Co-funded by the European Commission

Trends & topics in industrial transformation - A web search of "grey" literature.

WP4 Forecasting the future of Industry 5.0 jobs

Chapter of Deliverable D4.1

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Associated Work Package: 4

Lead Beneficiary – AIT

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Date: 10.12.2024

Funded by the European Union under grant agreement No 101069651. The contents of this publication are however the sole responsibility of the BRIDGES 5.0 project consortium only and do not necessarily reflect those of the European Union or HADEA. Neither the European Union nor HADEA can be held responsible for them.

Document Summary

Document type:	Public report
Title:	Trends & topics in industrial transformation - A web search of "grey" literature.
Author/s:	Wolfram Rhomberg (AIT)
Date:	10-12-2024
Document status:	Final
Keywords:	Trends, Industrial Transformation, Industry Stakeholders
Version:	1.0
Document level:	Public

Document description:

This document presents a detailed analysis of industrial transformation trends conducted in spring/summer 2024, based on 95 web sources of “grey literature”, and resulting into 52 trends & topics across 8 trend categories. The findings emphasize projected trends and expectations rather than current realities in the manufacturing sector. The document was elaborated within WP4, task 4.1, being a *section* to the upcoming final deliverable 4.1.

Please cite as:

Rhomberg, W. (2024). Trends & topics in industrial transformation - A web search of "grey" literature. (December 2024). Vienna: Bridges 5.0.

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1. Introduction.

The Horizon Europe Bridges 5.0 (Bridges 5.0) project focuses on workforce skills in Industry 5.0. Conducted in spring/summer 2024, the objective of the underlying trend document is to provide a detailed analysis of industrial transformation trends relevant to Industry 5.0. It is based on 95 web sources of “grey literature”, resulting into 52 trends & topics across 8 key trend categories, such as “Culture, Organisation & Workforce”, “Automation & Robotics”, and “Green Manufacturing & Emission Reduction”. The analysis includes quantitative insights on source frequency, observation frequency, and stakeholder classifications. The findings emphasize projected trends and expectations rather than current realities in the manufacturing sector.

The document was elaborated within WP4, task 4.1, being a *section* to the upcoming final deliverable 4.1. Hence, this quantitative analysis of the “grey” literature is part of the overall analysis of industrial trends and developments in Work Package 4, Task 4.1. This analysis is published in advance to provide up-to-date and timely input into the ongoing discussions in the work package and to support the development of scenarios. The final deliverable in Task 4.1 will be published at the end of the work package.

2. Methodology.

2.1 Approach & Structure of the Trends Analysis “Grey” Literature.

The initial exploration of Industrial Trends & Topics during spring/summer 2024 involved a keyword search on the internet using "Industrial Transformation Trends," followed by three targeted searches with the terms "Industrial Automation Trends," "Sustainable Manufacturing Trends," and "Resilient Manufacturing Trends." These searches yielded 42, 36, 24, and 27 suggested sources, respectively, totalling 129 suggestions. Searches were concluded when informational saturation was reached, or when sources were deemed insufficiently relevant, characterised by overly broad, superficial content or a lack of focus on the manufacturing sector.

A comprehensive review then led to the **selection of 95 web sources** for inclusion in the content analysis. The inclusion criteria required that sources not duplicate, demonstrate content relevance, clearly define a notable trend, topic, or driver, be recent, and come from professional backgrounds significant to the ecosystem or global value creation network.

The types of sources reviewed were articles, blogs, studies, surveys, and interviews.

In total, 853 trends/topics occurrences (referred to as "observations") were identified across the 95 web sources. A systematic clustering process categorised 52 unique trends/topics into 8 main trend categories, including among others "Culture, Organisation & Workforce", "Automation & Robotics", "Green Manufacturing & Emission Reduction" and "AI, Computing & Analytics".

The *quantitative analysis* emphasises several key areas:

- Search strategies based on targeted keywords.
- Source frequency, measured by the percentage of sources (out of overall 95) mentioning each specific trend/topic.
- Observation frequency, indicating the percentage of occurrences of each trend or trend category among all observations.
- Classification by four primary stakeholder groups: "Think Tanks & Political Forums", "Business Consultants", "Technology Providers & Associated Services" and "Media & Social Platforms".

Finally, it should be mentioned that the trends and topics analysed are primarily expectations, potentials, and projections, particularly of various stakeholder groups that are not themselves the end users of manufacturing solutions, etc. They therefore do not reflect the current reality in manufacturing companies. In addition, these groups also follow a group-specific “swarm intelligence”, i.e. they focus on specific argumentation patterns and topics.

3. Results.

3.1 Trends identified.

Within all 95 sources analysed, a total of 52 trends were identified and classified into 8 trend categories. The following table provides an overview.

Table 1. Overview of trends identified and analysed, by trend category

Trend / Topic	Trend category
Inclusive decision making & social dialogue; Inclusiveness & organisational agility/change	Culture, Organisation & Workforce
New ways of work; human factor & skilling becomes key	Culture, Organisation & Workforce
Process automation / Digital & AI for Automation	Automation & Robotics
dark factories	Automation & Robotics
Advanced & Collaborative (!) Robotics	Automation & Robotics
Automated & connected vehicles (incl. AGVS & AMRS)	Automation & Robotics
Drones	Automation & Robotics
Adaptive & Flexible Automation (cells & modules vs. lines)	Automation & Robotics
Robots as a service (esp. for SMEs)	Automation & Robotics
3D Printing	3D Printing
Digital Twin	Extended Reality & Convergence
IT & OT convergence & Soft PLCs	Extended Reality & Convergence
Extended reality (XR, VR, AR) & wearables; enterprise visualisation interfaces (EVI); immersive technologies	Extended Reality & Convergence
Rise of the industrial metaverse	Extended Reality & Convergence
Automation, Digital & AI for Green Sustainability	Green Manufacturing & Emission Reduction
Advanced Materials	Green Manufacturing & Emission Reduction
Recyclable Materials & Bioplastics	Green Manufacturing & Emission Reduction
Circular Economy	Green Manufacturing & Emission Reduction
Renewable energy / energy shift / emission reduction	Green Manufacturing & Emission Reduction
Energy & Resource Efficiency	Green Manufacturing & Emission Reduction
Waste reduction	Green Manufacturing & Emission Reduction
Sustainable logistics/supply chains	Green Manufacturing & Emission Reduction
ESG assessment tools	Green Manufacturing & Emission Reduction
LCA	Green Manufacturing & Emission Reduction
Sustainability reporting	Green Manufacturing & Emission Reduction
Sustainability and Profitability Working Together	Green Manufacturing & Emission Reduction
Sustainability as a Core Product/Facility Design Factor	Green Manufacturing & Emission Reduction
Lean Manufacturing (for sustainability)	Green Manufacturing & Emission Reduction
Safety & Security (in IT & OT)	Security & Regulation
Regulatory Requirements	Security & Regulation
Simplification & standardisation	Security & Regulation
Edge computing	AI, Computing & Analytics
Predictive maintenance & analytics	AI, Computing & Analytics
Common (data) platforms/CLOUD (computing) based solutions (e.g. Manufacturing X)	AI, Computing & Analytics
(I)IoT & 5G & big data analytics / digital performance management	AI, Computing & Analytics
(Generative) AI & machine learning	AI, Computing & Analytics
Responsible AI (no misuse)	AI, Computing & Analytics
No/low code platforms / solutions	AI, Computing & Analytics
Deep learning powered (machine/computer) vision	AI, Computing & Analytics
Synchronisation of software and chip designs	AI, Computing & Analytics
Digi Tech & AI for resilience	Supply chain & Customers
Ecosystems: Connected & digitally driven end-to-end supply chains (e.g. DPP)	Supply chain & Customers
Ecosystems: Glocalisation & redesigned supply chains/sourcing (incl. sustainability, fair trade)	Supply chain & Customers
Modular Micro factories & Design	Supply chain & Customers
Services & new business models (e.g. XaaS, PSS); closer to customers; hyper personalisation	Supply chain & Customers
Ecosystems: Digital demand management & distribution	Supply chain & Customers
Ecosystems: Increased cooperation and (regional) clusters	Supply chain & Customers
Consideration of location & weather	Supply chain & Customers
Blockchain (for supply chain management.)	Supply chain & Customers
automated warehouses & supply chains	Supply chain & Customers
Real time location systems (RTLS) of assets and personnel etc.	Supply chain & Customers
Tight cost controls & better financial risk management	Supply chain & Customers

3.2 Overview Source Frequency: How often does a specific trend occur?

At least 25% or 24 or more of all 95 "All Sources" analysed address/discuss these trends:

- Inclusive decision making & social dialogue; Inclusiveness & organisational agility/change (31% and 29 sources respectively)
- New ways of work; human factor & skilling becomes key (59% and 56 respectively)
- Process automation / Digital & AI for Automation (29% and 28% respectively)
- Advanced & Collaborative Robotics (38% or 36)
- Digital Twins (25% or 24)
- XR, wearables & immersive technologies (29% and 28% respectively)
- Automation, Digital & AI for Green Sustainability (36% or 34)
- Renewable energy / energy shift / emission reduction (27% or 26)
- Energy & Resource Efficiency (29% and 28% respectively)
- Safety & Security in IT & OT (32% and 30 respectively)
- Common (data) platforms / cloud computing based solutions (26% and 25 respectively)
- (I)IoT & 5G & big data analytics / digital performance management (66% and 63% respectively)
- (Generative) AI & machine learning (60% and 57 respectively)
- Digi Tech & AI for resilience (28% and 27% respectively)
- Ecosystems - Connected & digitally driven end-to-end supply chains (32% or 30)
- Ecosystems: Glocalisation & redesigned supply chains/sourcing (incl. sustainability, fair trade) (29% and 28% respectively)

16 of the 52 trends and topics identified were discussed in 25% or more of the sources. This corresponds to just under a third of the trends. The remaining majority of the identified trends appear in less than a quarter of the sources analysed.

The top 3 trends are "New ways of work; Human factor & skilling becomes key" (59% and 56 respectively), "(I)IoT & 5G & Big data Analytics / digital performance management" (66% and 63 respectively) and "(Generative) AI & Machine learning" (60% and 57 respectively), followed by "Advanced & Collaborative Robotics" (38% and 36 respectively) and "Automation, Digital & AI for Green Sustainability" (36% and 34 respectively).

Comparative analysis.

The following comparative analysis *by sources* refers to selected trends or topics that were thematised comparatively more or less frequently in one or more search strategies.

Trend category "Culture, Organisation & Workforce":

- *Inclusive decision making & social dialogue; inclusiveness & organisational agility/change:* On average, 31% of all 95 sources examined address this trend. This trend is most prominent in connection with "Industrial Transformation Trends" (48% of the sources analysed). It receives the least attention in connection with "Industrial Automation Trends" (7% of the sources analysed)
- *New ways of work; human factor & skilling becomes key:* apart from "Sustainable Manufacturing Trends" (29% of sources), there is broad agreement on the search strategies. On average, 59% of all sources analysed address this trend, i.e. 6 out of 10 sources. This makes this topic one of the top 3 trends analysed. This trend is most prominent in connection with "Industrial Automation & Transformation Trends" (67% and 65% of the sources analysed).

Trend category "Automation & Robotics":

- *Process automation / Digital & AI for Automation:* On average, 29% of all 95 sources analysed address this trend. This general trend is mentioned most prominently in connection with "Industrial Transformation Trends" (61% of the sources analysed).
- *Advanced & Collaborative Robotics*: This trend, which describes a specific application of automation through digitalisation and AI, namely new forms of intelligent robotics, is most prominent in connection with "Industrial Automation & Transformation Trends" (70% and 35% of the sources examined). On average, 38% of all sources analysed address this trend, i.e. 4 out of 10 sources.
- *Adaptive & flexible automation:* This general topic comes up comparatively often in connection with the search strategy "Industrial transformation trends" (26% of the sources analysed). On average across all search strategies, just under 2 in 10 sources address this trend.

Trend category "3D Printing":

- *3D printing*: This topic also appears comparatively more frequently in connection with the search strategy "Industrial Transformation Trends" (26% of the sources analysed). On average across all search strategies, 16% of sources refer to this already established trend.

Trend category "Extended Reality & Convergence":

- *Digital Twin:* On average, a quarter of all sources analysed mention this trend. In connection with "Resilience", 25% of the sources also refer to this topic. It is particularly prominent in connection with "Industrial Automation Trends" (41%). It receives almost no attention in connection with "Sustainable Manufacturing Trends".
- *Extended reality (XR, VR, AR) & wearables; enterprise visualisation interfaces (EVI); immersive technologies:* The situation is similar with this trend. Here too, it is particularly prominent in connection with "Industrial Automation Trends", with 5 out of 10 sources (52%). On average, 3 out of 10 sources refer to this topic. XR applications, immersive technologies and wearables receive almost no attention in connection with "Sustainable Manufacturing Trends" (6%).

Trend category "Green Manufacturing & Emission Reduction":

- *Automation, digital & AI for green sustainability*: On average, almost 4 in 10 of all sources examined (36%) address this trend, in which digitalisation, automation and AI are also expected to play a central role in connection with the greening of production. This general trend is mentioned most prominently in connection with "industrial transformation trends" (45% of the sources analysed) and "sustainable manufacturing trends" (59%). It does not appear to play a particular role for "resilience". From the perspective of "automation", three out of ten sources analysed mention it.
- Other trends and topics in this category are particularly important in connection with the "Sustainable Manufacturing Trends" search strategy: these include *"Recyclable Materials & Bioplastics", "Circular Economy" (both 53%), "Renewable Energy / Energy shift / Emission reduction" (71%), "Energy & Resource Efficiency" (59%), "Waste reduction" (47%), Sustainability as a Core Product/Facility Design Factor (41%) and "Sustainable logistics / supply chains" (35%).* The latter is also addressed to an above-average extent from the perspective of "Resilient Manufacturing Trends" (35% vs. 19% on average across all 95 sources analysed)

Trend category "Security & Regulation":

- *Safety & security in IT & OT:* On average, around 3 in 10 of all sources analysed (32%) address this trend. This trend is mentioned with above-average frequency in connection with "Industrial Automation and Transformation Trends" (37% and 35% of the corresponding

sources respectively). A quarter of the sources in the search strategies "Sustainable or resilient manufacturing trends" also mention safety & security as a relevant topic.

Trend category " AI, Computing & Analytics ":

- *Edge computing*: On average, only 14% of all 95 sources analysed address this trend. This trend is mentioned almost exclusively in connection with "industrial automation trends" (44% of the sources analysed).
- *(I)IoT & 5G & big data analytics / digital performance management*: There is broad agreement among the search strategies that this is a central "big" trend, except for "sustainable manufacturing trends" (29% of sources). On average, 66% of all sources analysed address this trend, i.e. around 7 out of 10 sources. This makes this topic one of the top 3 trends analysed. This trend is most prominent in connection with "Industrial Automation & Resilient Manufacturing Trends" (85% or 80% of the sources analysed).
- *(Generative) AI & machine learning*: Here too, except for "Sustainable Manufacturing Trends" (24% of sources), there is a majority consensus on search strategies. On average, 60% of all sources analysed address this "big" trend, i.e. 6 out of 10 sources. This topic is therefore also one of the top 3 trends analysed. This trend is most prominent in connection with "Industrial Automation & Resilient Manufacturing Trends" (81% or 70% of the sources analysed).

Trend category " Supply chain & Customers ":

- *Ecosystems - Increased cooperation and (regional) clusters*: On average, only just under 2 in 10 of all sources analysed (17%) address this trend. This specific trend is mentioned most prominently in connection with "Resilient Manufacturing Trends" (45% of the sources analysed). It does not appear to play a particular role for "Sustainability" and "Automation" in particular.
- Other trends and topics in this category are particularly important in connection with the "Resilient Manufacturing Trends" search strategy: these include in particular *"Digi Tech & AI for resilience" (90%), "Ecosystems - Connected & digitally driven end-to-end supply chains" (90%), "Ecosystems - Glocalisation & redesigned supply chains/sourcing (incl. sustainability/fair trade)" (60%).* The latter is also addressed above average from the perspective of "Sustainable Manufacturing Trends" (35% vs. 29% on average of all 95 sources analysed). From the perspective of the "Industrial Automation Trends" search strategy in particular, the above-mentioned trends do not play a special role.
- *Services & new business models (e.g. XaaS, PSS); closer to customer’s needs & hyper personalisation:* On average, under a quarter of all sources surveyed (23%) mentioned this trend. It was mentioned with above-average frequency in connection with the search strategy "Industrial Transformation Trends" (39% of sources). It was mentioned almost never in connection with "Industrial Automation Trends".

3.3 Overview Observation Frequency: What is the share of a specific trend category or a single trend?

In the total of all 95 sources analysed, a trend/topic was identified a total of 853 times (observations).

In connection with the trend category "Green Manufacturing & Emission Reduction", a related trend was discussed most frequently with a share of 23.4% or 200 observations; closely followed by the trend category "AI, Computing & Analytics" with 188 mentions (22% share) and "Supply chain & Customers" with 157 (18%).

The trend category "Culture, Organisation & Workforce" has a total of 85 mentions with a share of 10% and is therefore almost on a par with "Automation & Robotics" (11% or 97 mentions). See also the following pie chart.

The top 5 most popular individual trends/topics in the "All sources" search are:

1. (I)IoT & 5G & big data analytics / digital performance management (7.4%)
2. (Generative) AI & machine learning (6.7%)
3. New ways of work; human factor & skilling becomes key (6.6%)
4. Advanced & Collaborative Robotics (4.2%)
5. Automation, Digital & AI for Green Sustainability (4%)

Comparative analysis.

The comparative analysis *by observations*, according to trend categories and search strategies shows the following:

Trend category "Culture, Organisation & Workforce": In total, 10% of the trends/topics mentioned relate to this category (85 mentions). The spread between the search strategies is low at 7% to 12%.

Trend category "Automation & Robotics": A total of 11% of the trends/topics mentioned relate to this category (97 mentions). The spread between the search strategies is 7% (Resilient Manufacturing) to 16% (Industrial Automation).

Trend category "3D printing": In total, only 2% of the trends/topics mentioned relate to this category (15 mentions). The spread between the search strategies is 0% to 3%.

Trend category "Extended Reality & Convergence": A total of 8% of the trends/topics mentioned relate to this category (68 mentions). The spread between the search strategies is 2% (Sustainable Manufacturing) to 13% (Industrial Automation).

Trend category "Green Manufacturing & Emission Reduction": A total of 23% of the trends/topics mentioned relate to this category (200 mentions). This category therefore has the most mentions. The spread between the search strategies is 13% (Industrial Automation) to 56% (Sustainable Manufacturing). The other two search strategies, Industrial Transformation and Resilient Manufacturing, have a share of 18% and 19% respectively.

Trend category "Security & Regulation": A total of 5% of the trends/topics mentioned relate to this category (43 mentions). The spread between the search strategies is minimal at 4% to 6%.

Trend category "AI, computing & analytics": In total, 22% of the trends/topics mentioned relate to this category (188 mentions). This category therefore has the second most mentions. The spread between the search strategies is 10% (Sustainable Manufacturing) to 36% (Industrial Automation). The other two search strategies, Industrial Transformation and Resilient Manufacturing, have a share of 20% and 19% respectively.

Trend category "Supply chain and Customers": In total, 18% of the trends/topics mentioned relate to this category (157 mentions). This category therefore has the third most mentions. The spread between the search strategies is 6% (Industrial Automation) to 35% (Resilient Manufacturing).

Table 2. Overview of observations by trend categories and search strategies, in percentage

Trend Category/Search strategies	Overall	Transformation	Automation	Sustainability	Resilience
Culture, Organisation & Workforce	10%	12%	9%	7%	9%
Automation & Robotics	11%	14%	16%	6%	7%
3D Printing	2%	3%	2%	2%	0%
Extended Reality & Convergence	8%	9%	13%	2%	6%

Trend Category/Search strategies	Overall	Transformation	Automation	Sustainability	Resilience
Green Manufacturing & Emission Reduction	23%	18%	13%	56%	19%
Security & Regulation	5%	4%	5%	6%	5%
AI, Computing & Analytics	22%	20%	36%	10%	19%
Supply chain & Customers	18%	19%	6%	12%	35%

The trend "(I)IoT & 5G & Big data Analytics / digital performance management" is in the top 5 four times, making it a "top trend" in industrial transformation, followed by "(Generative) AI & Machine learning" and "New ways of work; Human factor & skilling becomes key", also with four top 5 rankings. "Automation, Digital & AI for Green Sustainability" and "Advanced & Collaborative Robotics" have two top 5 rankings.

The remaining top 5 trends each only achieve a single top ranking and can therefore be seen as more specific to the corresponding search strategy, particularly in connection with "Sustainable Manufacturing".

The trend "Inclusive decision making & social dialogue; inclusiveness & organisational agility / change", which describes the corporate level and changes in management culture, also made it into the top 5 in the thematically broadest search strategy "Industrial Transformation Trends". Together with the trend "New ways of work; human factor & skilling becomes key", both trends in the category "Culture, Organisation & Workforce" are therefore in the top rankings of this search strategy.

The following table provides an overview of the top trends by search strategy.

Table 3. Overview of top trends, by search strategies

Ranking Top 5 Trends / Trend Category	Overall	Transformation	Automation	Sustainability	Resilience
1st	(I)IoT & 5G & big data analytics / digital performance management	New ways of work; human factor & skilling becomes key	(I)IoT & 5G & big data analytics / digital performance management	Renewable Energy / Energy shift / Emission reduction	Digi Tech & AI for resilience
2nd	(Generative) AI & machine learning	(I)IoT & 5G & big data analytics / digital performance management	(Generative) AI & machine learning	Energy & Resource Efficiency	(I)IoT & 5G & big data analytics / digital performance management
3rd	New ways of work; human factor & skilling becomes key (6.6%)	Process automation / Digital & AI for Automation	Advanced & Collaborative Robotics	Automation, Digital & AI for Green Sustainability	(Generative) AI & machine learning

Ranking Top 5 Trends / Trend Category	Overall	Transformation	Automation	Sustainability	Resilience
4th	Advanced & Collaborative Robotics	(Generative) AI & machine learning	New ways of work; human factor & skilling becomes key	Circular Economy	Ecosystems: Connected & digitally driven end-to-end supply chains
5th	Automation, Digital & AI for Green Sustainability	Inclusive decision making & social dialogue; Inclusiveness & organisational agility / change	XR, wearables & immersive technologies	Recyclable Materials & Bioplastics	New ways of work; human factor & skilling becomes key

3.4 Classification by Stakeholders: What trend category or single trend is emphasised by which group?

By sources.

The following comparative analysis refers to selected trends or topics (20+% of total sources) that were comparatively significantly more prominent/broadly addressed by one or another stakeholder group.

Think Tanks and Political Forums:

- Inclusive decision making & social dialogue; Inclusiveness & organisational agility/change (77% of sources)
- New ways of work; human factor & skilling becomes key (77%)
- Circular Economy (38%)
- Renewable energy / energy shift / emission reduction (38%)
- Digi Tech & AI for resilience (54%)
- Ecosystems: Connected & digitally driven end-to-end supply chains (54%)
- Ecosystems: Glocalisation & redesigned supply chains/sourcing (62%)

Business Consultants:

- New ways of work; human factor & skilling becomes key (74%)
- Digital Twin (37%)
- XR, wearables & immersive technologies (37%)
- Energy & Resource Efficiency (32%)
- Safety & Security in IT & OT (42%)
- Predictive maintenance & analytics (37%)

Technology Providers & associates Services:

- Automation, Digital & AI for Green Sustainability (47%)
- Energy & Resource Efficiency (32%)
- Waste reduction (30%)
- Common (data) platforms/cloud-based solutions (30%)

Media & Social Platforms:

- Process automation / Digital & AI for Automation (44%)

- Advanced & Collaborative Robotics (50%)
- XR, wearables & immersive technologies (44%)
- Common (data) platforms/cloud-based solutions (44%)

By observations.

The comparative analysis by *trend category* and *stakeholder group* shows the following:

Trend category "Culture, Organisation & Workforce": In total, 10% of the trends/topics mentioned relate to this category (85 mentions). The spread between the stakeholders is 8% (Media & Social Platforms) to 16% (Think Tanks & Political Forums). Think Tanks & Political Forums have by far the largest share of mentions/observations in this category.

Trend category "Automation & Robotics": A total of 11% of the trends/topics mentioned relate to this category (97 mentions). The spread between the stakeholders is 7% (Think Tanks & Political Forums) to 17% (Media & Social Platforms). Media & Social Platforms have by far the largest share of mentions/observations in this category.

Trend category "3D printing": In total, only 2% of the trends/topics mentioned relate to this category (15 mentions). The low dispersion between the stakeholders is 1% to 3%.

Trend category "Extended Reality & Convergence": A total of 8% of the trends/topics mentioned relate to this category (68 mentions). The spread between the stakeholders is 5% (Think Tanks & Political Forums) to 11% (Media & Social Platforms).

Trend category "Green Manufacturing & Emission Reduction": A total of 23% of the trends/topics mentioned relate to this category (200 mentions). The spread between the stakeholders is 18% (Business Consultants) to 27% (Technology Providers & ass. Services).

Trend category "Security & Regulation": In total, 5% of the trends/topics mentioned relate to this category (43 mentions). The spread between the stakeholders is low at 3% to 6%.

Trend category "AI, computing & analytics": Overall, 22% of the trends/topics mentioned relate to this category (188 mentions). The spread between the stakeholders is 13% (Think Tanks & Political Forums) to 26% (Media & Social Platforms). While the shares of the other four stakeholder groups are largely the same, Think Tanks & Political Forums have by far the lowest share of mentions/observations.

Trend category "Supply chain and Customers": A total of 18% of the trends/topics mentioned relate to this category (157 mentions). The spread between the search strategies is 10% (Media & Social Platforms) to 30% (Think Tanks & Political Forums).

As the following chart shows, this group has by far the largest share in this category. At 30%, this share is also the largest in the comparison of the 8 trend categories analysed.

Looking at the *top 7 trends* in terms of mentions and differences/similarities between the stakeholder groups, the following results emerge:

- *New ways of work; human factor & skilling becomes key:* 7% of mentions overall. Broad agreement among stakeholders with a spread of 6% to 8%.
- *(I)IoT & 5G & big data analytics / digital performance management:* 7% of mentions overall. Broad agreement among stakeholders with a spread of 6% to 8%.
- *(Generative) AI & machine learning:* 7% of mentions overall. Broad agreement among stakeholders with a spread of 5% to 7%.
- *Advanced & Collaborative Robotics*: 4% of mentions overall. Dispersion among stakeholders from 2% (think tanks & political forums) to 6% (media & social platforms)
- *Automation, Digital & AI for Green Sustainability:* 4% of mentions overall. Dispersion among stakeholders from 2% (think tanks & political forums) to 6% (technology providers)

- *Safety & security in IT & OT:* 4% of mentions overall. Broad agreement among stakeholders with a spread of 2% to 4%.
- *Ecosystems: Connected & digitally driven end-to-end supply chains:* 4% of mentions overall. Broad agreement among stakeholders with a spread of 3% to 5%.

It is also noticeable that the stakeholder group "Think Tanks & Political Forums" gives more weight or attention to certain trends than the other three groups. These include *Inclusive decision making & social dialogue / Inclusiveness & organisational agility/change*; as well as *Ecosystems: Glocalisation & redesigned supply chains/sourcing and Ecosystems: Increased cooperation and (regional) clusters*. In other words, all trends that involve a different/new form of cooperation.

3.5 Summary & Conclusions.

By source frequency & search strategies.

The comparative quantitative analysis of industrial trends *by source frequency & search strategies* reveals several prominent and less prominent trends/topics across various trend categories.

Prominent trends include “New ways of work; human factor & skilling becomes key” which appears frequently across the different searches, especially in “Industrial Automation & Transformation Trends”, making it one of the top three most-discussed trends. Other key trends are “I(I)oT & 5G & big data analytics” and “(Generative) AI & machine learning” which are also among the top three. Both are highly relevant in “Industrial Automation trends” and “Resilient Manufacturing trends” contexts, underscoring the importance of advanced data analytics and AI-driven processes in future manufacturing.

The trend "Inclusive decision-making & social dialogue; inclusiveness & organizational agility/change," which focuses on corporate dynamics and shifts in management culture, ranks among the top five in the broadly scoped "Industrial Transformation Trends" search. Alongside the "New ways of work; human factor & skilling becomes key" trend, both topics within the "Culture, Organization & Workforce" category are top-ranked in this search strategy.

In the “Automation & Robotics” trend category, “Advanced & Collaborative Robotics” topic sees most interest, mainly tied to “Industrial Automation Trends”. Similarly, "Process automation/Digital & AI for Automation" is well-noted, especially in “Industrial Transformation Trends” contexts. "Adaptive & flexible automation" has comparably lesser prominence, discussed less frequently across sources.

“Green Manufacturing & Emission Reduction” trend category sees strong emphasis on sustainability trends such as “Automation, digital & AI for green sustainability”. “Renewable Energy”, “Energy Efficiency” and “Waste Reduction” are particularly tied to “Sustainable Manufacturing Trends” search strategy. Similarly, topics like “Recyclable Materials”, “Circular Economy” and “Sustainable logistics” receive attention, suggesting a substantial focus on eco-friendly practices in manufacturing.

“Safety & Security in IT & OT” has presence especially in automation and transformation trend search strategies, indicating the importance of secure industrial operations amid increasing digitalization.

Less prominent trends include “Edge computing”, mainly highlighted in “Industrial Automation trends”, and “Ecosystems - Increased cooperation and regional clusters”, primarily relevant to “Resilient Manufacturing Trends”. The analysis also shows limited overall emphasis on “3D Printing”, “Extended Reality (XR) & Wearables” and “Ecosystems - Connected end-to-end supply chains” with each having interest mainly in specific search strategies.

In conclusion, trends around workforce re- & upskilling, AI & data analytics, and sustainability are highly prominent, while niche topics like 3D printing and regional supply clusters are discussed less frequently, primarily in specialized contexts like resilience. This distribution highlights a strong industry focus on digital transformation, workforce development, and sustainable manufacturing practices, with attention to emerging automation and digitalization technologies.

Top Trend Categories by observations/mentions & stakeholders.

“Green Manufacturing & Emission Reduction” and “AI, Computing & Analytics “are the leading trend categories in overall observations/mentions, with notable focus from “Technology Providers & ass. Services” and “Media & Social Platforms” on AI applications and digitalization.

“Supply Chain & Customers” also stands out, with “Think Tanks & Political Forums” placing a strong emphasis on resilient supply chain strategies.

“Culture, Organization & Workforce” receives higher attention primarily from “Think Tanks & Political Forums”, especially in context of “Inclusive decision making & social dialogue; Inclusiveness & organizational agility/change”, with comparably a lower focus among technology-focused stakeholders.

Trends such as “New ways of work”, “IoT & 5G analytics”, and “(Generative) AI & machine learning” show high agreement among all stakeholders, indicating broad recognition of these trends as central to future industrial strategies.

Stakeholder-Specific Focus:

“Think Tanks & Political Forums” emphasize cooperative models, inclusiveness, and resilient ecosystems, reflecting a strategic focus on governance and social frameworks.

“Business Consultants” show an interest in human-centric work trends and digital technologies, aligning with client demands for strategic and digital solutions.

“Technology Providers” concentrate on digital tech-driven sustainability, favoring practical applications of AI and automation.

“Media & Social Platforms” emphasize visible, innovation-driven trends such as collaborative robotics and immersive technologies, showing interest in cutting-edge industrial developments.

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BRIDGES 5.0 PROJECT IDENTITY

Project name	BRIDGES 5.0 **B**ridging **R**isks to an **I**nclusive **D**igital and **G**reen future by **E**nhancing workforce **S**kills for industry 5.0
Coordinator	**Prof. Dr Steven Dhondt (scientific coordinator).Nederlandse Organisatie Voor Toegepast Natuurwetenschappelijk Onderzoek (TNO), (Netherlands)**
Consortium	Katholieke Universiteit Leuven Austrian Institute of Technology Panepistimio Patron (Patras University) Conservatoire National des Arts et Métiers, Centre d’Études de l’Emploi et du Travail-Lirsa Departamento de Educacion del Gobierno Vasco The University of Warwick Technische Universität Dortmund Stichting Platform Beta en Techniek Mondragon Goi Eskola Politeknikoa, Jose Maria Arizmendiarrieta S Coop Lietuvos Pramonininku Konfederacija Universita degli Studi di Bari Aldo Moro Universitetet I Agder Workplace Innovation Europe CLG Comau SPA Infineon Technologies Austria AG UAB Kitron Industrie 4.0 Plattform Osterreich Kriziu tyrimo centras (Hybridlab) FH Joanneum Gesellshaft MBH Kauno Technologijos Universitetas
Funding	Horizon Europe Programme, Grant Agreement Nr. 101069651
Duration	2023-2027

Funded by the European Union under grant agreement No 101069651. The contents of this publication are however the sole responsibility of the Bridges 5.0 project consortium only and do not necessarily reflect those of the European Union or HADEA. Neither the European Union nor HADEA can be held responsible for them.