalisation



- Affects all occupations
- Is **non-contemporaneous**
- Is dependent on company size in many occupations
- Is still at a relatively early stage with regard to networking

What is your current assessment of the degree of digitalisation at your company in the area of work of [occupation in question]?

Skilled worker requirement and altered work tasks

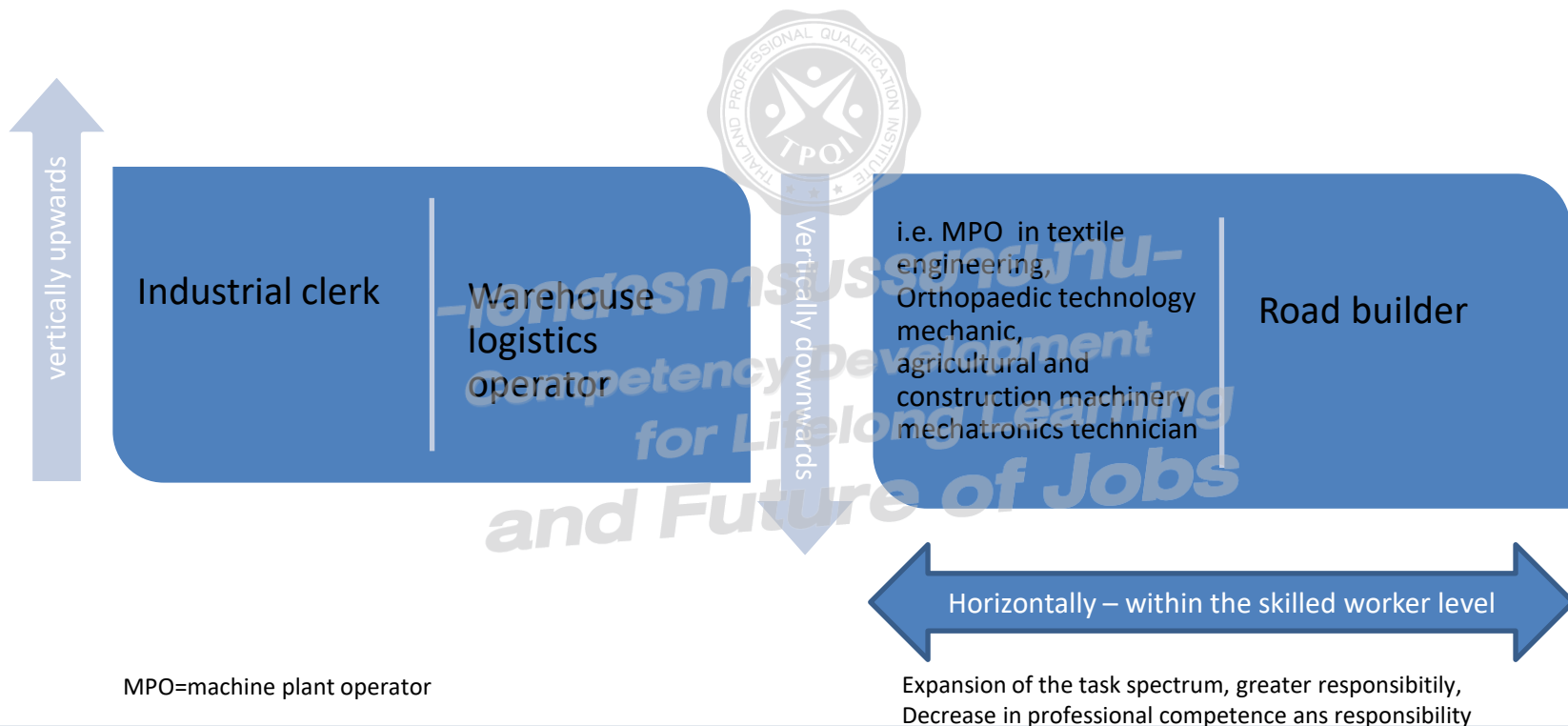


- Requirement will increase
- Requirement will remain the same
- Requirement will decrease

What is your assessment of the future requirement for skilled workers [all occupations surveyed] at your company in the light of ongoing digitalisation? (N = 2087)

- Skilled worker requirement fluctuates by occupation
- VET remains important
- Not confirmed that digitalisation leads to academisation
- Polarisation tendencies only discernible in individual cases
- Vertical shifts in occupational profiles, including between occupations
- Work tasks mostly change gradually, process is seldom abrupt

Shift of tasks in jobs



Changes to work

- Diffusion of and increase in IT-supported working
- Compliance with regulations and provisions relating to data privacy and security
- Physical work declining, screen-based work increasing
- Support for routine tasks and difficult tasks
- Function and status of jobs within work and business processes are being redefined
- Increase in the complexity of work tasks in many cases
- More activity in process networks rather than in process chains
- Intensity of change varies by company and occupation
- Shifts in occupational profiles will continue in future

Changes to competencies

- Learning (ability to learn)
- Occupation-specific skills and knowledge
- Process and system understanding
- Digital competencies
- Flexibility/spontaneity



General changes at the task level



Recommendations

- Urgency differentiated according to occupations (adaptations are sufficient in some cases)
- Necessary to take different levels of digitalisation (non-simultaneity) into account
- Use the structural leeway afforded by occupational profile items which are technologically neutral
- Scrutinise weighting and time positioning of topics (future core competencies and additional qualifications)
- Accord greater consideration to social and personal competencies, to learning how to learn and to process and system understanding
- Examine the instrument of additional qualifications



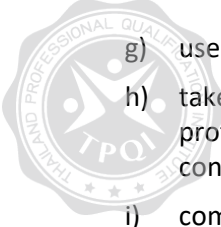
- Update occupational concept (generalist occupational and basic training + specialisation)
- Make use of and expand opportunities for differentiation in the regulatory instruments, including additional qualifications
- Create new 4.0 training occupations in individual cases
- Continue monitoring in a systematic way
- Address the topics of the conceptual shift and the didactics of regulatory work
- Use regulatory work to foster cooperation between learning venues
- Strengthen upgrading training and specialist careers

Needs of revising training regulations

Occupational profile	urgency
- Media designer of audiovisual media - Media designer of digital and print media - Sewage engineering technician - Industrial clerk - Mechanic in plastics and rubber processing	revision finished
- Warehouse logistic operator - Agricultural and construction machinery mechatronics engineer	revision in the near future
- Machine and plant operator in textile engineering and finishing - Machine and plant operator in food engineering	medium-term revision
- Farmer, agricultural services specialist - Orthopaedic technician - Road builder	revision not urgent

„Digitalisation“ as standardized item of occupational profiles*

Digitalisation of work, data protection and information security

- 
- a) prepare order-related and technical documents with the aid of standard software
 - b) maintain, exchange, save and archive data and documents
 - c) enter, process, transmit, receive and analyse data
 - d) apply data protection rules
 - e) use information technology systems (IT systems) for order planning, order processing and deadline tracking
 - f) research information sources and information in digital networks and retrieve and evaluate information from digital networks
 - g) use digital learning media
 - h) take into account the information technology protection objectives of availability, integrity, confidentiality and authenticity
 - i) comply with operational guidelines for the use of data carriers, electronic mail, IT systems and Internet pages
 - j) Recognizing anomalies and irregularities in IT systems and taking measures to eliminate them
 - k) use assistance, simulation, diagnostic or visualization systems
 - l) communicate, plan and collaborate in interdisciplinary teams

(*compulsory for all occupations from 1.08.2021)

Additional qualifications as a means of differentiation

Additional qualifications (AQ)	Metal technicians	Electrical + mechatronics technicians	Mechanic in plastics and rubber processing
AQ 1	System integration	Digital networking	
AQ 2	Process integration	Programming	Process integration
AQ 3	IT-supported system modification	IT-security	
AQ 4	Additive manufacturing *)	*) also for mechatronics	Additive manufacturing

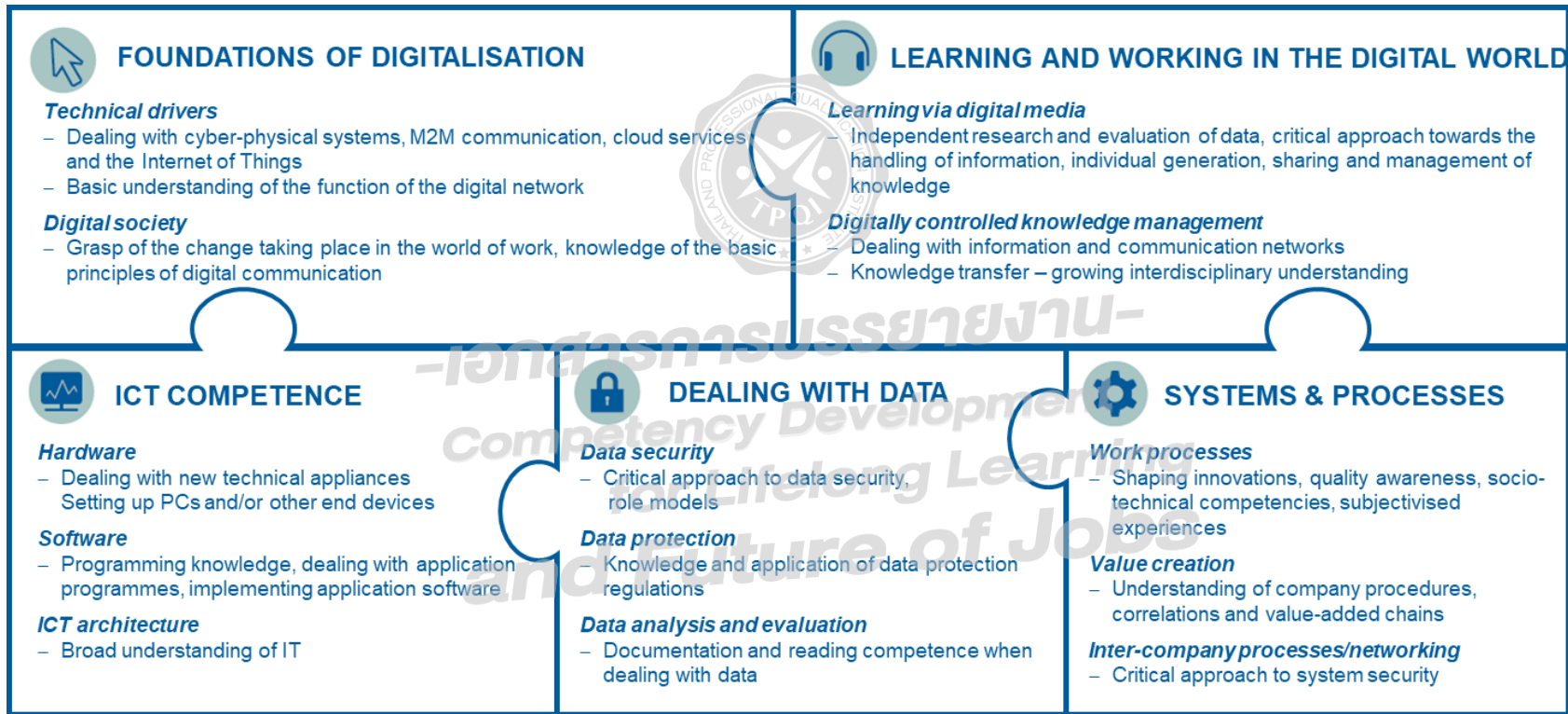
Metal technicians	Electrical +mechatronics technicians
System integration - Analyse technical orders and develop solutions - Plan system integration - install and commission cyber-physical systems	Digital networking - Analyse systems, process flows and technical conditions, determine network requirements, develop, evaluate and select solution variants, - Select, install, configure and integrate network components into the infrastructure - Analyse errors, faults or bottlenecks, evaluate data throughput and error rates, rectify errors, test systems
Process integration - Analyse digitally networked production processes - Plan process integration - Adapt and modify digitally networked production systems - Test production processes and document process data	Programming - Analyse systems, process flows, technical conditions and determine requirements for software modules, - customise software modules, integrate them into systems and document changes, - Create test plans and test data, test systems
IT-supported plant modification - Plan and implement plant modifications - Follow up changes digitally	IT security - Develop and coordinate technical and organisational IT security measures, - implement IT security measures - monitor implemented IT security measures
Additive manufacturing processes *) - Modelling components - Set up additive manufacturing systems - Apply additive manufacturing processes - Check and ensure quality	*) also for mechatronics engineers

Special programme*: Digitalisation of inter-company training centres and competence centres (ÜBS)

- ÜBS support companies in training skilled workers in a modern way. They supplement training with digital content if companies are unable to provide it themselves.
- Expansion of equipment with digital technologies, e.g. VR glasses, simulators, drones, robots and tablets (around 61,000 items have been installed in the workshops and learning rooms of the ÜBS at over 200 ÜBS locations (as of May 2022)).
- Development and testing of new training courses and concepts (with regard to the requirements of digitalisation and new technologies), e.g. online courses, learning platforms, virtual workshops, explanatory videos

*funded by BMBF from 2023-2023,
[BIBB / Sonderprogramm ÜBS-Digitalisierung](#)

Cross-cutting additional qualifications for digital competencies



<https://kompetenzen-digital.de/>

Publications relating to the results

Publications on
occupation screening:
BIBB'S Academic
Research Discussion
Papers (WDP)



[Website: www.berufsbildungvierpunktnull.de](http://www.berufsbildungvierpunktnull.de)
[BIBB / Berufsbildung 4.0 - Digitalisierung der Arbeitswelt](http://www.berufsbildungvierpunktnull.de)

CONDITION

Competence-retention for non-routine activities in digital work environments - studies based on the professions chemical- and pharmaceutical technician



Skill decay



CONDITION: What is the problem?

CONDITION



Routine-situations

Competences: often, regular, already known

Non-routine-situations

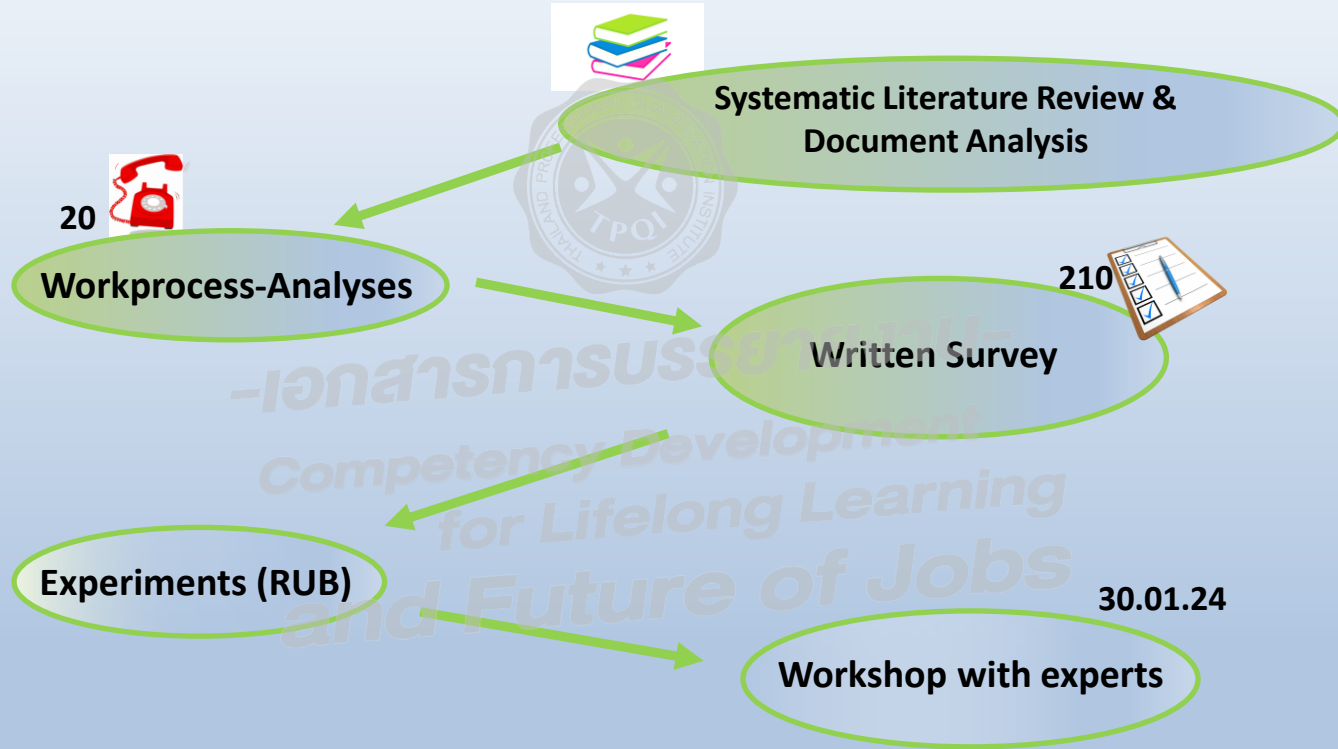
Competences: rare, irregular, unknown

1. Digitized automation technology is implemented in companies of chemical and pharmaceutical production to ensure safety and increase economic benefits. It should facilitate the work of the operators and prevent human errors. Nonetheless, non-routine situations occur (Bainbridge 1983).
2. Competences needed to handle non-routine-situations differ significantly from competences normally required in the everyday-routine at highly automated workplaces (Frank & Kluge 2018)
3. Competences for non-routine-situations are rarely used and therefore prone to decay (Bjork & Bjork 2006).

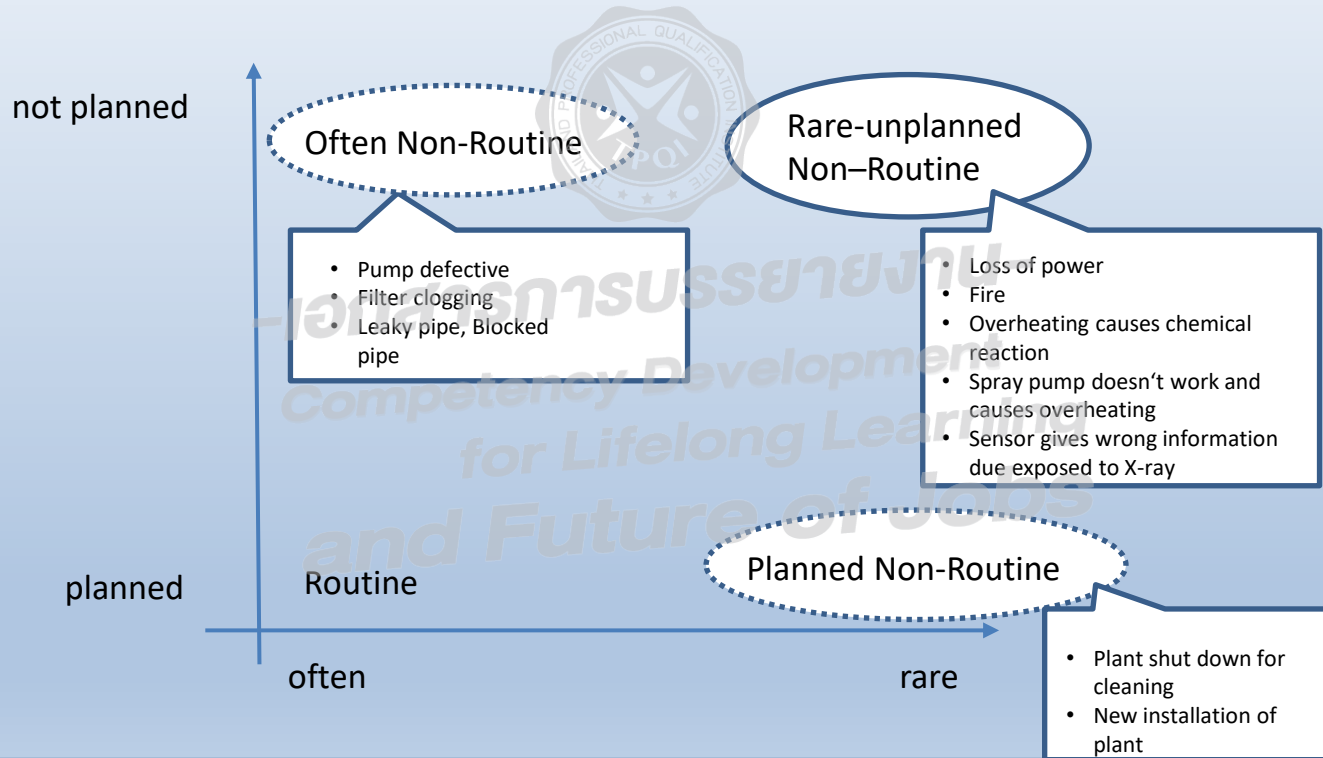
Research questions

- **Does the problem of the automation-related skill decay also exist in the occupational activities of chemical technician and pharmaceutical technician?**
- Which competences are affected?
- How is the impact of influencing factors such as task-characteristics or personal-characteristics?
- What measures are suitable for preventing the automation-related skill decay in the work tasks identified as problematic?
 - Which are already applied?
 - Which are especially suitable for the respective professions?

Study Design



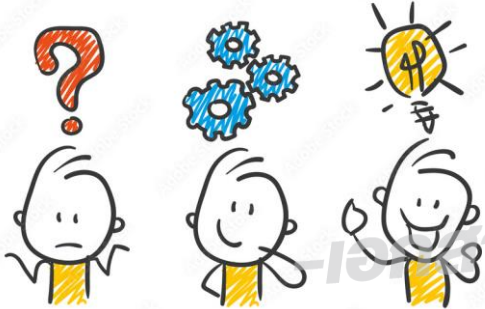
The problem of automation-related loss of competence also exists in the chemical and pharmaceutical production



Summary of outcomes

- The problem of automation-related skill decay also exists in the chemical industry
- Competences (knowledge, skills and attitudes) which are affected could be detected. The main are knowledge about the actual plant, process knowledge, skill to operate the plant by hand and an attitude of calmness and curiosity.
- Experience is a key-factor for achievement and retention of competences necessary in non-routine-situations.
- Younger professionals are less likely to gain these experience due to the highly-automated environment they are working in.

Digitalisation represents both an opportunity and a challenge for the vocational education and training system.



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Discussion/Questions?