Investments Efficiency in Industry 4.0

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Investments

Who invests?
- Person
- People
- State
- Companies

What?
- Money
- Materials
- Buildings
- Securities
- Equipment
- Technologies
- Other assets

Why?
- Profit
- Impact
- Solving social problems
- Improvement of ecology
- Other goals

Where?
- Enterprises
- Banks
- Startups
- Hospitals
- Schools
- Securities
- Infrastructure
- Other objects
Investments are all types of property and intellectual values invested in objects of entrepreneurial and other types of activity, as a result of which profit (income) is created and / or a social and environmental effect is achieved.
Investments can be made in the forms

- funds, bank deposits, shares, stocks and other securities (except bills)
- movable and immovable property (buildings, structures, equipment and other material values)
- intellectual property rights
- technical, technological, commercial and other knowledge, which are issued in the form of technical documentation, skills and production experience that are necessary for the organization of a particular type of production ("know-how")
- rights to use land, water, resources, buildings, structures, equipment, as well as other property rights
- other values
Industry 4.0 describes the growing trend towards automation and data exchange in technology and processes within the manufacturing industry, including:

- The internet of things (IoT)
- The industrial internet of things (IIoT)
- Cyber-physical systems (CPS)
- Smart manufacture
- Smart factories
- Cloud computing
- Cognitive computing
- Artificial intelligence
# Investment in technology innovation

<table>
<thead>
<tr>
<th>Greatest potential for transformation and long-term value creation</th>
<th>Investing in now</th>
<th>Plan to invest in three years from now</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Internet of Things (IoT)</td>
<td>Internet of Things (IoT)</td>
<td>Internet of Things (IoT)</td>
</tr>
<tr>
<td>2 Robotic process automation (RPA)</td>
<td>Artificial intelligence</td>
<td>Robotics (including autonomous vehicles)</td>
</tr>
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<td>3 Artificial intelligence</td>
<td>Robotic process automation (RPA)</td>
<td>Artificial intelligence</td>
</tr>
<tr>
<td>4 Blockchain</td>
<td>Robotics (including autonomous vehicles)</td>
<td>Blockchain</td>
</tr>
<tr>
<td>5 Robotics (including autonomous vehicles)</td>
<td>Augment reality</td>
<td>Robotic process automation (RPA)</td>
</tr>
<tr>
<td>6 Augment reality</td>
<td>Blockchain</td>
<td>Virtual reality</td>
</tr>
<tr>
<td>7 Virtual reality</td>
<td>Social networking, collaboration technologies</td>
<td>Biotech, digital health, genetics</td>
</tr>
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<td>9 Biotech, digital health, genetics</td>
<td>Virtual reality</td>
<td>On Demand platforms</td>
</tr>
<tr>
<td>10 On Demand platforms</td>
<td>On Demand platforms</td>
<td>Augment reality</td>
</tr>
</tbody>
</table>

**KPMG Technology Industry Innovation Survey, 2019**
The main quantitative indicators:

- Annual digital revenue increases by 2.9% on average – and a significant minority that expect total increases of more than 50% over five years. That adds up to $493 billion in increased annual revenues for the next five years across the industrial sectors.

- Cost reductions by 3.6% per year on average. Digital technologies enable shorter operational lead times, higher asset utilisation and maximum product quality. All respondents expect to save $421 billion in costs every year for the next five years.

Geissbauer R., Vedso J., and Schrauf S. Global Industry 4.0 Survey. Industry 4.0: Building the digital enterprise. URL: https://www.pwc.com
### Expected Cost Reduction by Industry Sector (%)

<table>
<thead>
<tr>
<th>Industry Sector</th>
<th>Cost Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation &amp; logistics</td>
<td>3.2</td>
</tr>
<tr>
<td>Metals</td>
<td>3.2</td>
</tr>
<tr>
<td>Industrial manufacturing</td>
<td>3.6</td>
</tr>
<tr>
<td>Forest, paper &amp; packaging</td>
<td>4.2</td>
</tr>
<tr>
<td>Engineering &amp; construction</td>
<td>3.4</td>
</tr>
<tr>
<td>Electronics</td>
<td>3.7</td>
</tr>
<tr>
<td>Chemicals</td>
<td>3.9</td>
</tr>
<tr>
<td>Automotive</td>
<td>3.9</td>
</tr>
<tr>
<td>Aerospace, defence &amp; security</td>
<td>3.7</td>
</tr>
</tbody>
</table>

**Weighted Average:** 3.6

*created by the data of [https://www.pwc.com](https://www.pwc.com)*
Planned investments in Industry 4.0 by industry sector, in % per year

- Transportation & logistics: 5%
- Metals: 4%
- Industrial manufacturing: 5%
- Forest, paper & packaging: 4%
- Engineering & construction: 5%
- Electronics: 7%
- Chemicals: 5%
- Automotive: 5%
- Aerospace, defence & security: 5%

created by the data of https://www.pwc.com
Planned investments in Industry 4.0 by industry sector, in billions of dollars per year

- Transportation & logistics: 97 billion
- Metals: 55 billion
- Industrial manufacturing: 177 billion
- Forest, paper & packaging: 15 billion
- Engineering & construction: 195 billion
- Electronics: 243 billion
- Chemicals: 45 billion
- Automotive: 65 billion
- Aerospace, defence & security: 13 billion

created by the data of https://www.pwc.com
## Investment volumes in Industry 4.0 by countries

<table>
<thead>
<tr>
<th>Year Launched</th>
<th>Initiative</th>
<th>Declared Funding US Millions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>Industry 4.0</td>
<td>$550</td>
</tr>
<tr>
<td>2010</td>
<td>Industry 4.0</td>
<td>$280</td>
</tr>
<tr>
<td>2011</td>
<td>Manufacturing USA</td>
<td>$700</td>
</tr>
<tr>
<td>2011</td>
<td>Catapult centers</td>
<td>$430</td>
</tr>
<tr>
<td>2012</td>
<td>Intelligent Factories Clusters</td>
<td>$48</td>
</tr>
<tr>
<td>2013</td>
<td>Factories of the Future</td>
<td>$1,120</td>
</tr>
<tr>
<td>2014</td>
<td>Revitalization/Robots Strategy</td>
<td>$916</td>
</tr>
<tr>
<td>2015</td>
<td>Industrie du futur</td>
<td>$1,800</td>
</tr>
<tr>
<td>2015</td>
<td>Manufacturing Innovation 3.0</td>
<td>$1,160</td>
</tr>
<tr>
<td>2015</td>
<td>Productivity 4.0</td>
<td>$1,000</td>
</tr>
<tr>
<td>2016</td>
<td>Research Innovation and Enterprise</td>
<td>$2,300</td>
</tr>
<tr>
<td>2017</td>
<td>Made in China 2025</td>
<td>$3,000</td>
</tr>
</tbody>
</table>

High-technology exports (current US$), GDP, PPP (current international $)
Ukraine has developed a draft National Strategy Industry 4.0

1. Institutionalization of the development of industrial high-tech segments at the state level, i.e. recognition of target sectors of industrial high-tech as key for the development of the Ukrainian economy. This will restore confidence in the state and give a powerful impetus to the development of priority industries.

2. The creation of an innovative ecosystem of industrial high-tech involves solving such development problems: complete independent audit of the existing elements of the ecosystem (design bureaus of leading enterprises, a system of universities and NASU, scientific and technological parks, etc.) and the determination of their target indicators; establishing a technology transfer from Ukrainian scientific institutions, science parks, R & D laboratories to end customers, as well as creating network links between them; attracting investments and funds to accelerate innovative development.

3. Acceleration of clustering in the field of Industry 4.0 both at the regional and national levels. High-tech industrial clusters must solve a number of problems both in terms of increasing value in the chains of their ecosystems and in the growth of exports.

Yurchak O. Ukrainian Industry Strategy 4.0 - 7 trends
URL: https://industry4-0-ukraine.com.ua/
Ukraine has developed a draft National Strategy Industry 4.0

4. Full-scale digitalization of key sectors of industry, energy and infrastructure. It is planned to create regulatory incentives to accelerate digitalization, both among end customers and innovators 4.0; creation of digital transformation roadmaps by industry; large-scale digitalization of industrial sectors.

5. The maximum integration of innovations in the strategy of the defence complex and the country’s security is especially important in the context of aggression from the Russian Federation. This includes the launch of special state programs for the transition of defence plants to technologies 4.0 and increasing their innovativeness, ensuring cybersecurity.

6. Launch of export programs for the industrial high-tech sector. It is necessary to create a special trade mission for the export of products and services in the era of 4.0.

7. Internationalization and integration into the global space 4.0 - the creation of separate programs for integration into the 4.0 space in the EU. At the same time, it is necessary to create programs for integration into value chains at the level of other world communities and states.

Yurchak O. Ukrainian Industry Strategy 4.0 - 7 trends
URL: https://industry4-0-ukraine.com.ua/
Investments and income in Ukraine, 2010-2018, UAH million

created by the data of http://www.ukrstat.gov.ua/
Dependence of nominal GDP on FDI

created by the data of  https://data.worldbank.org/
Dependence of nominal GDP on the share of R&D

![Graph showing Dependence of nominal GDP on the share of R&D](https://data.worldbank.org/)

*created by the data of [https://data.worldbank.org/](*
Dependence of the share of R&D on FDI

Foreign direct investment, million dollars

Share of R&D in GDP, %

- South Korea
- Japan
- Germany
- France
- China
- United Kingdom
- Italy
- Russia
- Brazil
- South Africa
- Ukraine
- Saudi Arabia
- India
- Australia
- USA

created by the data of https://data.worldbank.org/
Impact of Industry 4.0 instruments on financial performance

- **Revenue**
  - Increasing the speed of bringing new products to market by accelerating the production cycle
  - Increasing customization of goods and services through more accurate identification and meeting the needs of society
  - Improving the quality of goods and services by reducing defective products, delivery times

- **Costs**
  - Reducing the cost of maintenance needs due to predictive analytics
  - Reducing of electricity costs due to its reasonable use
  - Reducing of costs due to automation and robotization of production

- **Non-current assets**
  - Growing investment in fixed assets of industry: robots, 3D printers, server equipment
  - Growing of investments in intangible assets: software, licenses, patents
  - Growing investment in Research & Development
How Industry 4.0 is delivering revenue, cost and efficiency gains?

<table>
<thead>
<tr>
<th>Additional revenue from:</th>
<th>Lower cost and greater efficiency from:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digitising products and services within the existing portfolio</td>
<td>Real-time inline quality control based on Big Data Analytics</td>
</tr>
<tr>
<td>New digital products, services and solutions</td>
<td>Modular, flexible and customer-tailored production concepts</td>
</tr>
<tr>
<td>Offering big data and analytics as a service.</td>
<td>Real-time visibility into process and product variance, augmented reality and optimisation by data analytics</td>
</tr>
<tr>
<td>Personalised products and mass customisation.</td>
<td>Predictive maintenance on key assets using predictive algorithms to optimise repair and maintenance schedules and improve asset uptime</td>
</tr>
<tr>
<td>Capturing high-margin business through improved customer insight from data analytics</td>
<td>Vertical integration from sensors through MES to real-time production planning for better machine utilisation and faster throughput times</td>
</tr>
<tr>
<td>Increasing market share of core products</td>
<td>Horizontal integration, as well as track-and-trace of products for better inventory performance and reduced logistics</td>
</tr>
<tr>
<td></td>
<td>Digitisation and automation of processes for a smarter use of human resources and higher operations speed</td>
</tr>
<tr>
<td></td>
<td>System based, real-time end-to-end planning and horizontal collaboration using cloud based planning platforms for execution optimisation</td>
</tr>
<tr>
<td></td>
<td>Increased scale from increased market share of core products</td>
</tr>
</tbody>
</table>

https://www.pwc.com/
## Annual innovation investment by company size

<table>
<thead>
<tr>
<th></th>
<th>Startup</th>
<th>Mid-Market</th>
<th>Large Enterprise</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ 0 - $ 9.9 M</td>
<td>84 %</td>
<td>59 %</td>
<td>40 %</td>
</tr>
<tr>
<td>$ 10 M - $ 99.9 M</td>
<td>14%</td>
<td>32 %</td>
<td>28 %</td>
</tr>
<tr>
<td>$ 100 - $ 499.9 M</td>
<td>0 %</td>
<td>3 %</td>
<td>11 %</td>
</tr>
<tr>
<td>$ 500 M +</td>
<td>1 %</td>
<td>6 %</td>
<td>18 %</td>
</tr>
</tbody>
</table>
Companies that do not strategically invest will lose competitive advantage.
Most companies expect Industry 4.0 investments to pay back within two years.
Performance indicators on investment project

**Dynamic methods**
- Net present value
- Profitability index
- Discounted payback period
- Internal rate of return

**Static methods**
- Payback period
- Accounting rate of return

![Project life cycle diagram](image-url)
Static methods

+ easy to calculate
+ easy to understand result

- time value of money is not considered
- risk is not considered
- the duration of the project life cycle is not considered
- ignores cash flows after payback period
Payback period

The payback period refers to the amount of time it takes to recover the cost of an investment. Shorter paybacks mean more attractive investments.

Accounting rate of return

\[
\text{ARR} = \frac{\text{Average annual profit after tax} \times 100\%}{\text{Average or Initial Investment}}
\]

Of the various accounting rates of return on different alternative projects, the one having highest rate of return is taken to be the best investment proposal.
Dynamic methods

+  
-  

- difficult to calculate
- subjective assessment
- difficult to understand the result

- time value of money is considered
- risk is considered
- the duration of the project life cycle is considered
Net present value

Net present value is the sum of discounted future cash inflow and outflow related to the project. Generally, the weighted average cost of capital (WACC) is the discounting factor for future cash-flows in net present value method.

\[ NPV = \sum_{t=0}^{n} \frac{R_t}{(1 + i)^t} \]

- \( R_t \) – net cash inflow-outflows during a single period \( t \)
- \( i \) – discount rate or return that could be earned in alternative investments
- \( t \) – number of time periods

The company should accept the project if the NPV is positive.
INTERNAL RATE OF RETURN METHOD

- An internal rate of return is the discounting rate, which brings discounted future cash flow at par with the initial investment. It is the discounting rate at which the company will neither make loss nor make a profit.

- IRR is the rate at which the NPV of the project will be zero.

\[
0 = NPV = \sum_{t=1}^{T} \frac{C_t}{(1 + IRR)^t} - C_0
\]

- \(C_t\) – net cash inflow during the period \(t\)
- \(C_0\) – total initial investment costs
- \(IRR\) – the internal rate of return
- \(T\) – the number of time periods

Because of the nature of the formula, however, IRR cannot be calculated analytically and must instead be calculated either through trial-and-error or using software programmed to calculate IRR.

The higher the IRR value, the more attractive the project.
PROFITABILITY INDEX

- The profitability index (PI) is the present value of the future cash inflows divided by the initial investments.

\[
\text{Profitability Index (PI)} = \frac{\text{Present Value of Cash Inflows}}{\text{Present Value of Cash Outlay}}
\]

- The only difference between the net present value method and profitability index method is that when using the NPV technique the initial investments is deducted from the present value of the expected cash inflows, while with the profitability index approach the initial investments is used as a divisor.

- The project is acceptable if its profitability index value is greater than 1.

DISCOUNTED PAYBACK PERIOD METHOD

- In this method, the payback period is calculated on the basis of discounted future cash flows, and in the payback method, it is calculated on the basis of future cash flows.
The balanced approach to assessing the efficiency of investments in Industry 4.0
Economic efficiency
- cost reduction
- sales increasing
- improving of product quality
- increasing of the profitability of production and others

Environmental efficiency
- reduction of emissions into the environment
- reduction of environmental pollution
- installation of treatment facilities and others

Social efficiency
- improving the living standards of the population
- increasing in the number of jobs
- providing some important goods and services of a specific region
- improving the working conditions of staff and others

Innovative efficiency
- relevance of the introduced technologies on the market
- the prospects of the proposed technical solutions
- increasing labor productivity and product quality
- increasing the level (quality) of labor resources
- the level of reduction of natural and labor resources and others
Interpipe's digital transformation of manufacturing

https://www.youtube.com/watch?v=KlHXEIJy3ug
Amid unprecedented change and the rapid pace of innovation, digitalization is no longer tomorrow’s idea. We take what the future promises tomorrow and make it real for our customers today. Welcome to... Where today meets tomorrow.
**Consumer Products & Retail**

**Electrical for Fitness Wearables**

Polar Electro and Siemens bring together electronics, mechanical and software development to run past the competition.

[Watch →](#)

**AUTOMOTIVE & TRANSPORTATION**

**Chip to City**

More than an electric car, Siemens and Uniti embrace global electromobility for a greener planet.

[Watch →](#)

**Aerospace & Defense**

**Industrial Additive**

The sky’s the limit! Sintavia, a global leader in aerospace parts manufacturing, joins forces with Siemens NX for the design and production of high-volume, high-value parts.

[Watch →](#)

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**Comprehensive Digital Twin**

We blur the boundaries between industry domains by integrating the virtual and physical, hardware and software, design and manufacturing worlds.

**Personal and adaptable**

We offer flexible and scalable applications for new ways of working. With insights and data, we can predict and adapt products to future needs, allowing you the ability to meet rapidly changing consumer preferences.

**Open, modern, flexible ecosystem**

Access to a diverse field of partners in an open ecosystem gives you the opportunity to build on your investment. We offer application development services along with native cloud and cloud-connected products.

[https://www.sw.siemens.com/](https://www.sw.siemens.com/)
Our portfolio for your future

Software solutions

Our i4.0 software solutions link all the components of your value stream with each other and the people involved. What we want to achieve: full-grade connectivity, complete transparency, and reduced complexity.

Logistics and manufacturing

We connect machines and whole manufacturing lines to value-creation networks. With our solutions you can achieve complete transparency and coordination of all logistics operations in and outside your factory.

Service and consulting

Bosch offers a wide range of services and consulting in the field of Industry 4.0, including collaborative projects to test new business models. We'll help you discover new potentials along your value stream.

Field level equipment

Components, modules, and systems for the optimal integration of the solutions of machine manufacturers into vertically and horizontally networked Industry 4.0 environments.

https://www.bosch.com/products-and-services/connected-products-and-services/industry-4-0/
Main activities and tasks of the Association include:

- Harmonization and promotion of international standards (IEC/ISO) in the field of industrial automation and IT.
- Consolidation and development of expert groups.
- Improving dialogue between different groups of stakeholders (incl. researchers and Universities).
- Providing industry insights, outline critical development problems and suggest appropriate solutions.
- Set up and provide new services for community members and partners, including promotion and export.
- Developing hi-tech communities and eco-systems in cluster-like approach.
- Moving innovations in line with developing countries.

https://appau.org.ua
Members

Vendors (manufacturers – suppliers of equipment and software in the industrial automation system):

- Siemens Ukraine
- Owen
- Microl
- Rittal
- Phoenix Contact
- Radmirtech
- Bosch Security
- Schneider Electric
- Novatek Electro
- Alay
- Fractal Tools Inc.
- Kontron
- Information Technologies
- Refit

High schools:

- National University of Food Technologies, Department of Acid
- National Technical University of Ukraine “Kyiv Polytechnic Institute, Igor Sikorsky, Department of AETP
- Donetsk National Technical University (DonNTU)
- Kyiv National University of Construction and Architecture, Department of ATP
- Kryvy Rih National University, Department of Computer Science and Technology Automation
- National University “Lviv Polytechnic”
- Zaporizhzhya National Technical University
- Kharkiv National University of Radio Electronics
- National Aerospace University “Kharkiv Aviation Institute”
- Sumy State University
- Vinnytsia National Technical University
- Ivano-Frankivsk National Technical University of Oil and Gas (IFNTUNG), Department of ITTS
- Odessa National Academy of Telecommunication Research Laboratory of Mechatronics and Robotics (ONAFT)

System Integrators, OEMs, IT Developers and Integrators, Engineering Companies:

- Techinservice
- Azov Controls
- Artezia
- CJSC Saturn Date International
- Elius-M
- Innovative Technical Solutions
- Scientific-Production Enterprise “Information Technologies” Ltd.
- NVP Zaliznicchavomatika
- Naftogazhimm Service
- CANT +
- SoftElegance
- BusinessLogic
- PassivDom Ukraine LLC
- Infocom Ltd.
- Systems Automation Service Ltd.
- Flexlink Systems
- Indusoft Ukraine
- 482.solutions

End users – Industrial Enterprises:

- Interpipe Ltd.
- Milkiland N.V. Ltd.
- METinvest holding

Others:

- Promelelect magazine
- B2B Ray
- Synergy, Center for Partnership and Innovation

Engineering:

- Kryukiv Carriage Works

https://appau.org.ua/
Risks of investment projects

The decision on an investment project can be characterized by the following features:
- the presence of uncertainty and (or) conflict
- the availability of alternatives and the need to choose one of them
- the opportunity to evaluate the available alternatives - to make a decision

**Industry 4.0 threats and risks:**

- Cybersecurity and the need to counter cyber attacks
- Process control problems
- Growth of unemployment (low-skilled personnel performing routine work) and imbalance in the labor market (lack of highly qualified personnel, creative specialists)
- Psychological conflicts and man-machine conflicts, etc.
I wish good luck in choosing ideas, evaluating the efficiency of projects and neutralizing risks!

I hope all your projects will be effective and will bring profit

Thank you for attention!