

Scenarios of the impact of automation and digitalisation on the education, schooling and science sectors

Polish Digital Resilience Agenda 2040 - a model of strategic preparedness for the antinomies of digitalisation.



Fundamental megatrends – irreversible forces

Key factors shaping the educational and economic reality until 2040



Automation of cognitive processes

Artificial intelligence and machine learning (ML) are becoming the main enablers, taking over tasks requiring data analysis and synthesis.



Digital hyperconnectivity

Universal access to the Internet (95%+ penetration) and digital resources creates the foundation for global knowledge exchange, but also for digital exclusion.



Globalization of talent markets

Free, digital movement of specialists between countries. Remote work blurs geographic boundaries, increasing competition for talent.



Progressing automation of work

Elimination of 2.5–4 million jobs in routine professions. The need for mass retraining (reskilling) of the workforce.

The crisis of traditional institutions – the common denominator

All scenarios assume a deep erosion of the current institutional model



The erosion of public education

The progressive degradation of public schools, which are losing their educational function in favor of a caring function. Privatizing the real learning process.



Non-competitiveness of universities

Lack of Polish universities in the global TOP 100 of the Shanghai ranking in 2040. Marginalization of Polish science in the international arena.



Brain drain

Mass emigration of talents - 40-50% of the best STEM graduates leave the country in search of better development conditions.



Chronic underfunding

Expenditures on education at the level of 4.5-4.8% of GDP, significantly below significantly below the OECD average (5.5-6.5%), which prevents effective effective transformation.



Transformation of school functions

Transition from the transmission of knowledge to the welfare and socialization function. The school becomes a "place of safe care" rather than an education center.

Shanghai 2040 Ranking

0

Polish universities in the TOP 100

STEM emigration

~50%

Graduates leave the country

Funding gap

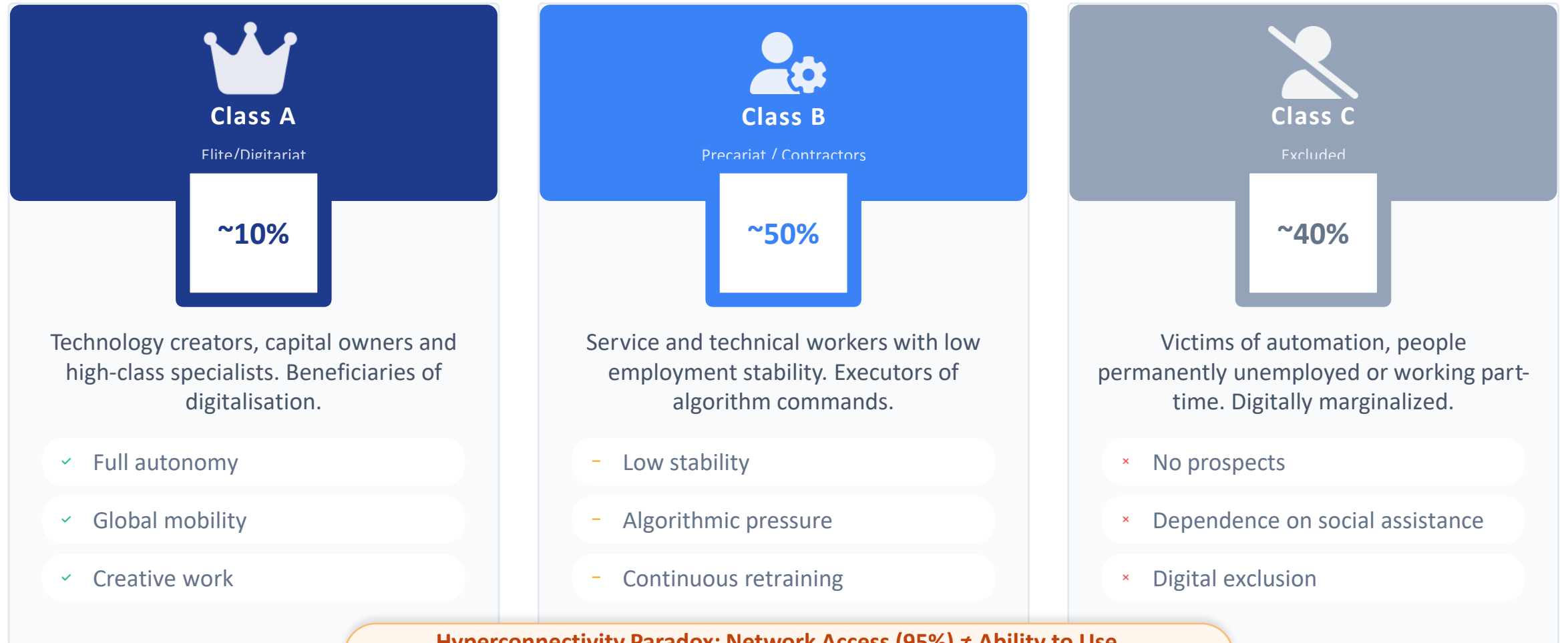
-1.5% of GDP

Relative to the OECD average



New social structure – three-class division

Crystallization of stratification based on digital competences and adaptability



Hyperconnectivity Paradox: Network Access (95%) ≠ Ability to Use ("Competence Gap")

New digital professions – common categories

Labor market transformation and future competences required in all scenarios



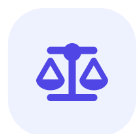
AI specialists

Prompt designers, algorithm auditors, model trainers. The key group responsible for creating, optimizing and supervising artificial intelligence systems.



Technological hybrids

Combining soft skills with technology. Examples: cyber physiotherapist, surgical robot operator - professions requiring empathy supported by the precision of machines.



Verification competition

A new sphere of supervision: compliance, AI ethical audit, truth verification. Ensuring the security, regulatory compliance and ethical operation of algorithms.



Competitions of experience

UX/CX designers, curators of personalized educational paths. Creating engaging digital experiences and managing user experience.

Scenario 1: "Her Majesty Emergence"

An optimistic vision: Synergy of science, education and economy



Optimistic

💡 Screenplay philosophy

"An integrated innovation ecosystem based on conscious meritocracy with strong compensation mechanisms for groups at risk of exclusion."

⚙️ Key Differentiators & Programs

"Second Chance" program

- Reskilling 100 thousand people per year with a training voucher 30 thousand. PLN/person

Retention policy

- 50% tax relief for 5 years for returnees; granty 200 tys. PLN PLN to start.

IP and grants reform

- 70% rights for creators; "Fast Track" (decision within 30 days, up to PLN 5 million).

Seed funds

- Public VC support of PLN 1 billion per year for deep-tech.

📈 Results 2040

GDP per capita

50 000+ USD

↑ vs 18k currently



High-Tech Export

>40%

↑ total exports



Gini coefficient

0.30

– Moderate inequality



Talent balance

+10%

↑ More returns than departures



Scenario 1 – mechanisms for equalizing opportunities

Systemic interventions that build social cohesion in a world of automation



Proactively manage polarization

The "Second Chance" program (100,000 people per year, PLN 30,000/person) ensuring real reskilling for people at risk of automation.



Hyperconnectivity as a balancing mechanism

Access to the Internet treated as a civil right, combined with mass digital education eliminating the "use gap".



Micro-certificate system

A flexible system of confirming competences, recognized by 50+ largest employers, replacing ossified diplomas.



Positive circulation of talents

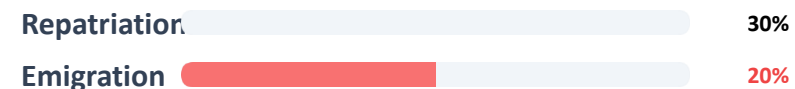
Reversing the brain drain trend: 30% repatriation of experts vs. 20% emigration. Poland is becoming a hub attracting talents.



Capital support (Deep-Tech)

Seed funds (PLN 1 billion per year) and repatriation grants (PLN 200,000) for establishing technology companies in the country.

🌐 Talent Balance (annually)



+10 p.p. positive balance

👥 "Second Chance" program

100,000 participants/year

Goal: 80% retraining effectiveness

🏢 Employment Ecosystem

🏢 50+ Corporations 📄 Micro-certificates

🚀 PLN 1 billion Seed

Scenario 2: "Separated Worlds"



Dystopian

Dystopian vision: The middle income trap and technology as an inequality amplifier

“ Screenplay philosophy

"Technology serves as an amplifier of existing inequalities, not a tool for democratization. Stabilization comes through accepting deep divisions as the new normal."

Key differentiators

The collapse of public education

- Schools have only a protective function; lack of real education in the public system.

The collapse of the world of science

- The division into narrow enclaves of perfection and mass "zombie science" is meaningless.

Low value economy

- Dominance of the processing industry (45-50% of GDP); High-tech High-tech are isolated enclaves (5-5-8%).

Secession of the elites

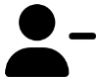
- Elites use private systems, there is no pressure to reform public services.

Results 2040

Job deficit

-2.5 million

↓ Automation balance



Actual Unemployment

15-18%

↑ vs 6-8% officially



R&D expenditure

1.2% of GDP

— Stagnation



Social Degradation

25%

↓ Relegation from class B to C



Scenario 2: The social mobility gap

A dystopian vision of blocked channels of advancement and degradation of the middle class



Blocked promotion (Class C → A)

Only 0.5% of the age group (1 in 200 people) makes it from the lower class to the elite. The glass ceiling becomes a concrete ceiling.



Massive degradation (Class B → C)

22-27% of middle class people lose their status. There are many times more relegations than promotions, which leads to the erosion of the social center.



Cultural determinism

The cultural capital of the family determines 70% of life chances. Public education ceases to fulfill the function of equalizing opportunities.



Stratification of science

Institutional division into mass "service science" (80%) and small, small, isolated "enclaves of excellence" (15-20%).



Secession of the elites

Acceptance of deep divisions as the "new normal" and the withdrawal of elites from public systems (education, health).

Chance for Promotion

0,5%

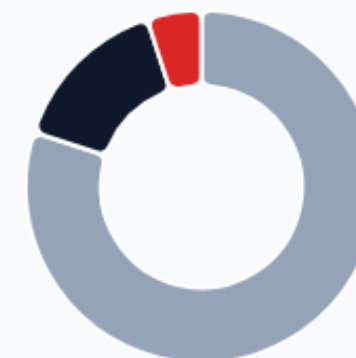
Class C to A

Downside Risk

~25%

Class B to C

The structure of Polish science 2040



■ Nauka Serwisowa ■ Enklawy Doskonałości ■ Nauka Zombie

*Structural forecast for Scenario 2

Scenario 3: "Phoenix from the Ashes"



Paradoxical

Paradoxical vision: Non-institutional innovations despite the system crisis

💡 Screenplay Philosophy

"Innovations arise DESPITE institutions, not because of them. Economic success is limited to isolated high-technology clusters without the diffusion of knowledge to society."

🛠️ Key Differentiators & Structure

Functional dualism

5-7 world-class startup clusters completely cut off from the rest of the backward economy.

"Lone Wolves" model

80 thousand self-taught freelancers outside the system (SaaS, NFT, micro-innovations).

Ecosystems without universities

Corporate R&D centers are replacing replacing universities as the only sources of innovation.

Global sources of knowledge

Learning from repositories (GitHub, ArXiv) bypassing local institutions.

📊 Results 2040

R&D centers

150-200

↑ Growth from 50 (2024)



R&D employment

120 thousand

👤 Elite specialists



Wages in Innovation

350%

📊 National median



Diffusion of Knowledge

Low

🚫 Isolated enclaves



Scenario 3

The paradox of hyperconnectivity: universal access does not mean universal ability to use



Elite uses effectively

A narrow elite ("Digitariat") effectively uses free, global resources for continuous learning (lifelong learning), building a competence advantage.



The "lone wolf" phenomenon

Creation of a group of 50-80 thousand individual self-taught creators, operating completely outside the formal system, relying on knowledge from the Internet.



Global products, local isolation

Products (SaaS, NFTs, micro-innovations) are sold on global markets, without any connection to the local economy or tax system.



Lack of knowledge diffusion

Knowledge accumulated in innovation enclaves does not permeate permeate the broader economy or society, creating functional



functional dualism Algorithmic bubble

"Information banks" and personalization algorithms isolate the passive majority of society from development content, serving only entertainment.

Independent Creators

50-80 thousand

Autodidacts outside the education system

Sources of Knowledge

Global

GitHub, ArXiv, MIT OCW (not universities)

Knowledge Transfer

Blocked

No diffusion to the public sector

Scenario 4: "The Obedience Factory"

The totalitarian vision: Educational Taylorism and façade meritocracy



Totalitarian

Screenplay Philosophy

"Standardization at the expense of creativity. The system is officially meritocratic, but in fact caste. Education serves as a tool for control and selection of obedient cadres."

Key Differentiators & Mechanisms

Educational Taylorism

- "Uniform lesson plans" eliminating critical thinking; emphasis on measurable indicators of obedience.

Elite Segregation

- Complete separation of classes - private private international schools for class A, class A, public "factories" for the rest. rest.

Regulatory Asymmetry

- "Compliance hell" for universities vs. "fast track" and tax relief for selected business.

Automation without covers

- Elimination of 2.8-4 million jobs in the absence of effective retraining programs.

Results 2040

GDP per capita

Stagnation

▲ The middle income trap



Innovation (GDP)

12-18%

🔒 Narrow corporate enclaves



Social Mobility

Facade

🚫 Caste system



Balance of Jobs

-3 million

↓ Technological unemployment



Scenario 4: Regulatory asymmetry

Two separate operating systems for business and science ("Obedience Factory")

For business "Fast Track"



📈 R&D relief: 200%

Incentive

Maximum deductions of eligible costs for companies investing in innovations, regardless of actual novelty.

📄 CIT per IP: 5%

Preference

Extremely low tax on income from intellectual property (vs. standard 19% standard 19%) promoting commercialization.

🛡️ Regulatory sandboxes

Freedom

Zones free from legal restrictions for testing new technologies (AI, biotech) without standard security requirements.

VS

For universities "Compatibility Hell"



📊 Total parameterization

Load

30-40% of scientists' work time is spent on administration, reporting indicators and "producing points" instead of research.

🛡️ GDPR and Bioethics

Blockade

Rigid, bureaucratic procedures for data security and ethical approvals paralyzing social and medical research.

🚫 Lack of flexibility

Stagnation

Rigid framework for spending grants, inability to move funds and experiment (a requirement for success in every project).

Scenario 4: Totalitarian social selection

Façade meritocracy with systemic casteism and lack of compensation



Meritocracy as a façade

The system officially promotes ability and performance, but in practice it functions as a caste system. Birth status is a hidden but decisive factor in success.



The scholarship paradox

Financial support programs go 70% to students from the privileged Class A, instead of equalizing the opportunities of disadvantaged groups.



Advancement bottleneck

Subject Olympiads remain the only truly meritocratic channel of social advancement, available to only 1-2% of the age group.



Three waves of automation

The process of job elimination progresses sequentially: from routine cognitive tasks, through physical work, to semi-creative professions.



No social protections

The elimination of 2.8 to 4 million jobs takes place without effective retraining programs, which leads to mass exclusion.

Scholarship Beneficiaries

70%

Comes from the elite Class A

Real Social Advancement

1-2%

Yearbook (via Olympics)

Jobs (Balance)

-4 million

The effect of automation without covers

Key differences in approaches to education

Comparison of system philosophies and strategies in four scenarios



Scenario 1: Her Majesty Emergence Sentient

Conscious meritocracy supported by strong compensation mechanisms. The system actively manages polarization through equalization programs.



Scenario 2: Stratified Worlds Passive

Accepting deep inequalities as the "new normal". Lack of political will to reform, technology acts as an amplifier of divisions.



Scenario 3: Phoenix from the Ashes Grassroots

Non-institutional innovations – success achieved "despite" the system. Bypassing inefficient formal education in favor of self-education.



Scenario 4: Control Obedience Factory

Educational Taylorism and standardization at the expense of creativity. Façade meritocracy serving to maintain the caste system.



Common element: Erosion of institutions

All scenarios (without active intervention by S1) assume the degradation of public schools and the transition to a care function.

Key Difference

Mechanisms for equalizing opportunities

The main determining factor

Present (Scenario 1)

Active public policy

Retention programs, IP reform, talent support

Absent (Scenarios 2-4)

Passivity/Control

Deepening polarization, stagnation, brain drain

The role of public policy – levers for choosing a path

System decisions 2026–2030 that will determine which scenario will come true



Talent Policy: Retention and Repatriation

Key to Scenario 1: tax breaks (50% for 5 years) for returning specialists and start-up grants (PLN 200,000) to reverse the brain drain.



Intellectual Property (IP) Reform

Paradigm change: 70% of rights to inventions for creators (instead of the current 30%) and a fast grant path (decision within 30 days) for deep-tech projects.



Scalable reskilling ("Second Chance")

Implementation of a mass retraining program (100,000 people per year) based on micro-certificates recognized by the largest employers.



Inclusive hyperconnectivity

Treating access to the internet as a fundamental right, but complemented by digital education to prevent the "paradox of exploitation".



Consequences of inaction (Scenarios 2-4)

The lack of the above interventions leads to the perpetuation of the middle income trap, deep social polarization and permanent loss of competitiveness.

Key instruments

Capital priority

Seed funds

PLN 1 billion annually to support startups and innovations at an early stage

Regulatory priority

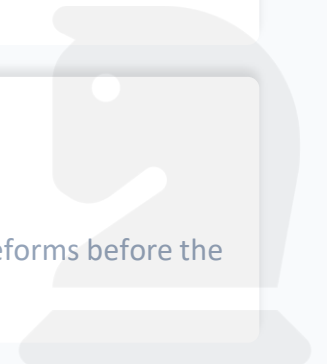
IP reform

Unlocking the potential of commercialization at universities

Time window

2026–2030

A critical period to implement reforms before the wave of automation



Conclusions and implications

Key observations from scenario analysis – what is certain and what depends on us?



Automation and digitalisation are inevitable

They appear in all scenarios as external forces over which Poland has no regulatory influence - we can only adapt.



Degradation of public institutions

This is the common denominator for all scenarios without radical intervention. The "business as usual" model leads to collapse.



Social polarization will deepen

The question is not "if?", but "how much?". The risk of a persistent digital underclass is critically high.



The paradox of hyperconnectivity

Access to technology alone does not equalize opportunities. The ability to use resources (cultural capital) becomes crucial.



Only an active policy works

Avoiding the worst-case scenarios requires proactive, costly state action, not just deregulation.



The decision window is limited

The time for effective decisions is the next 5-10 years. After this period, structural changes may become irreversible.

Strategic proposal

Political passivity does not lead to maintaining the status quo, but to the implementation of dystopian scenarios.

Critical risk

Permanent loss of 40-50% of intellectual potential (brain drain) in the absence of reforms.

Action horizon: 2026-2035



Strategic questions

Key dilemmas determining the future of Polish education and science



Policy of equal opportunities

Are we ready to implement systemic compensation mechanisms for victims of automation on a massive scale?



The middle income trap

How to avoid permanent economic stagnation and move to a model based on high added value?



Reform of the innovation system

Will we reform intellectual property law and the R&D financing system to truly support creators and scientists?



Talent management

How to effectively stop the brain drain and launch repatriation programs for programs for STEM specialists?



The mission of public education

Will we rebuild the public school as a center of learning or will we accept its role as a purely caring one?

Decision window

2026–2030

A key time to implement reforms

Risk of omission

Permanent Stagnation

Loss of competitiveness of the economy

The stakes of the game

Sovereignty

Technological and social independence

Summary – the future is not certain

We have a choice between four alternative development paths until 2040



Four alternative paths

From the optimistic "Emergency" requiring proactive actions, to the dystopian "Stratified Worlds" and the totalitarian "Obedience Factory".



Common challenges, different responses

The megatrends of digitalisation and automation are inevitable for everyone, but it is political and systemic decisions that determine the final outcome.



Cost of inaction vs. investment cost

The optimistic scenario requires bold, costly interventions. Negative scenarios are a natural consequence of inaction.



Key decision window

The next 5-10 years will be decisive. Reforms implemented after 2030 may be too late considering the pace of technological change.



Social consequences

Without systemic equalization of opportunities, technology will become the strongest amplifier of social inequality in history.

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A fundamental question

What kind of society do we want to build in the digital age? Is technology intended to be inclusive or perpetuate divisions?

The path to success

Conscious meritocracy + Compensation

Risk of passivity

Permanent stagnation and polarization

Key strategic implications for the education system

- changing the educational paradigm towards the creation and search for talents,
- back to the concept of master disciple: teacher as a mentor, educator and guide enabling the search for an individual life path,
- transferring the educational offer of university humanities courses to the secondary school level,
- launching a labor market prediction system at the local level



Ministerstwo Nauki
i Szkolnictwa Wyższego



The project is financed from state budget funds allocated by the Minister of Education and Science under the "Science for Society II" Program.
Funding: PLN 1,467,000, Total value: PLN 1,467,000