

McKinsey
& Company

The economic potential of Generative AI in Norway

The next productivity frontier

June 2023



About this document

- In the newest report from McKinsey Global Institute (MGI), MGI discuss how **GenAI can transform the way we work**
- To assess the **effect of GenAI adoption in Norway** and the Norwegian workforce and businesses, McKinsey Norway **used numbers calculated by MGI, and method applied there, with Norwegian revenue¹, employment and education data from SSB** (Statistics Norway)
- Additional data was from Statista, European Commission, Eurostat, OECD, and GEDI

1. 2020, the most recently available at the time of writing



Executive summary

Generative AI (GenAI) is experiencing significant momentum globally and is expected to gain traction in Norway with **value creation potential of 95-159 bn NOK by 2045 across Norwegian industries**

- We expect Norway to be a **leading global adopter of GenAI due to the economic environment, education level of the population, and high degrees of digital adoption**
- The impact of Generative AI will fall heavily on occupations requiring higher levels of education. Norway is the 10th highest educated country in the world, and much of the workforce is classified as knowledge-workers, typically with high wages. This increases the feasibility of **early adoption** of GenAI in daily activities

The highest potential value in Norway is expected to be unlocked in selected sectors, including Energy, High Tech, Travel, Transport & Logistics, and Retail, but true value unlock comes from three major business functions as opposed to sectors

- **Marketing and Sales** (28-43 bn NOK), **Software Engineering** (21-43 bn NOK), and **Customer Operations** (12-17 bn NOK) **will drive the highest amount of value unlock** in Norway due to the high degree of **“generation” activities** i.e., generating content such as marketing material, code and emails
- While the highest potential value is expected to be unlocked in the **Energy industry (~21 bn NOK)**, **High Tech (~18 bn NOK)** is expected to experience a more disruptive shift (7%) following the adoption of GenAI

Productivity growth has slowed in the last decade but will likely be advanced by GenAI. We expect work activities within decision making and collaboration, and data management, to be most affected by GenAI. Such activities are most commonly performed by highly educated workers, and educators / workforce trainers, employees within business and legal professions, and STEM professionals, are likely to see the largest productivity gains upon GenAI adoption

What is Generative AI?

✔ Suitable ✘ Unsuitable

Non-exhaustive

Generative AI (GenAI) enables the **creation of new unstructured content**, such as text, images, etc.

Recent GenAI efforts are powered by Foundational Models trained on a **broad set of data** that enables them to respond to a wide range of prompts.

These models are typically also **better at interpreting / labelling unstructured data than traditional AI**



Generate marketing or social media copy in "house style" using ChatGPT, Copy.A, etc.



Automate code generation in programming languages like Python with Codex / Github Copilot, etc.

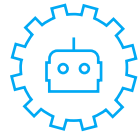
Although **some areas are unsuited** for GenAI, several **applications emerge²**:

- ✔ **Code/image/audio/video/text generation and editing**, while taking surrounding context into account
- ✔ **Conversational interfaces** to convert natural language dialog into specific executions of a technical system
- ✔ **Querying** a large set of unstructured data, and **synthesizing** a human readable output
- ✘ **High-stakes scenarios** with potential for harm
- ✘ **Unconstrained, long, open-ended generation** that may **expose harmful or biased content** to users
- ✘ Applications requiring **explainability and/or full understanding of potential failure modes**, including numerical reasoning¹

1. Current topic of research: how to use GPT-like models to generate code that involves solving numerical problems

2. Additional resources can be found in the McKinsey Report "Economic potential of generative AI", and the article "What every CEO should know about generative AI"

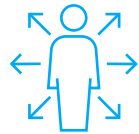
GenAI will mainly impact three areas, leading to reinvention of major processes in Norway and rest of world



Automation

Giving software predictable tasks that can be more easily automated today with FM powered GenAI

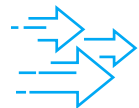
A multinational tech company offers a GenAI app which can **read customer emails and generate well-documented tickets** based on these



Augmentation

Enhance human productivity to do work more efficiently

A GenAI-chatbot is already in use in several large Norwegian banks, and institutions, to **improve productivity and reduce use of human agents** in more simple cases



Acceleration

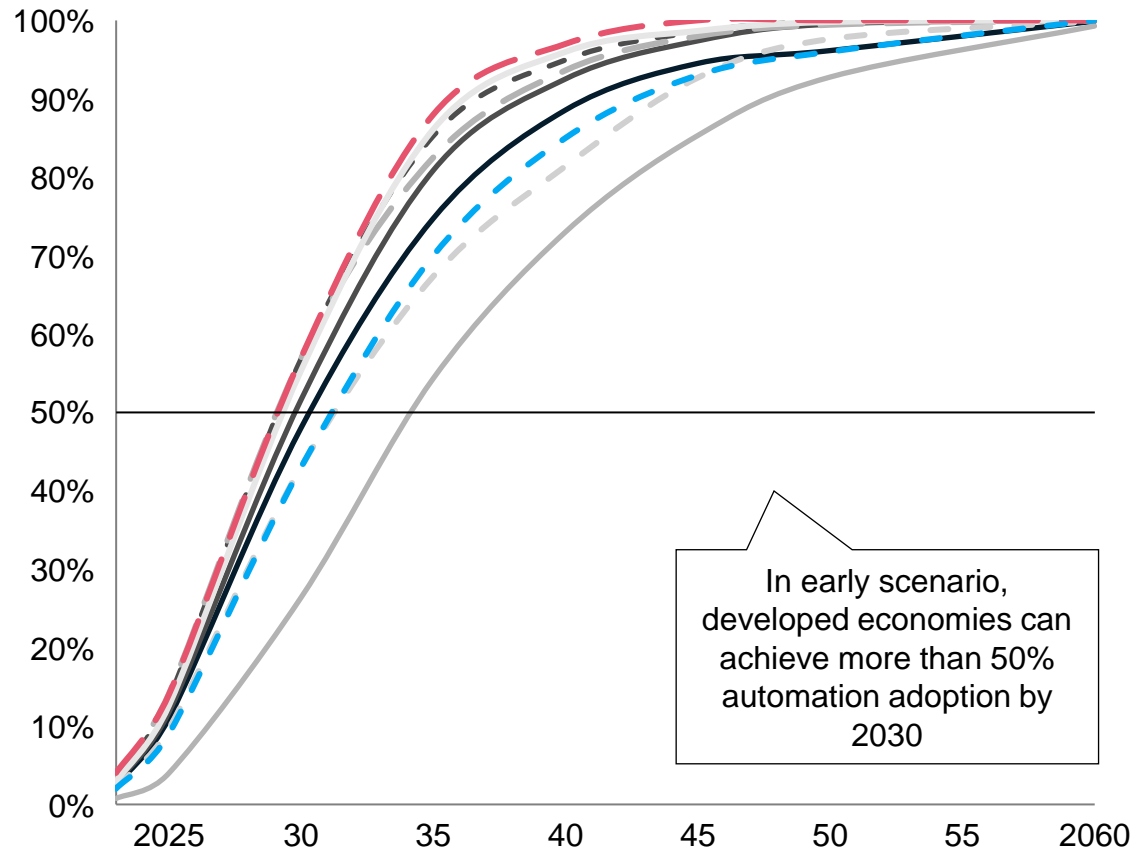
Extract and index knowledge to shorten innovation cycles enabling continuous innovation

A large Norwegian house building company has invested heavily in GenAI for product development, using it to **generate thousands of building configurations** prior to any building activity, allowing for more thorough checks, e.g., ensuring that building dimensions follow regulation

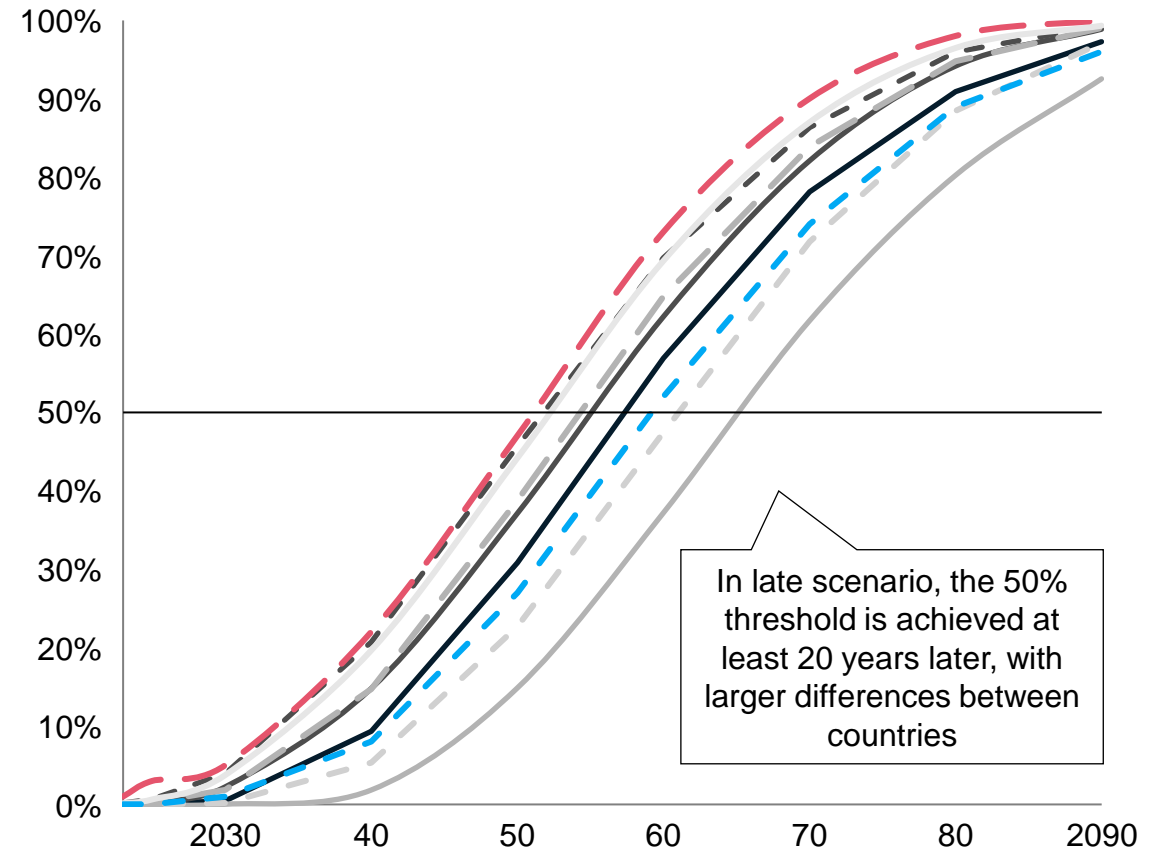
Norway is expected to be an early adopter of automation with other economies such as the US and Germany

— China — Germany — France — India — Japan — Mexico — US — Nordics² — Global avg

Automation adoption, generative AI early scenario¹, % automation



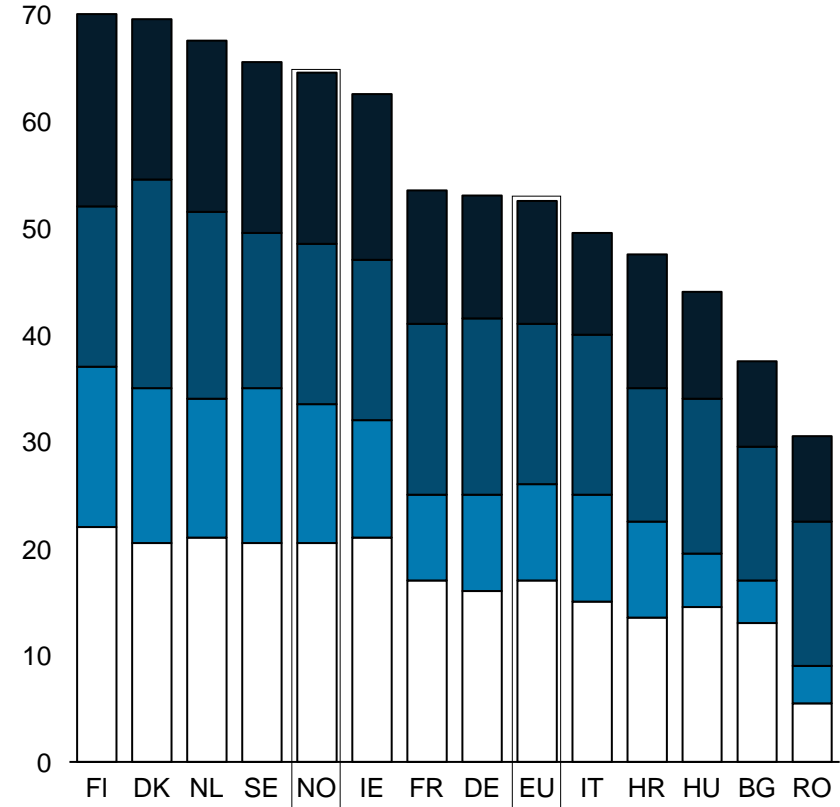
Automation adoption, generative AI late scenario¹, % automation



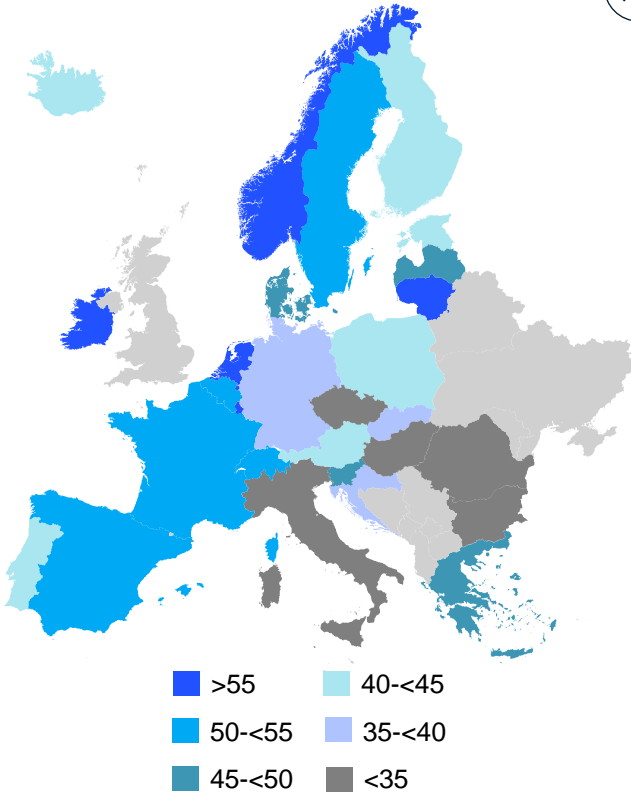
1. Early scenario - aggressive scenario all key model parameters (tech automation, integration timeline, economic feasibility, regulatory and public adoption); late scenario - parameters are set for the later adoption potential
 2. McKinsey Norway estimate

The Norwegian digital foundation and education level are key advantages that can drive nationwide GenAI adoption

Digital economy and society index¹, 2022



Share of population with tertiary education², 2022 %, aged 25-34



- Human capital
- Integration of digital technology
- Connectivity
- Digital public services

Comments

- Norway has one of the highest education levels in the world, leading to an affluent, skilled workforce that is adaptable and open to learning, making new technology adoption economically feasible
- Norway has a large population of knowledge workers, whom typically have a high proportion of activities that can see a productivity boost from using GenAI to augment knowledge-based activities
- Norway ranks 5th in the 2022 DESI Index – emphasizing the Norwegian society’s strong digital foundation and GenAI transformation potential
- Norway has a robust digital infrastructure with high internet penetration rates and widespread access to fast broadband. This kind of environment is conducive to the growth and adoption of AI technologies.

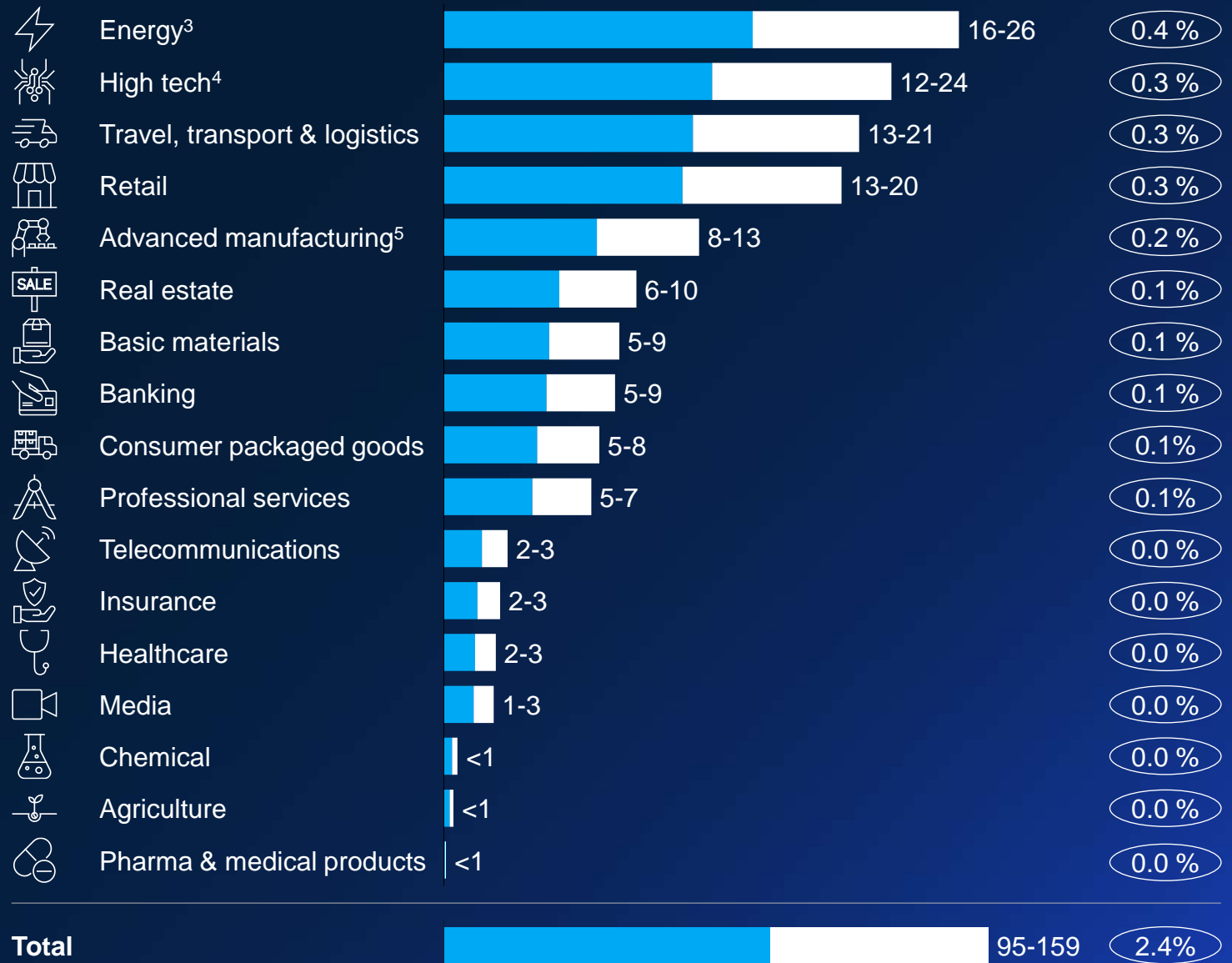
1. The Digital Economy and Society Index (DESI), non-exhaustive country list
 2. Eurostat “Educational attainment statistics”

The potential value unlock from GenAI is 95-159 bn NOK across Norwegian industries¹ ...

1. Based on the early adoption scenario, median expected impact of GenAI, % of industry revenues. 2020 revenues, inflation adjusted
2. By 2030, ~60% of the value potential will be unlocked, by 2045 100% of the value will be unlocked. Calculations based on 2020 industry revenues
3. Includes utilities and oil and gas, of which oil and gas contributes ~85% of revenues
4. Includes advanced electronics
5. Includes automotive and assembly, and aerospace and defense

Source: Internal experts; annual reports; Statista

Value potential per industry², bn NOK



... But **business functions**, as opposed to specific industries, will be the **driving forces of value creation**

1. Based on the early adoption scenario. By 2030, ~60% of the value potential will be unlocked, by 2045 100% of the value will be unlocked. Calculations based on 2020 industry revenues
2. Excluding corporate software engineering, including activities such as e.g., network maintenance

Source: Internal experts; annual reports; SSB

Value potential per business function¹, bn NOK

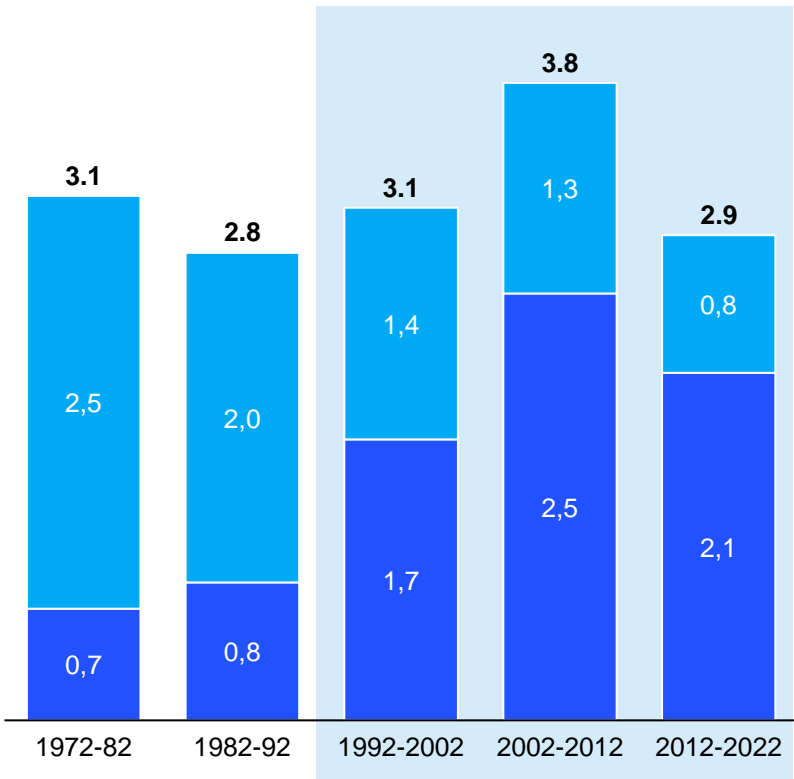
■ Value realized by 2030
 ■ Value realized by 2045



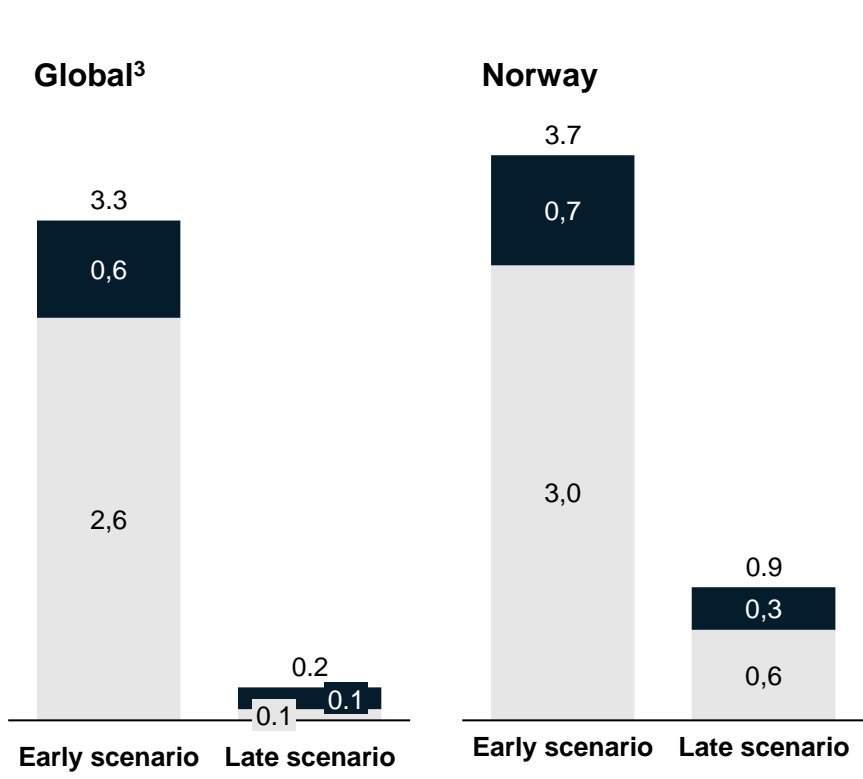
Productivity growth, the main engine of GDP growth, slowed down in the last decade but is likely to be advanced by GenAI

- Employment growth
- Productivity growth
- Productivity growth bigger contributor to GDP growth
- Additional with GenAI
- Without GenAI¹

Global GDP growth, CAGR, %



Productivity impact from automation, 2022-40, CAGR², %

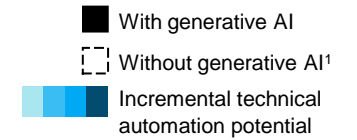


Comments

- Examining the real GDP growth contribution of employment and productivity growth, increased **productivity has been the main engine for GDP growth**
- Implementation of **GenAI can significantly contribute to increased productivity** in Norway going forward

1. Previous assessment of work automation before the rise of generative AI
 2. Based on the assumption that the automated work hours are integrated back to work at productivity level of today
 3. Based on 47 countries which constitute almost 80% of the world employment

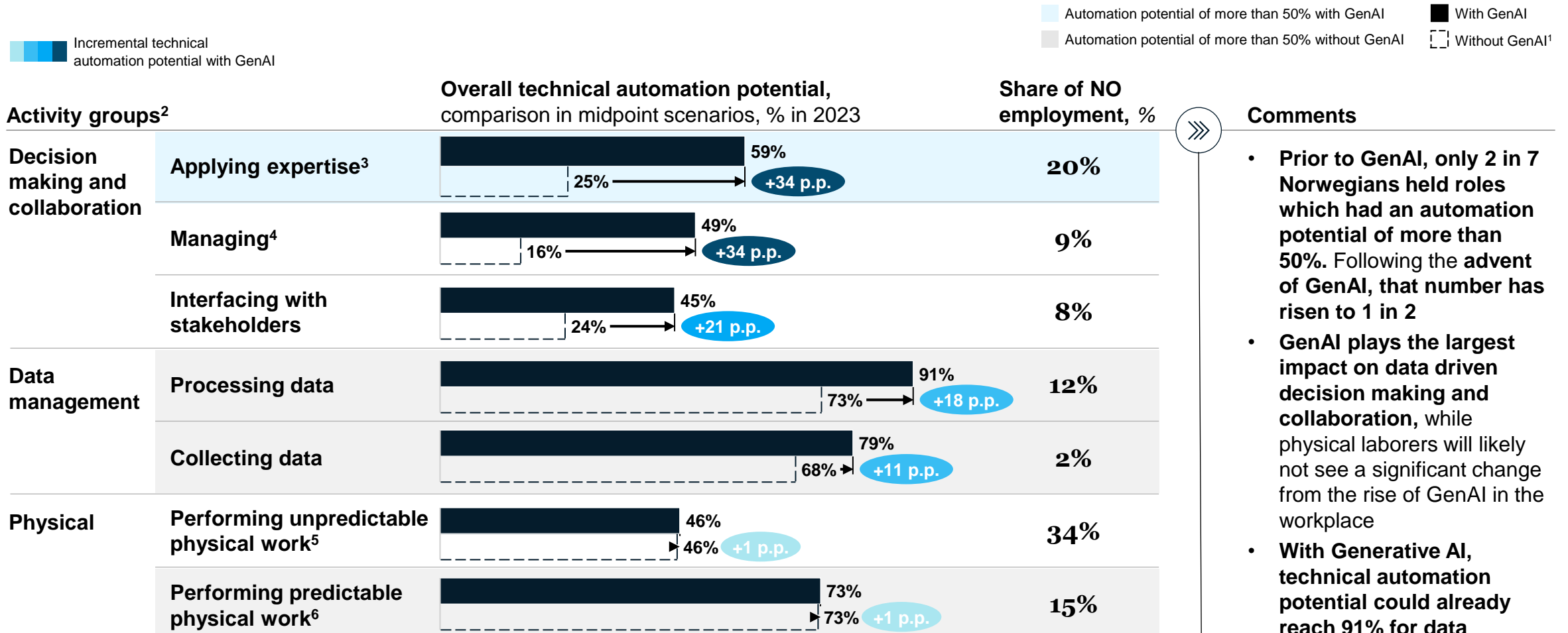
Key activities forecasted to be affected are typically executed by employees holding an advanced degree



Education level	Overall technical automation potential, Comparison in midpoint scenarios, % in 2023	Share of NO work force ¹ , %	Comments
Master, PhD or similar		13%	<ul style="list-style-type: none"> Higher educated workers are likely set to see the largest incremental impact from automation as they land in jobs as “knowledge workers” which spend a high share of their time on activities most likely to benefit from GenAI (i.e., applying expertise to planning and creative tasks, managing and stakeholder management). An example of this is within science: researchers spend ~30 minutes to read one scientific paper², but GenAI could summarize hundreds of papers in minutes
Bachelor’s degree		29%	
High school diploma or equivalent		36%	
Without a high school degree		19%	

1. Does not sum up to 100% due to some minor educational levels not included
 2. 2014 statistic

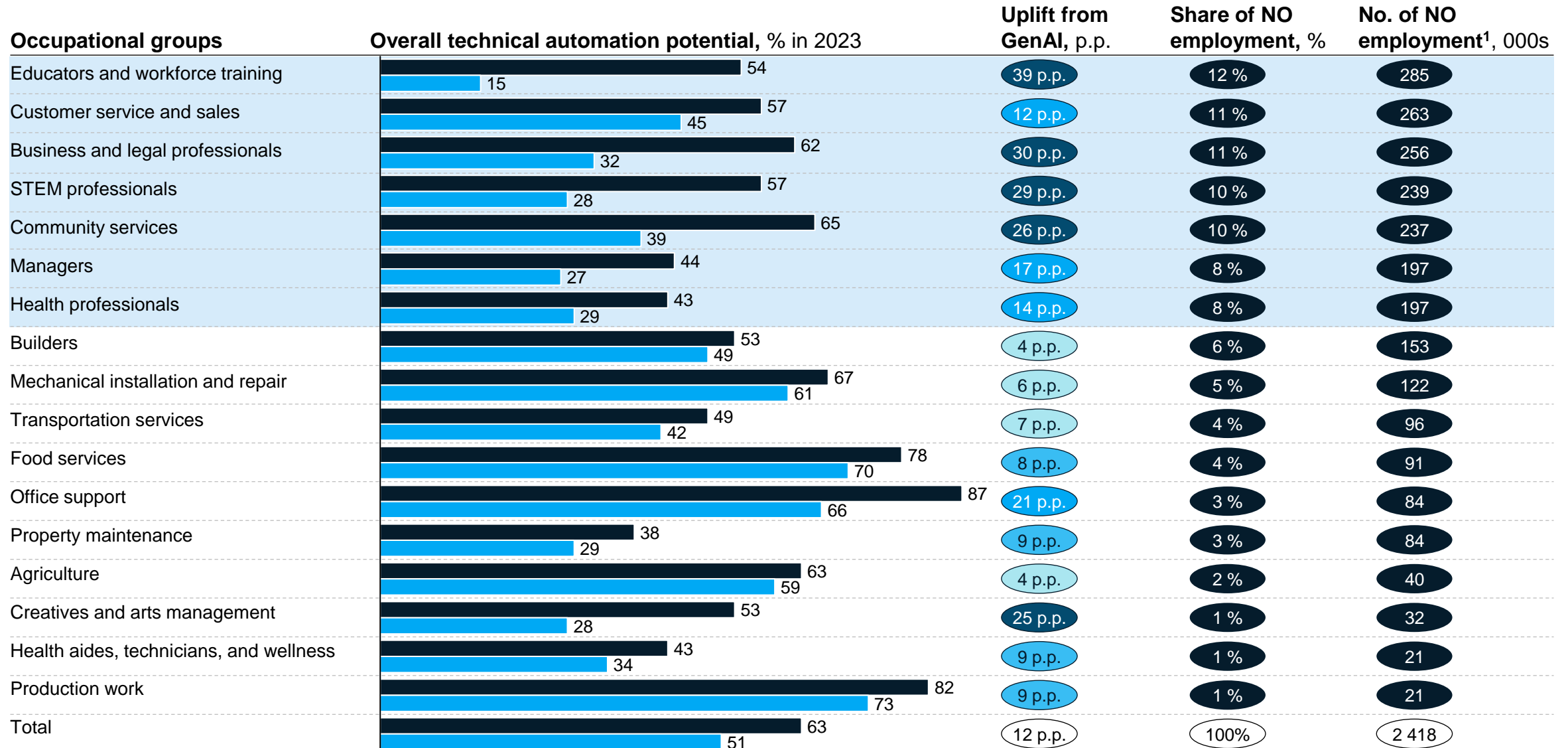
GenAI could have the biggest impact on activities which previously had a lower potential for automation



1. Previous assessment of work automation before the rise of generative AI
2. Jobs are categorized by main activity, but some jobs include activity from multiple groups
3. Applying expertise to decision making, planning, and creative tasks
4. Managing and developing people
5. Physical activities and operating machinery in unpredictable environments
6. Physical activities and operating machinery in predictable environments

The 7 largest occupational groups, representing >70% of Norwegian workers, can expect a large productivity uplift from GenAI

■ With GenAI ■ Without GenAI ■ Top 7 largest occupational groups Low High



1. Jobs with <5k holding the job title excluded by SSB
Source: McKinsey Global Institute; SSB

Norway can realize significant value from GenAI, mainly unlocked by automating activities performed by white-collar workers



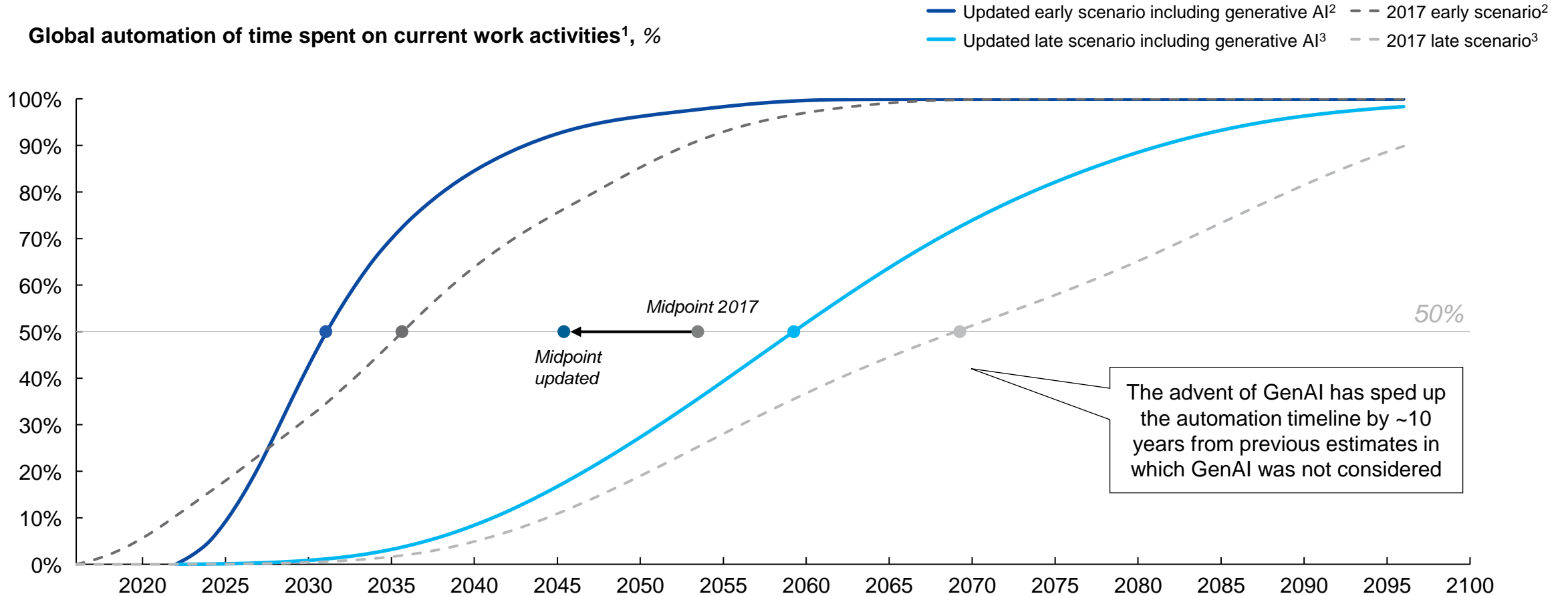
Norway is primed for adoption of GenAI due to **high levels of education and strong digital foundation ...**

... with the potential to **unlock values up to ~127 billion NOK** across various industries ...

... mainly due to productivity gains from activities related to **decision making, collaboration and data management**

Appendix

The midpoint scenario at which automation adoption could reach 50% of time spent on current work activities has accelerated by a decade



- Includes data from 47 countries representing about 80% of employment across the world. 2017 estimates are based on the activity and occupation mix from 2016. Scenarios including generative AI are based on the 2021 activity and occupation mix
- Early scenario: aggressive scenario for all key model parameters (technical automation potential, integration timelines, economic feasibility, and technology diffusion rates)
- Late scenario: parameters are set for later adoption potential.

GenAI is expected to have different impact across the business functions dependent on industry sizes

Generative AI productivity impact by business functions¹, % of industry revenue

Impact in bn NOK Low High Impact as % of industry rev. Low High Low High

	Total industry size ² , % of total revenue	Expected impact of GenAI, % of industry rev.	Total added value from GenAI, bn NOK	Marketing and sales	Customer operations	Product and R&D	Software engineering	Supply chain and operations	Risk and legal	Strategy and finance	Corporate IT (excluding SWE)	Talent and organization
Total² bn NOK	6,754		95 – 159	28 - 43	12 - 17	8 - 15	21 - 43	10 - 19	7 - 9	4 - 9	1 - 2	2 - 3
Energy	22%	1% - 1.6%	16 - 26									
High tech	4%	4.8% - 9.3%	12 - 24									
Travel, transport & logistics	14%	1.2% - 2%	12 - 21									
Retail	14%	1.2% - 1.9%	12 - 20									
Advanced manufacturing	7%	1.4% - 2.4%	8 - 13									
Real estate	8%	1% - 1.7%	6 - 10									
Basic materials	10%	0.7% - 1.2%	5 - 9									
Banking	3%	2.8% - 4.7%	5 - 9									
Consumer packaged goods	5%	1.4% - 2.3%	5 - 8									
Professional services	7%	0.9% - 1.4%	5 - 7									
Telecommunications	1%	2.3% - 3.7%	2 - 3									
Insurance	1%	1.8% - 2.8%	2 - 3									
Healthcare	1%	1.8% - 3.2%	2-3									
Media	1%	1.5% - 2.6%	2-3									
Chemical	1%	0.8% - 1.3%	0.5 - 1									
Agriculture	1%	0.6% - 1%	0 - 0.5									
Pharma & medical products	0%	2.6% - 4.5%	0									

1. Excl. implementation costs (e.g., training, licenses)

2. Figures may not sum to 100% because of rounding

GenAI can reduce the cost of large effort tasks, enabled through 4 archetype of applications which are emerging across industries

Not exhaustive for all use cases for Generative AI



Content synthesis (virtual expert)

Generate insights and drive actions based on summarization and synthesis of unstructured data

GenAI capability



Coding & software

Interpret and generate code and documentation, i.e., improving efficiency and reducing technical debt



Creative content

Create marketing messages, and images, support ideation for new product development and generate personalized marketing copy



Customer engagement¹

Streamline interactions by interpreting text and analyze customer journeys through customer service, chatbots, recommenders, task automation, etc.

Use case

- Summarize **text or audio** and generate insights
- **Perform actions** triggered by user prompt
- **Augment capabilities of operations staff** (e.g., inventory/maintenance management)

- **Generate code** and assist developers
- **Refactor translate code** to accelerate mainframe migration
- Create **model documentation** (e.g., risk)

- **Generate visuals** (images, designs, 3D models) to accelerate the product design process
- **Draft and personalize outbound customer comms** or marketing

- **Streamline customer communications**, e.g., customer service issue resolution (driving action to resolve) and Q&A
- **Model and predict elements** in patient or customer journey

1. Includes B2B customer interactions and transactions

The energy sector has the highest value potential, but GenAI will be most disruptive in High Tech

Impact as % of industry revenues, bubble size proportional to bn NOK impact: Small Large

Impact¹, median calculation, bn NOK



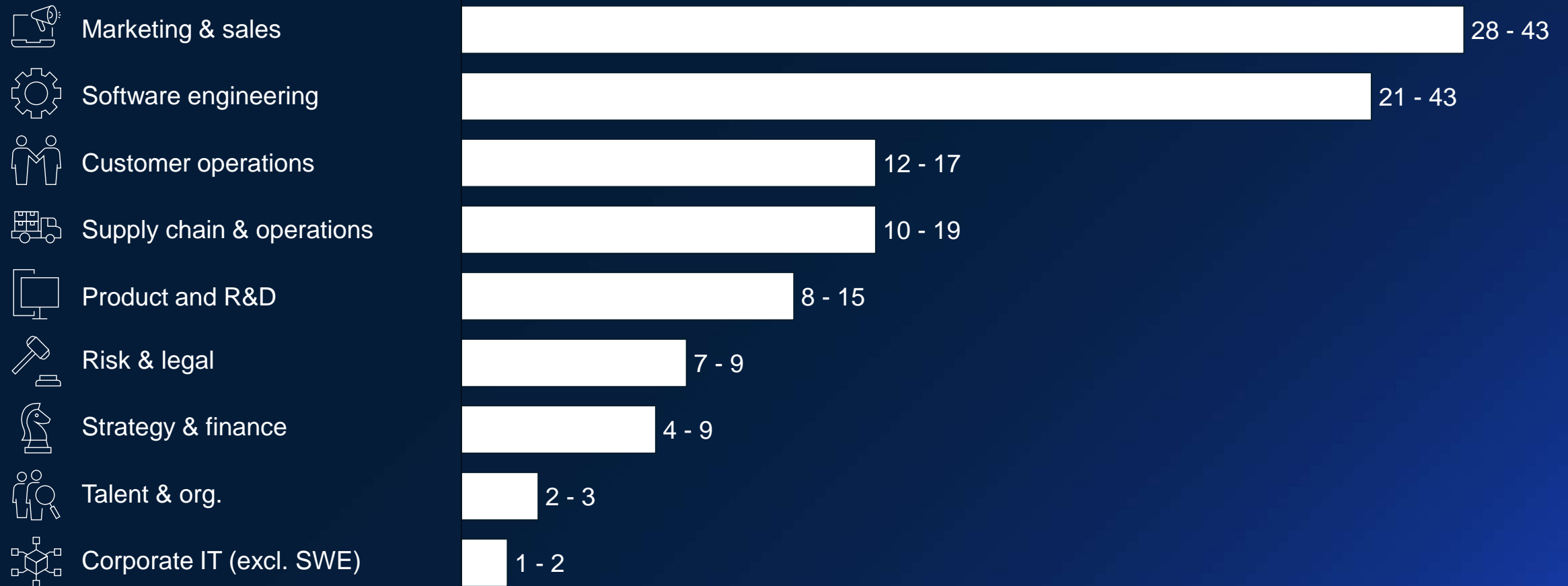
1. Based on the early adoption scenario, median expected impact of GenAI, % of industry revenues. 2020 revenues, inflation adjusted

>50% of the value unlock can be achieved in two large business functions

Deep dive follows

Business functions

Value potential from GenAI¹, bn NOK



1. Excl. implementation costs (e.g., training, licenses)

1: Marketing & Sales

Illustrative



Value unlock examples



Writing marketing and sales copy content of text, images and videos



Improving sales force, e.g., by flagging risks, recommending next interactions



Analyzing customer feedback



Industry examples

Augment sales teams with **technical proprietary knowledge and historic customer interactions**

Generate personalized marketing content based on (un)structured data from **consumer profiles and community insights**

Automate **booking management and customer follow-up** during travels

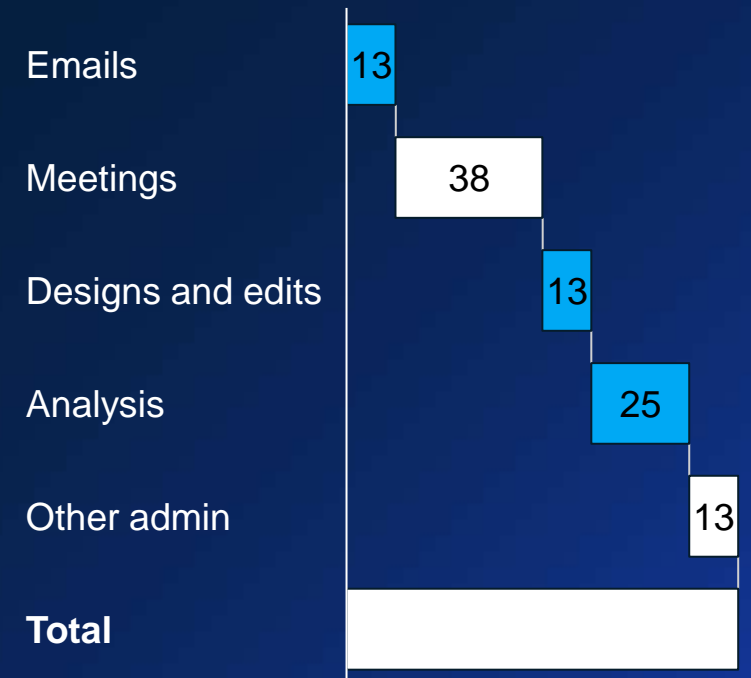


Key industries

- CPG
- Retail
- Travel, Transport & Logistics
- Insurance
- Financial services



Typical working day marketing executive % time spent



Total value potential, bn NOK 28 - 43

2: Software Engineering

Illustrative



Value unlock examples



Generating, prioritizing, and running code



Generating synthetic data to **improve training accuracy of ML models**



Reviewing code for defects and inefficiencies



Industry examples

Create alerts and automated bots based on news, industry reports, internal research and economic trends that can **impact trading strategies**

Generate code that creates **hyper-personalized trip recommendations**

Accelerate transition from legacy software / code (e.g., banks still use system written in COBOL) **to modern**



Key industries

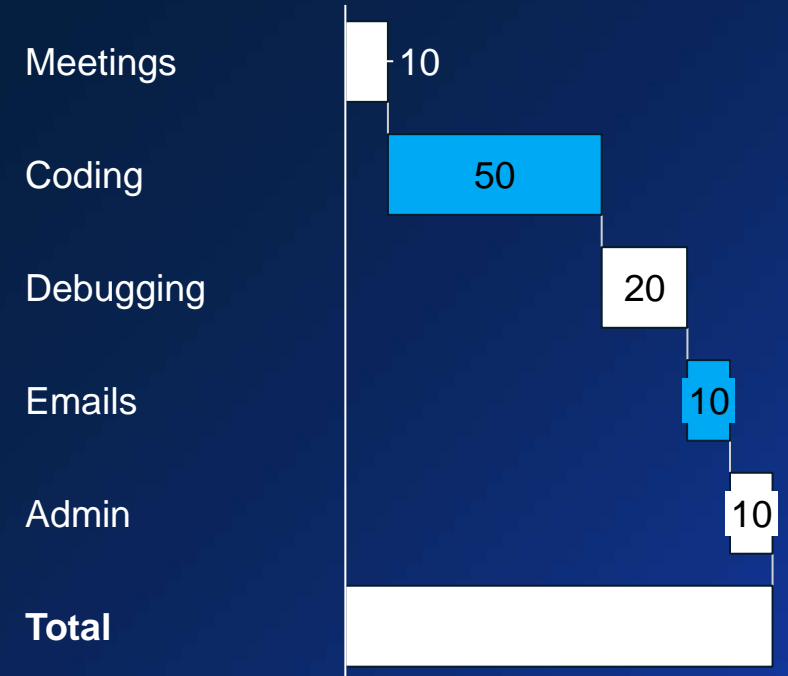
- High Tech
- Media
- CPG
- Retail
- Energy
- Insurance
- Financial services

“50% of code on GitHub is written by an AI, e.g., a co-pilot doing code suggestions, corrections and writing”

- Productivity opportunity with GenAI
- Not expected to be affected by GenAI



Typical working day software engineer % time spent



Total value potential, bn NOK 21 - 43

3: Customer Operations

Illustrative



Value unlock examples



Auto-generating customer profile and segment for each unique customer



Generating post call **summary to customers and agents**



Developing first-line response in customer service for all inquiries



Industry examples

Zero customer service reps, with all **internal helpdesk automated** via self-serve and GenAI-powered chatbots to handle all omnichannel helpdesk engagement

Summarize speech to distinctive text to **create records of customer complaints**

Manage disruptions during vacations by being **first point of contact for customers**, offer **translation and content customized for the customer** and their vacation

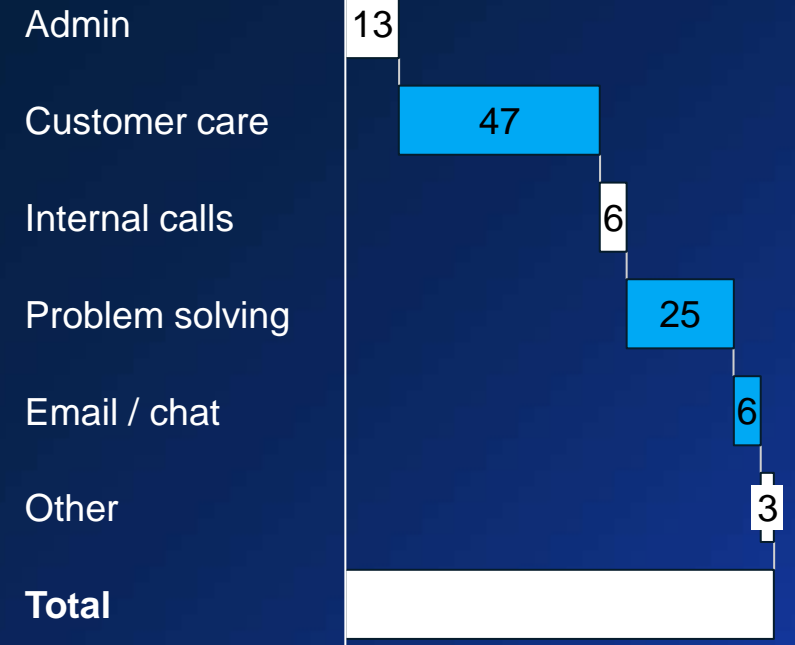


Key industries

- CPG
- Retail
- Insurance
- Financial services
- Travel, Transport & Logistics
- Telecommunications



Typical working day call center % time spent



Total value potential, bn NOK **12 - 17**

■ Productivity opportunity with GenAI
 ■ Not expected to be affected by GenAI

4: Supply Chain & Operations

Illustrative



Value unlock examples



Warehouse and **inventory management**



Forecasting demand and disruptions in supply chain



Optimize transportation route



Industry examples

Interpreting data, labelling unstructured data and **identifying patterns for future trends and demand**

Synthesizing data from previous jobs to **predict potential issues**

Act as an **intelligent maintenance or safety advisor**, leveraging insights and knowledge from equipment and process manuals

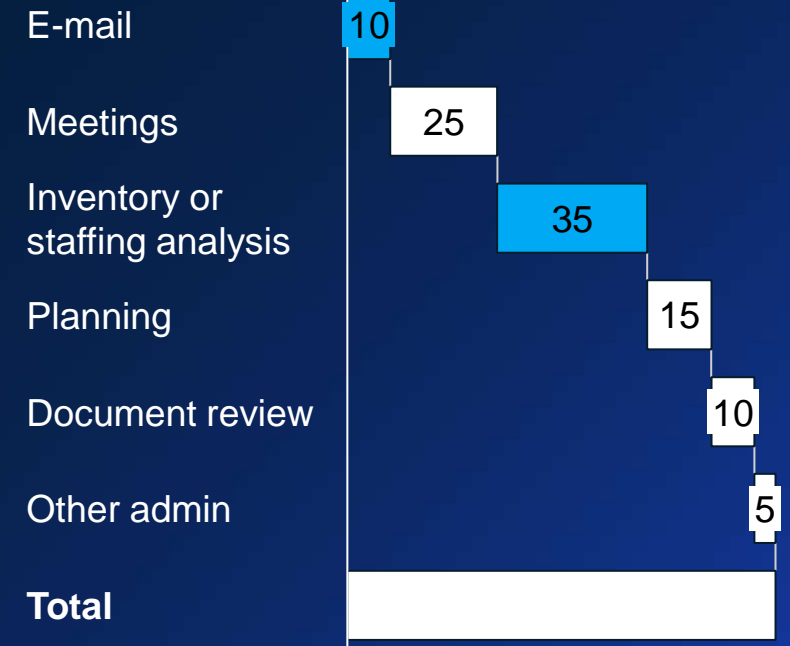


Key industries

- Energy
- CPG
- Retail
- Advanced Manufacturing
- Travel, Transport & Logistics
- Basic Materials



Typical working day supply chain manager % time spent



Total value potential, bn NOK 10 - 19

5: Product and R&D

Illustrative



Value unlock examples



Creating 3D visual models and digital product designs



Prioritizing product backlog by synthesizing customer feedback



Measuring and tracking engineering metrics



Industry examples

Improve pipeline maintenance by synthesizing maintenance and inspection records, **predict areas at risk for corrosion** based on historic maintenance records

Reimagine product portfolio through GenAI opportunity themes

Translate code from legacy systems at scale, **prioritizing interventions and re-factoring**



Key industries

- High tech
- CPG
- Retail
- Travel, Transport & Logistics
- Telecommunications
- Insurance
- Financial services

“The amount of time spent in each category depends on which stage of development you are, but most time is spent on product development, troubleshooting or fixing”

- Productivity opportunity with GenAI
- Not expected to be affected by GenAI



Typical working day product owner % time spent



Total value potential, bn NOK

8 - 15

6: Risk & Legal

Illustrative



Value unlock examples



Draft and review legal documents



Summarize and highlight changes in large bodies of regulatory documents



Answer questions & cite justifications from large documents



Industry examples

Summarize regulation, including safety & equipment manuals changes from industry & regulatory databases

Informative queries from agents to identify & generate required legal and non-legal documents for transportation based on classification from GenAI model

Generate life-like fraud attempts for **pro-active testing**



Key industries

- Energy
- High Tech
- Media
- Insurance
- Financial services
- Real Estate
- Telecommunications



Typical working day junior lawyer % time spent

E-mail

10

Writing documents

45

Review documents

5

Calls

30

Meetings

5

Other admin

6

Total

Total value potential, bn NOK

7 - 9

- Productivity opportunity with GenAI
- Not expected to be affected by GenAI