Co-funded by the
Erasmus+ Programme
of the European Union

Sustainability of Industry 4.0

Anna Wiśniewska-Sałek and Tomasz Nitkiewicz
Czestochowa University of Technology

Curriculum Development
of Master's Degree Program in
Industrial Engineering for Thailand Sustainable Smart Industry

Sustainability of Industry 4.0

Sustainable development - Polish Environmental Protection Act

Socio-economic development in which there takes place the process of integrating political, economic and social activities maintaining the natural balance and durability of basic natural processes in order to guarantee the possibility of satisfying basic needs of individual communities or citizens of both modern generation and future ones.*

* Environmental law of April 27, 2001, art.3, point.50

Co-funded by the Erasmus+ Programme of the European Union

Sustainability of Industry 4.0

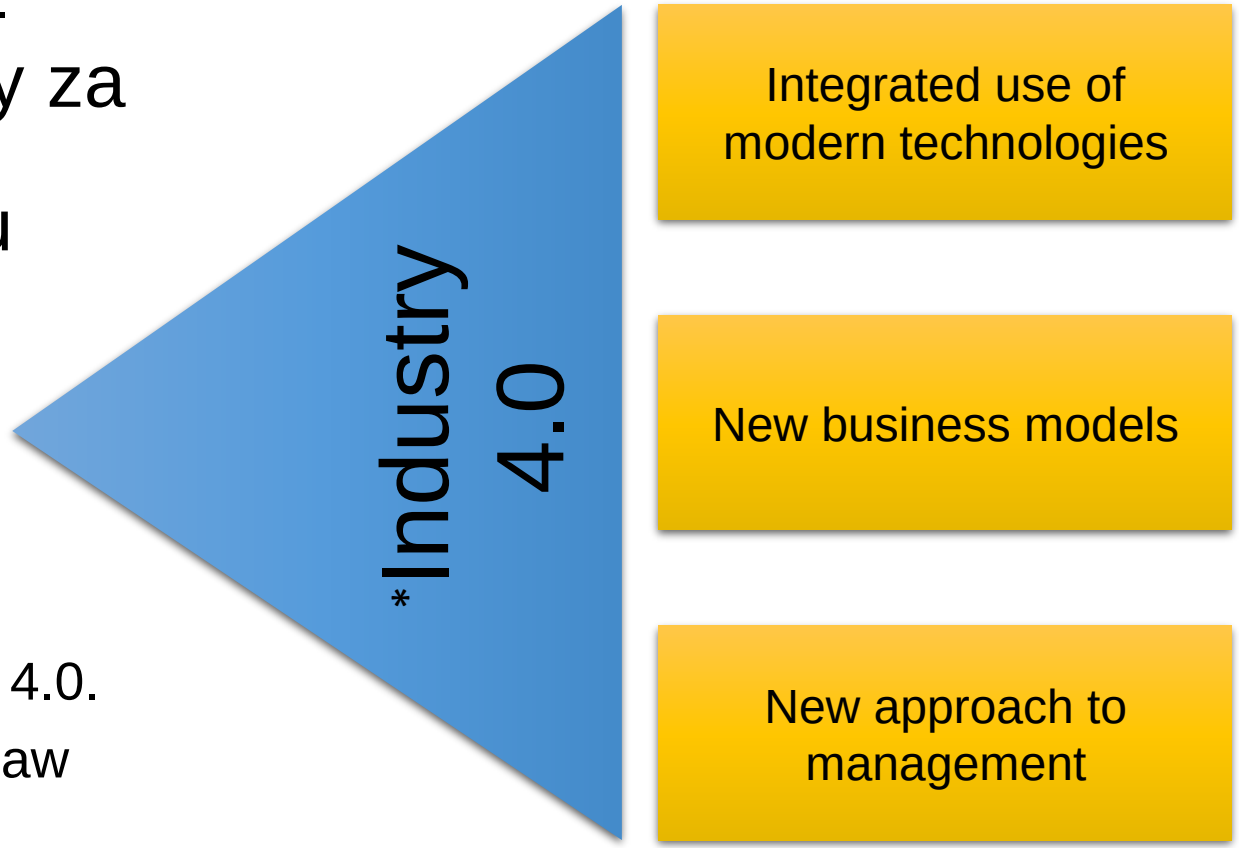
In Poland ***reindustrializacja*** jest filarem *Strategii na rzecz Odpowiedzialnego Rozwoju* (przyjęta przez Radę Ministrów 14 lutego 2017 roku), która jest wynikiem prac w ramach tworzenia nowej wizji rozwoju Polski ujętej w Planie na rzecz Odpowiedzialnego Rozwoju (przyjęty 16 lutego 2016 r. przez Radę Ministrów) oraz będąca aktualizacją średniookresowej strategii rozwoju kraju, tj. Strategii Rozwoju Kraju 2020, przyjętej uchwałą Rady Ministrów z dnia 25 września 2012 r., zgodnie z wymogami ustawy z dnia 6 grudnia 2006 r. o zasadach prowadzenia polityki rozwoju (Dz. U. z 2016 r. poz. 383, 1250, 1948 i 1954 oraz z 2017 r. poz. 5).

Strategia określa nowy model rozwoju – suwerenną wizję strategiczną, zasady, cele i priorytety rozwoju kraju w wymiarze gospodarczym, społecznym i przestrzennym do 2020 r. oraz w perspektywie do 2030 r.

Co-funded by the Erasmus+ Programme of the European Union

Sustainability of Industry 4.0

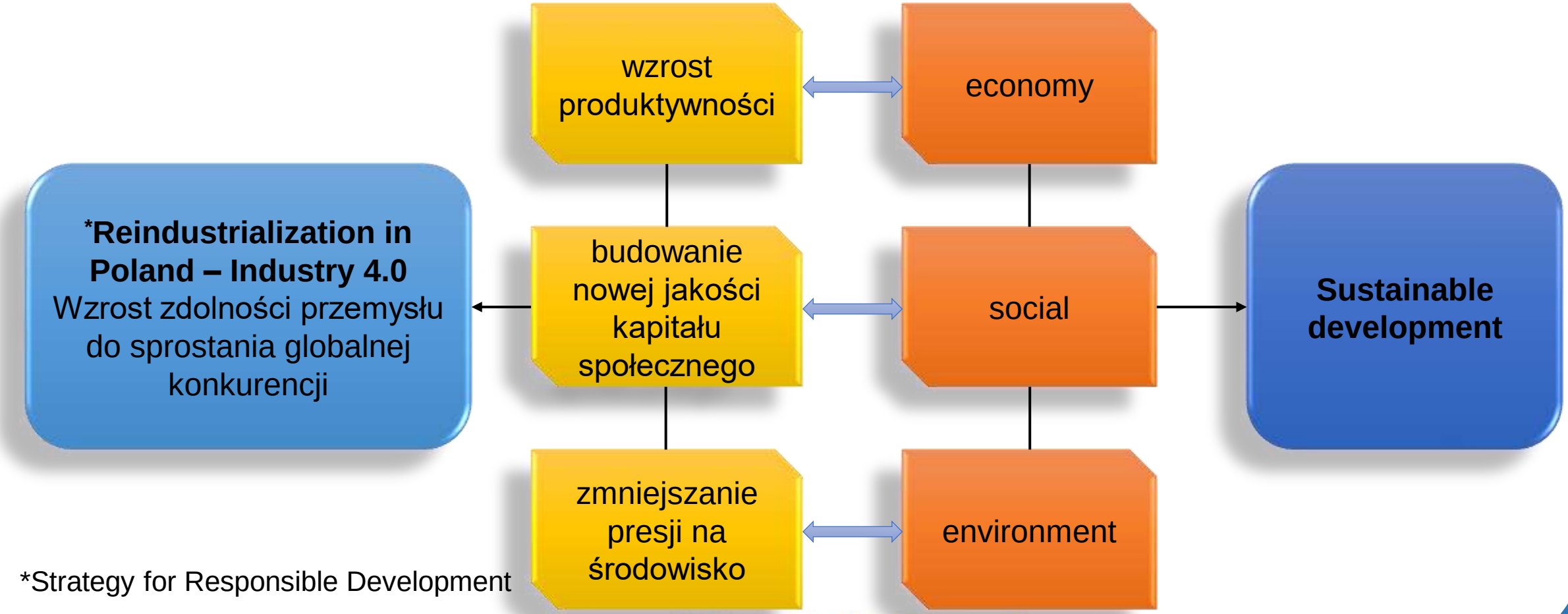
Polska Platforma Przemysłu 4.0 - krajowy integrator odpowiedzialny za doprowadzenie do transformacji krajowego przemysłu do poziomu określanego jako „Industry 4.0”



*The Foundation Act - Polish Industry Platform 4.0.
Ministry of development of May 18, 2017 Warsaw

Co-funded by the Erasmus+ Programme of the European Union

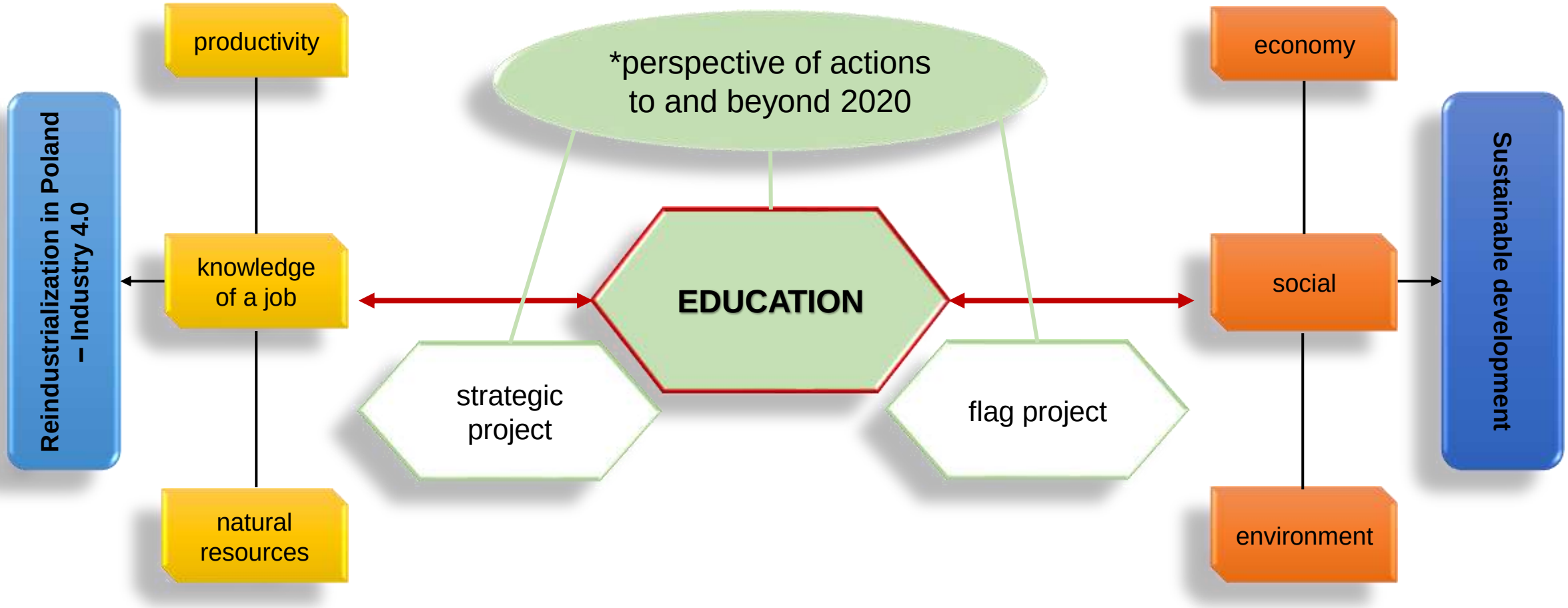
Sustainability of Industry 4.0



*Strategy for Responsible Development

Co-funded by the Erasmus+ Programme of the European Union

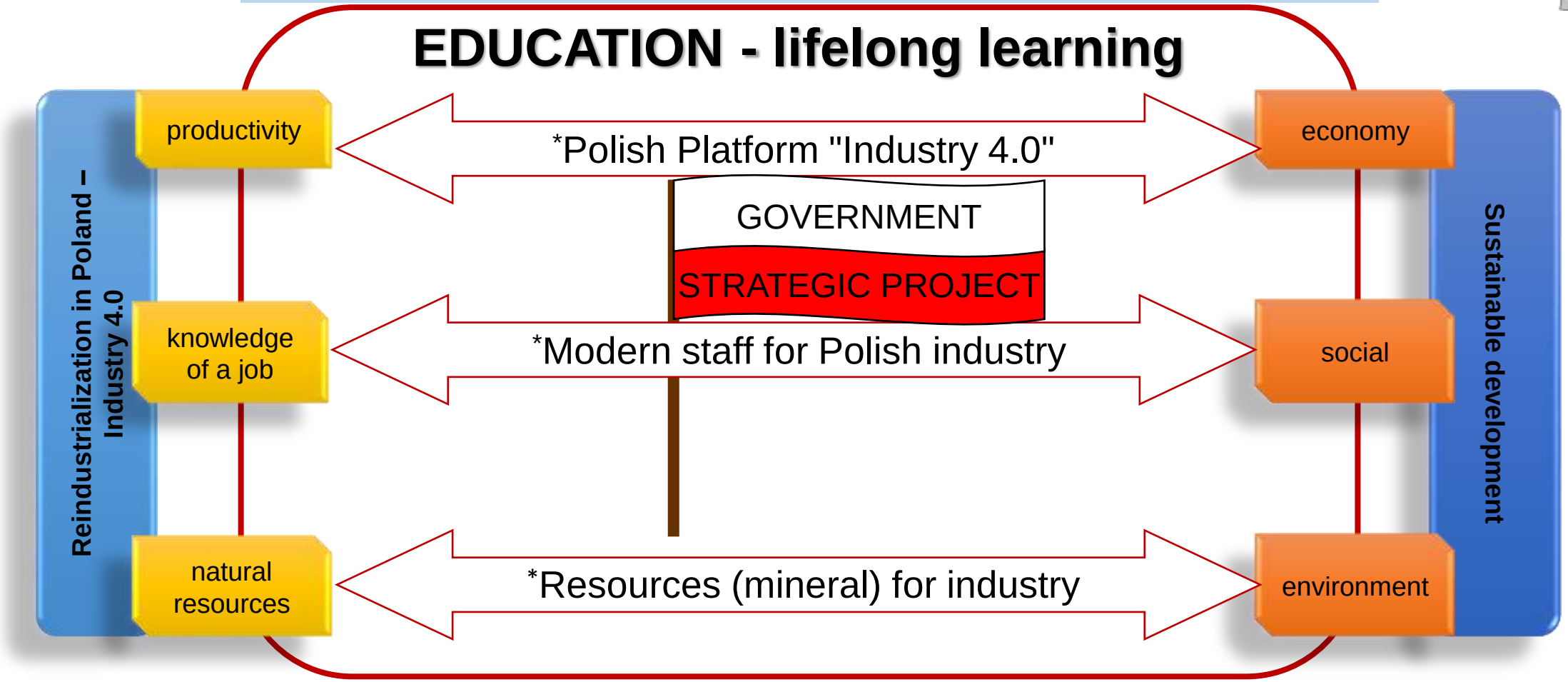
Sustainability of Industry 4.0



*Strategy for Responsible Development

Co-funded by the Erasmus+ Programme of the European Union

Sustainability of Industry 4.0



*Strategy for Responsible Development

Co-funded by the Erasmus+ Programme of the European Union

Sustainability of Industry 4.0

EDUCATION IN POLAND

* Dz. U. 2017 poz.59 USTAWA z dnia 14 grudnia 2016 r. Law on education

** Dz. U. 2018 poz. 1668 USTAWA z dnia 20 lipca 2018 r. Law on higher education and science

3-6 year olds

eight-year primary school

since 7 years old

eight-year primary school

1. four-year general education secondary school
2. five-year technical secondary school
3. three-year first cycle degree vocational school
4. three-year special vocational preparatory school
5. two-year second cycle degree vocational school
6. a post-secondary school for people with secondary education or secondary vocational education, with the education period of not more than 2.5 years

secondary schools

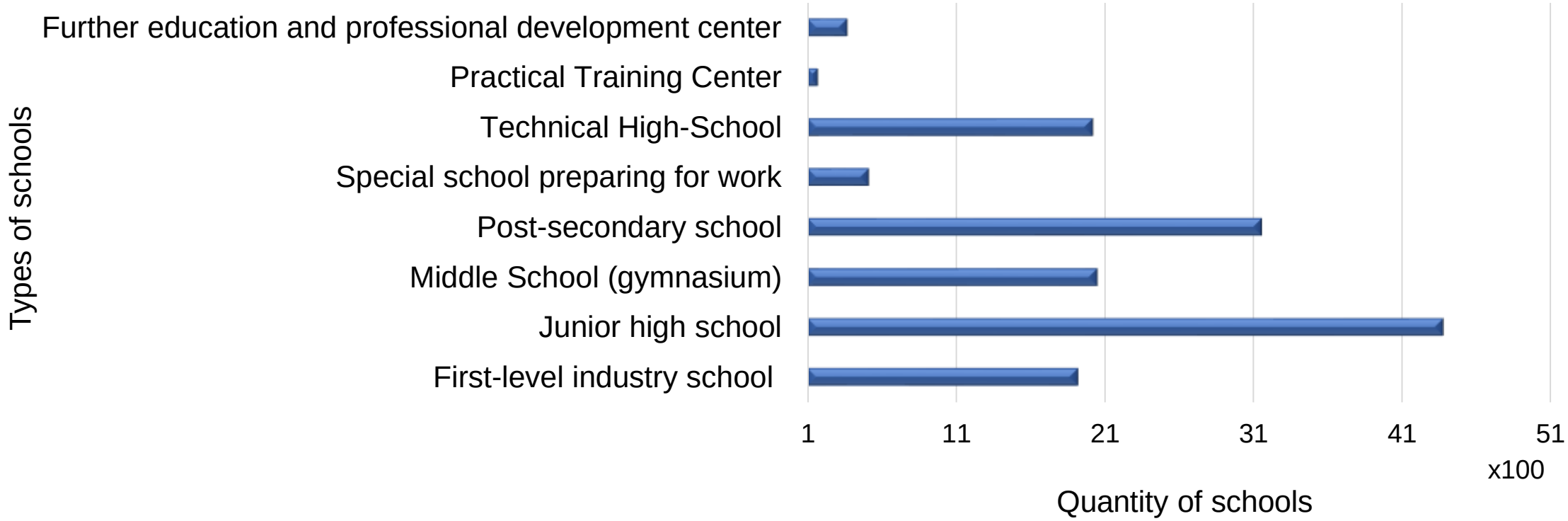
1. undergraduate (first cycle degree program) (at least 3 years and for engineering competences - 3.5 years)
2. graduate (second cycle degree program) (from 1.5 to 2.5 years)
3. long-cycle Master's degree program (from 4.5 to 6 years)

Higher education (practical or general academic profile)

Co-funded by the Erasmus+ Programme of the European Union

Sustainability of Industry 4.0

Quantity of schools divided into types of schools in Poland in 2017 (based on data published on the website of Information Center of Education)



Co-funded by the Erasmus+ Programme of the European Union

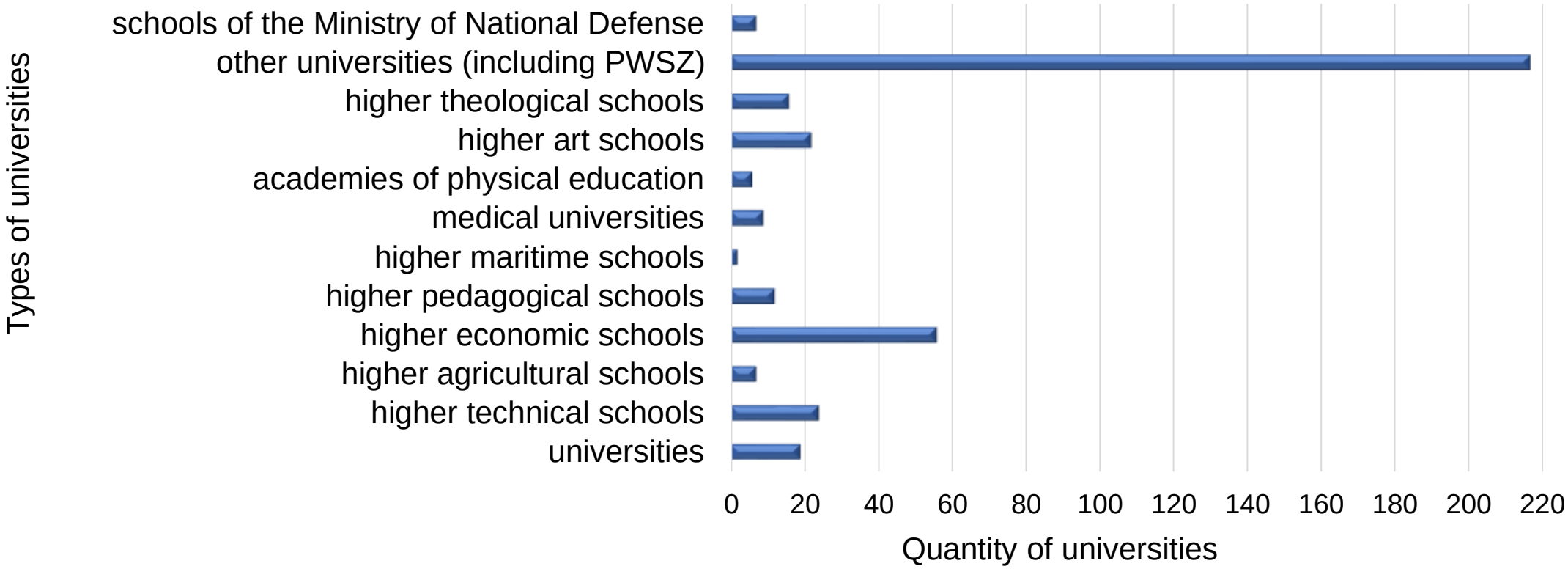
Sustainability of Industry 4.0

The average number of branches per school type in Poland in 2017 (Data published on the website of Information Center of Education)	
Types of schools	Number of branches
First-level industry school	5-26*
Secondary school	6
Junior high school	4
Post-secondary school	6
Special school preparing for work	3
Technical High-School	11
*The branch School, due to the large discrepancy in data, has been divided into the average number of branches for the interval (1-16: average 5; and 16-74: average 26)	

Co-funded by the Erasmus+ Programme of the European Union

Sustainability of Industry 4.0

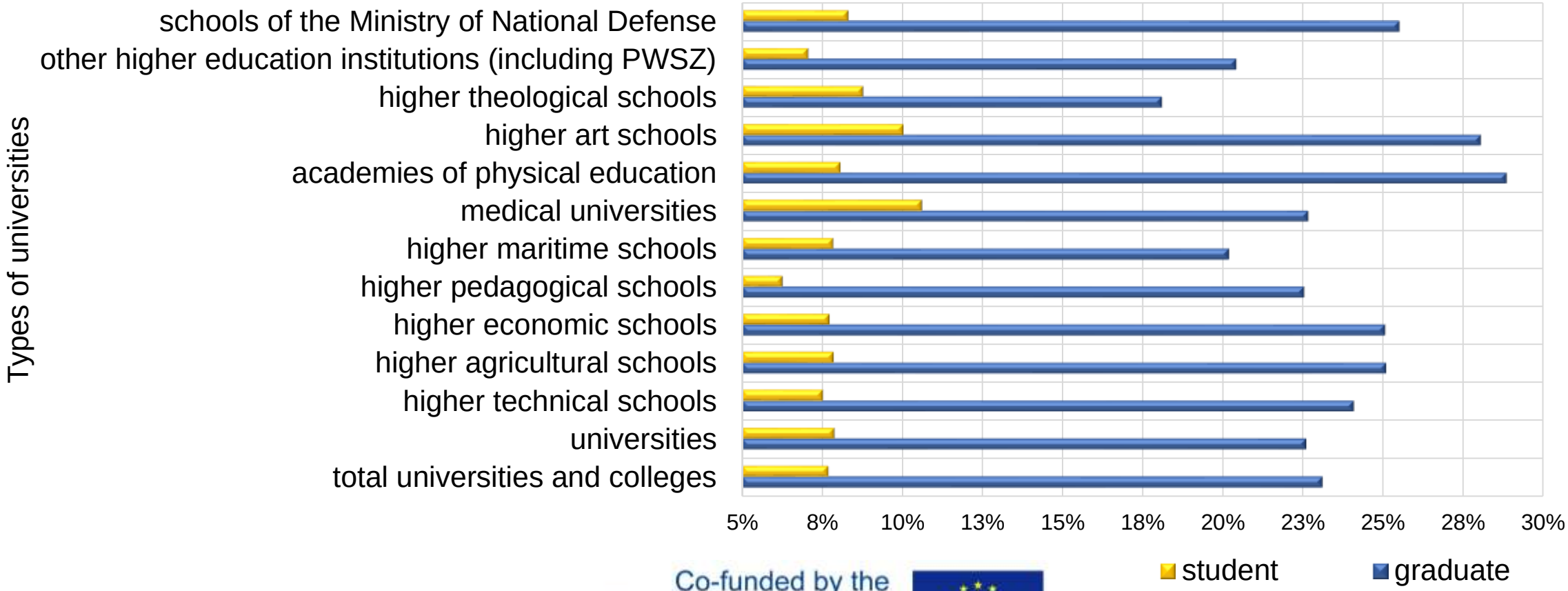
The number of universities divided into types of universities in Poland in 2017 (Based on data published on the CSO website - Local Data Bank)



Co-funded by the Erasmus+ Programme of the European Union

Sustainability of Industry 4.0

Percentage of the number of students and graduates by type of university in Poland in relation to 2012 by 2017 (based on data published on the CSO website - Local Data Bank)



Co-funded by the Erasmus+ Programme of the European Union

Sustainability of Industry 4.0

FUTURE OCCUPATIONAL PATHWAY IN POLAND

- 3-year special vocational preparatory school → employment;
- 3-year first cycle degree vocational school → employment;
- 3-year first cycle degree vocational school → 2-year second cycle degree vocational school → employment;
- 3-year first cycle degree vocational school → 2-year second cycle degree vocational school → university → employment;
- 5-year technical secondary school → employment;
- 5-year technical secondary school → university → employment;
- 4-year general education secondary school → employment;
- 4-year general education secondary school → 1-2.5- year post-secondary school → employment;
- 4-year general education secondary school → 1-2.5-year post-secondary school → university → employment.

Co-funded by the Erasmus+ Programme of the European Union

Sustainability of Industry 4.0

The characteristic “Engineer 4.0” relating to the realities of the Polish economy and entities constituting it:

- developing technical skills;
- development through knowledge outside the area of own specialization;
- development of competences associated with communication and skills in conducting an activity by means of e.g. work organization.

The process of knowledge management in the context of Industry 4.0 can be brought to the following structure: primary school (general knowledge), secondary school (professional knowledge), university (expertise). It is important for the whole level of education to introduce the element of interdisciplinarity. For example, in technical secondary schools, not to limit education to practical learning of a profession but also to show the significance of a profession in the process of building the economy. In turn, management staff should not limit themselves only to managing teams but also they ought to learn the specificity of technical work so as to assign task properly and assess them objectively.

Co-funded by the
Erasmus+ Programme
of the European Union

Sustainability of Industry 4.0

INTERDISCIPLINARY EDUCATION = CREATIVE EMPLOYEE







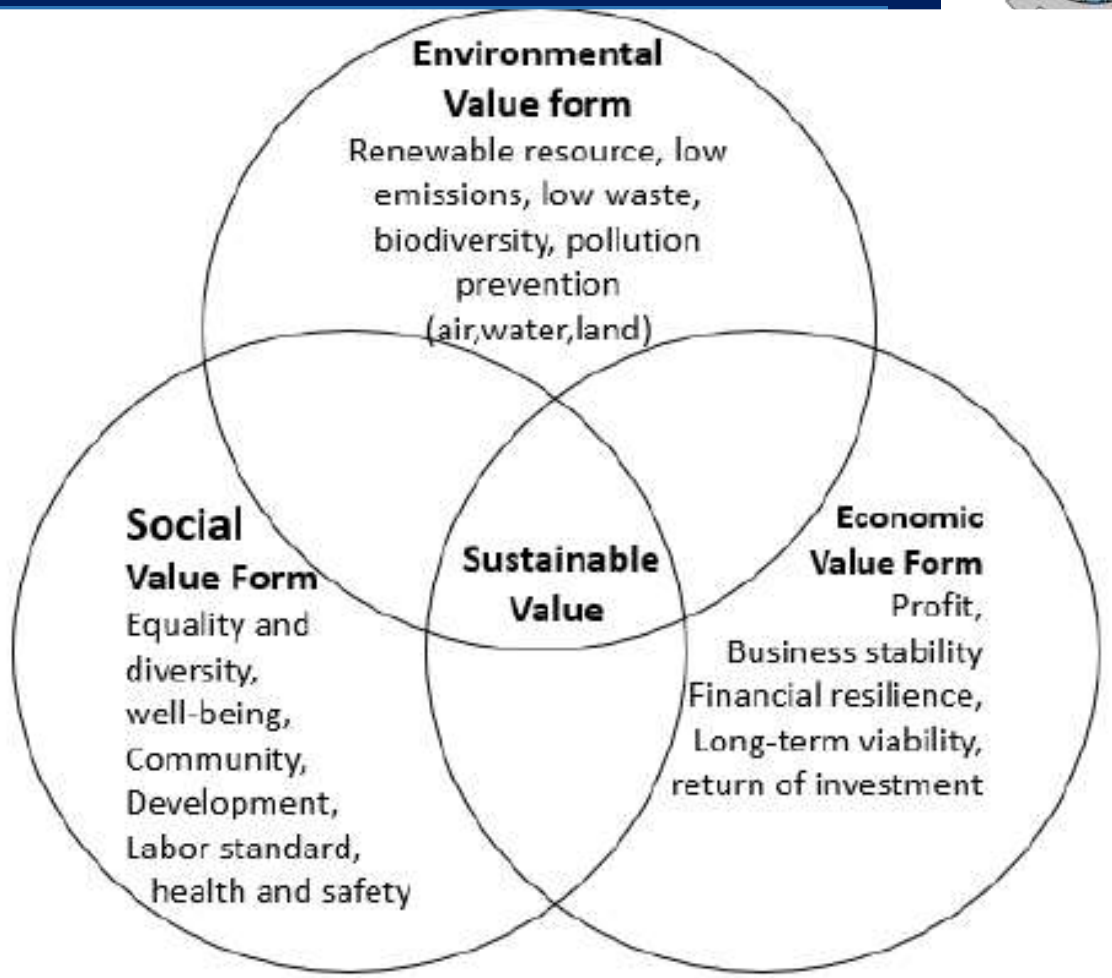



Co-funded by the
Erasmus+ Programme
of the European Union

Triple bottom line in I4.0 concept

Sustainability is one of the drivers of Industry 4.0, an industry initiative that through the adoption of digital technologies on the assembly line is changing traditional factories into smart factories.

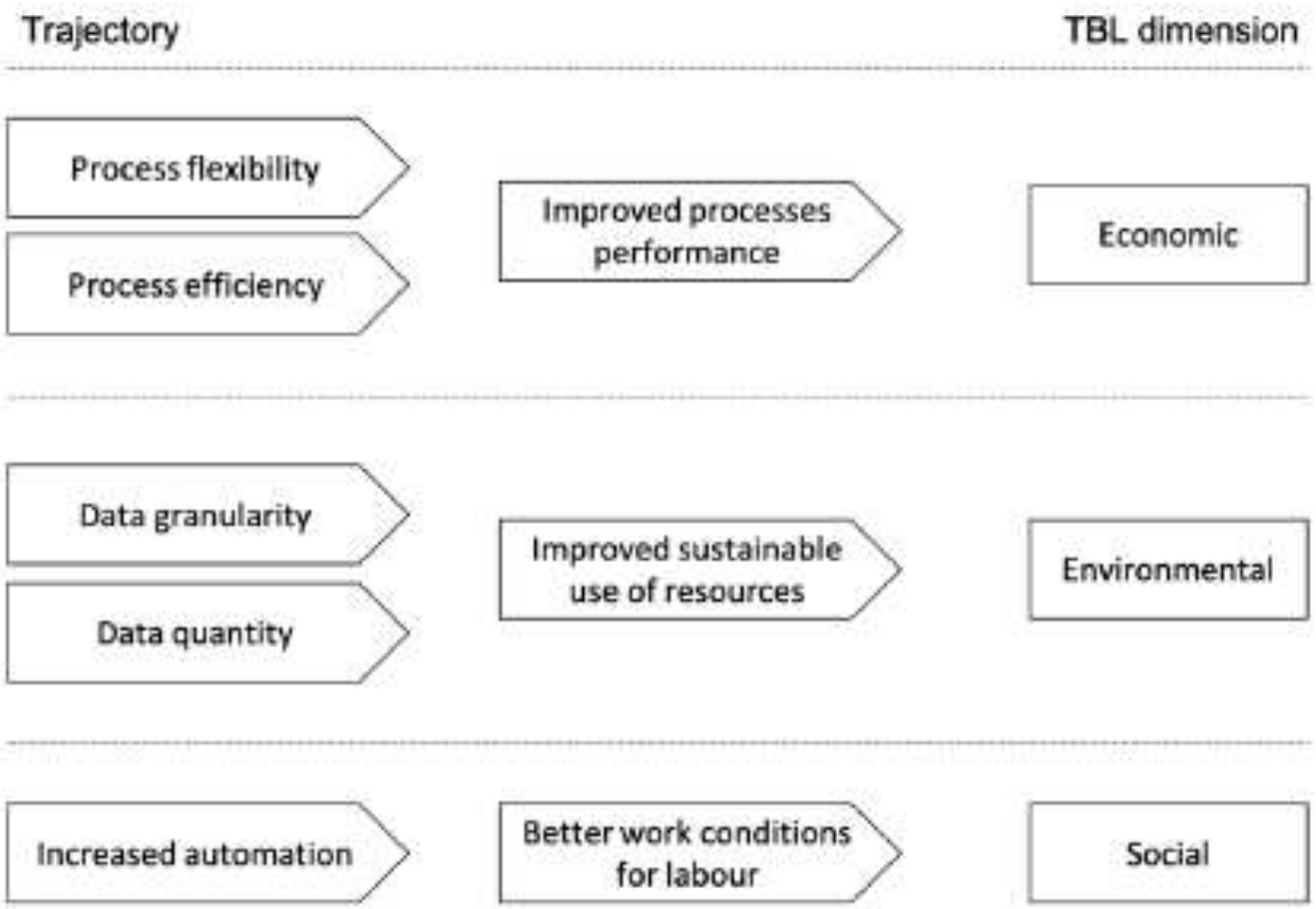
(Kagermann et al., 2013; Thoben et al., 2017)



(Barccini & Margherita, 2018)

Co-funded by the Erasmus+ Programme of the European Union

Possible trajectories of sustainability



(Barccini & Margherita, 2018)

Co-funded by the Erasmus+ Programme of the European Union

Areas of sustianability building

Areas	Specification
Business Models	Create positive or reduce negative impacts; solving social or environmental problems; comptitiveness on the long-run
Value Creation Networks	Closed-loop life cycles and industrial symbiosis; efficient coordination of material and energy flows
Equipment	Better control and self-guiding equipement
Product	Sustainable design of products: cradle to cradle principle and closed loop products
Process	Sustainable design of processes
Organization	Decentralized organization; efficient allocation of flows; holistic resource efficiency
Human	Increasing training efficiency, motivation; decentralized decision making;

(Stock & Seliger, 2016)

Co-funded by the Erasmus+ Programme of the European Union

Possible impact of Industry 4.0

Pillars of sustainability	Positive impacts	Negative impact
Economy	Increased efficiency / productivity More flexibility Reduction of costs and risks New economic model	Decrease of jobs and transformation of workforce Shift of strategic business sectors
Society	Llife quality increase Higher participation in product and service designing Improved quality New jobs	Need to redefine occuppational skills and competences Less job opportunities 4.0 dependency
Environment	New Energy resources More circular solutions Sustainable consumption	Intensive use of rare and strategic resources Different technological impacts

Co-funded by the Erasmus+ Programme of the European Union

Examples of impacts

- Smart Factory & Smart Operations
- Real Time Controlling, Adjusting and Monitoring Process
  - Autonomously responding production processes
  - Self-guiding / autonomous workpieces
- Deacrease of basic level jobs
- Need for new job for low qualified employees
- Need for new qualifications
- Decrease of incomes

Co-funded by the
Erasmus+ Programme
of the European Union

Co-funded by the
Erasmus+ Programme
of the European Union

Thank You

Curriculum Development

of Master's Degree Program in

Industrial Engineering for Thailand Sustainable Smart Industry