

A photograph of a modern industrial manufacturing facility. The scene is filled with yellow robotic arms, likely KUKA models, working on an assembly line. The background shows complex machinery, metal structures, and safety railings. The lighting is bright, typical of a factory environment. A semi-transparent dark overlay is present in the lower half of the image, containing text and logos.

MIT Machine Intelligence for Manufacturing and Operations

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MIMO.MIT.EDU



Machine Intelligence for
Manufacturing & Operations

Finding the shortest path from data to impact



Machine Intelligence for
Manufacturing & Operations

MIT Machine Intelligence for Manufacturing and Operations

Research and educational program to increase industrial competitiveness by accelerating the deployment and understanding of machine intelligence.

Research

Field-based PhD and Masters research in Manufacturing and Operations

Education

Field-based education of PhD and Masters students and industry executives

Collaboration

Authentic collaboration among students, faculty, operational executives and data scientists

Machine Intelligence Transformation



Machine Intelligence for
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McKinsey
& Company

Toward smart- production

The emergence of machine intelligence in operations

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Our goals for today

Introduce you to and review the scope and impact of the effort

Highlight what leaders do well, what we can learn from them

Introduce the individualized MIMO implementation playbook

Lay out next steps on journey to using machine intelligence

Executive summary

Top performers in Machine Intelligence (MI) in operations have reported average KPI improvements of 9.5% vs. the 3.5% reported by less mature organizations

Leveraging the combined networks of MIT and McKinsey, we set out to understand how 100 companies in North America were (or weren't) applying MI in their operations

- **The impact on 21 key performance indicators** was evaluated based on **9 categories of enablers**, **17 desired business outcomes**, and the impact of **17 different use cases**

We used **three groups of attributes** to understand drivers of success

1. **Results**: what impact the company achieved, and across how many use cases/topics
2. **Enablers**: practices and procedures used to identify, develop and deploy use cases
3. **Deployment**: how long a company has worked on MI topics, maturity of implementations and sophistication

From survey and the interviews, 5 categories of enablers stood out

- **Governance, Deployment, Partnering, People and Data execution**

There's a **substantial gap** in performance against these **enablers**, between **leaders** and **the rest**

- **Leaders** have only **accelerated their investments** vs. the rest

What do we mean by Machine Intelligence

From insight to autonomy



Machine Intelligence

Computer model that learns from historical or real-time data and adjusts its actions autonomously to achieve a human-set goal



Predictive Analytics

Past and present data are used to forecast the likelihood of future outcomes



Digital reports/dashboards

Data is reported directly from the system with simple visualizations



Prescriptive Analytics

Data is analyzed to predict future outcomes and advise/determine next steps



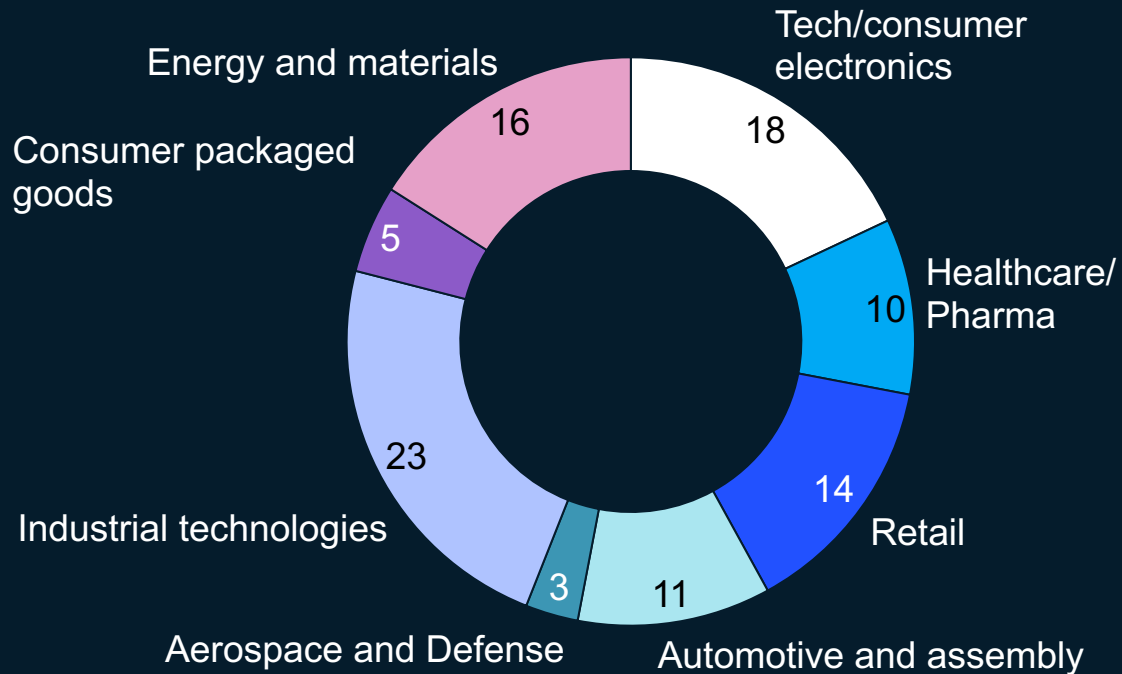
Descriptive Analytics

Data is collected and analyzed to summarize and capture general trends

191 individuals completed surveys, across ~100 companies

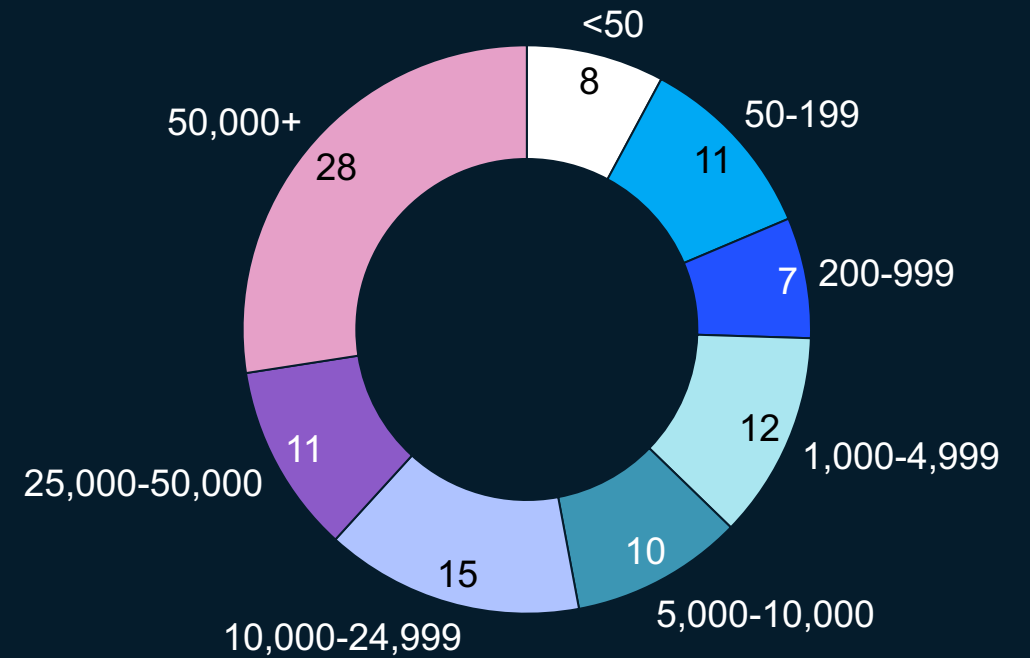
Survey completed by industry

% of response, N=191



Survey completed by size

% of responses, N=191

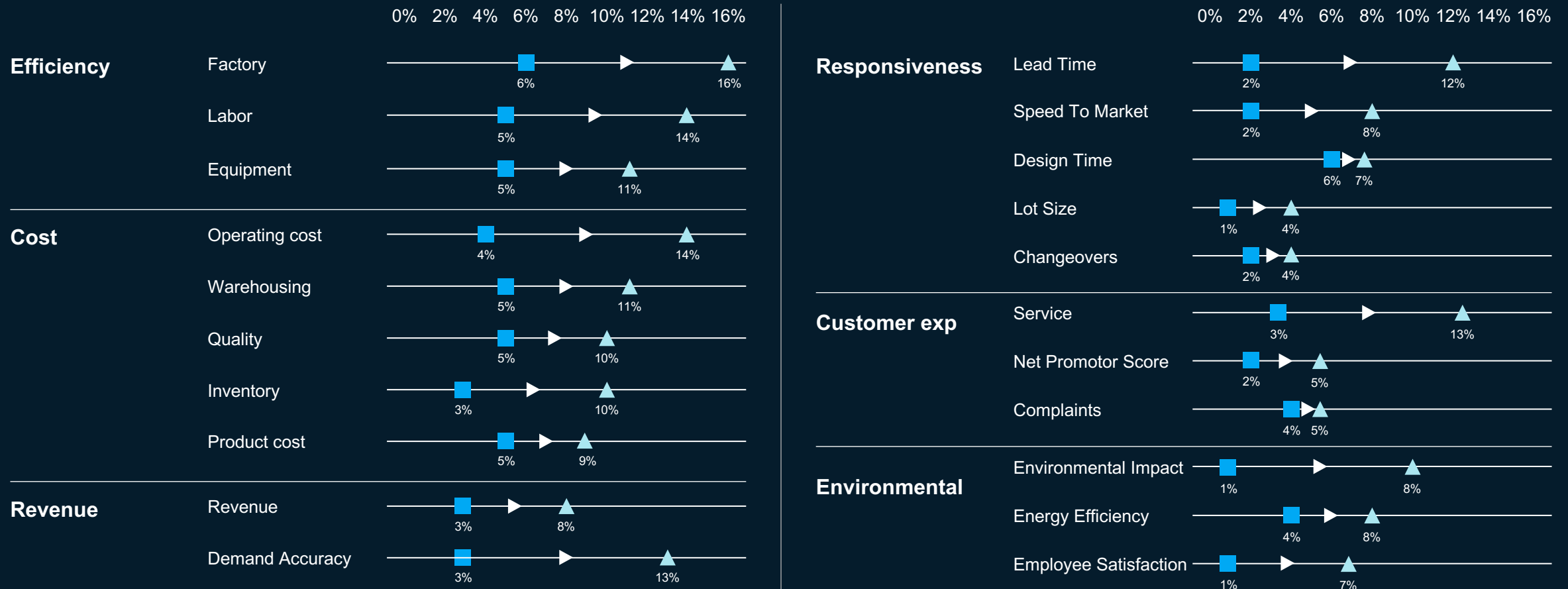


What's at stake – leaders are driving 2x the impact through Machine Intelligence

Everywhere leaders have chosen to play they are better than the rest

■ Bottom 50% ▲ Leaders

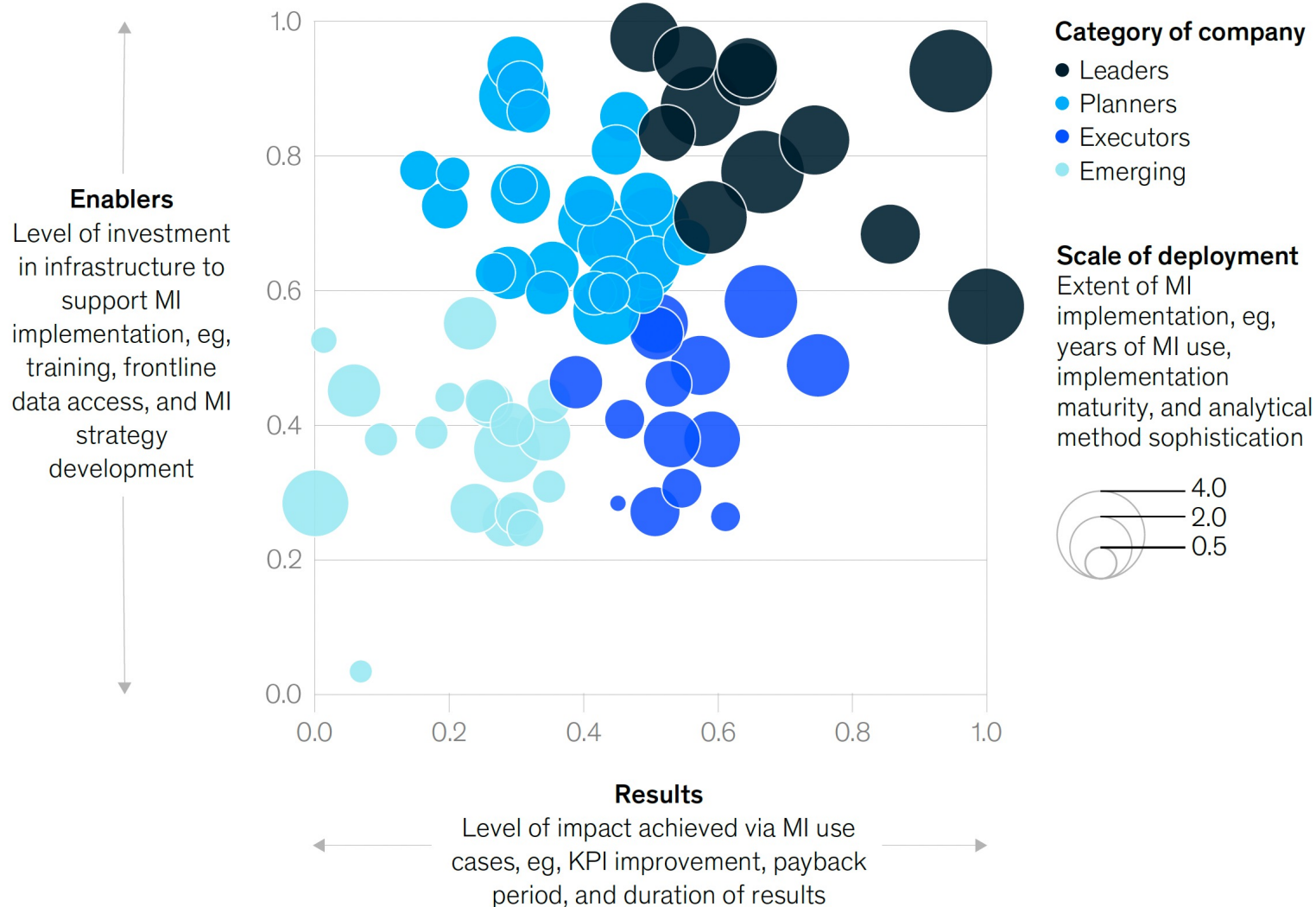
What was the average improvement on the following KPIs through machine intelligence?, All variables are normalized to a 0 to 1 scale



What are the leaders doing different?

Introduction to the MI Impact matrix

Machine-intelligence (MI) impact matrix, variables are normalized to a 0 to 1 scale



This MI Impact matrix allows us to quantitatively measure, compare and group companies based upon their actions and results.

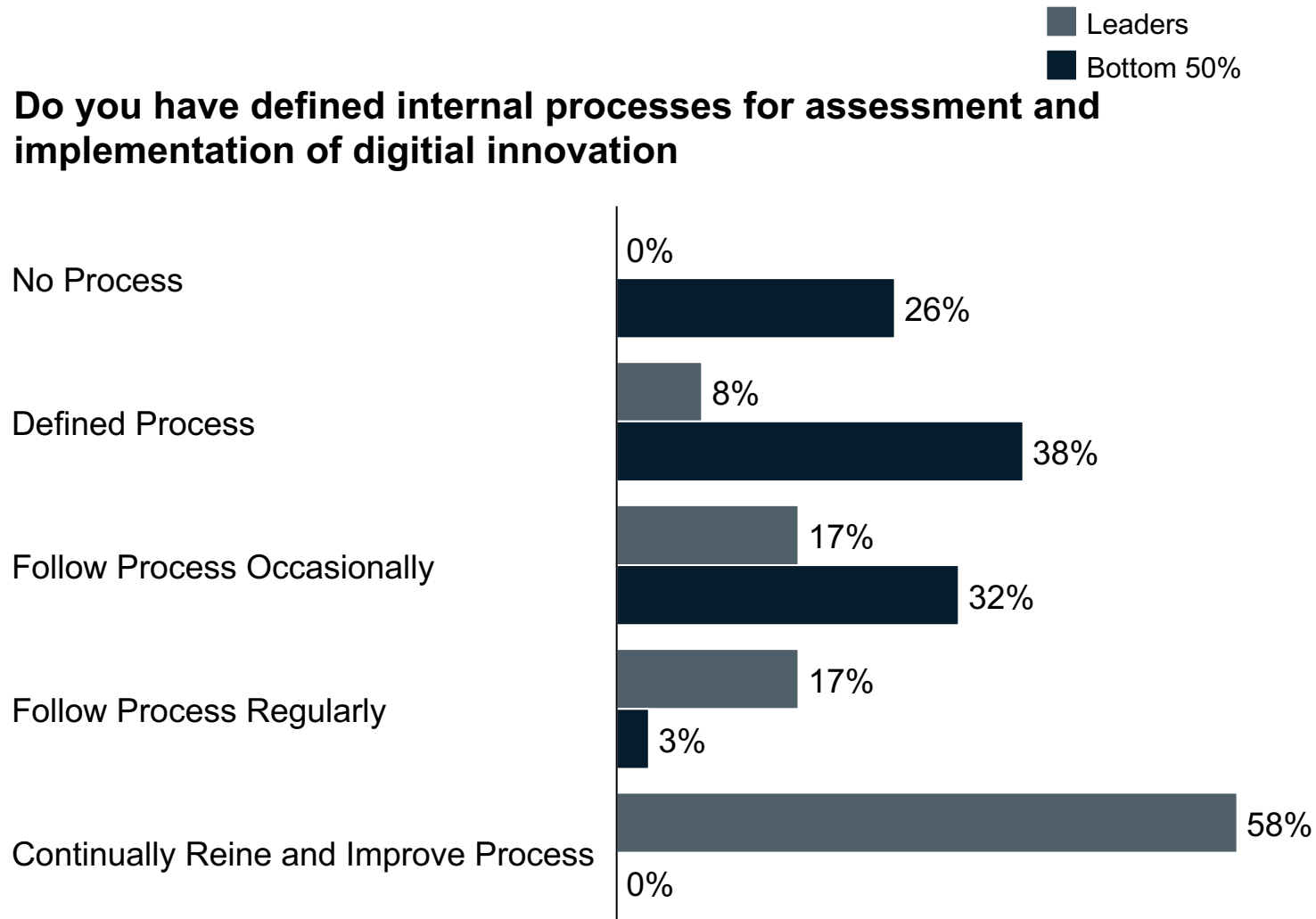
Created using Machine Intelligence

Taking a deeper look – what are the leaders doing different?

Top Quartile, 75%+ Above Average, 50%+ Bottom Half, <50% # Key differentiators



1: What leaders do well: Governance - processes & capabilities to rapidly scale

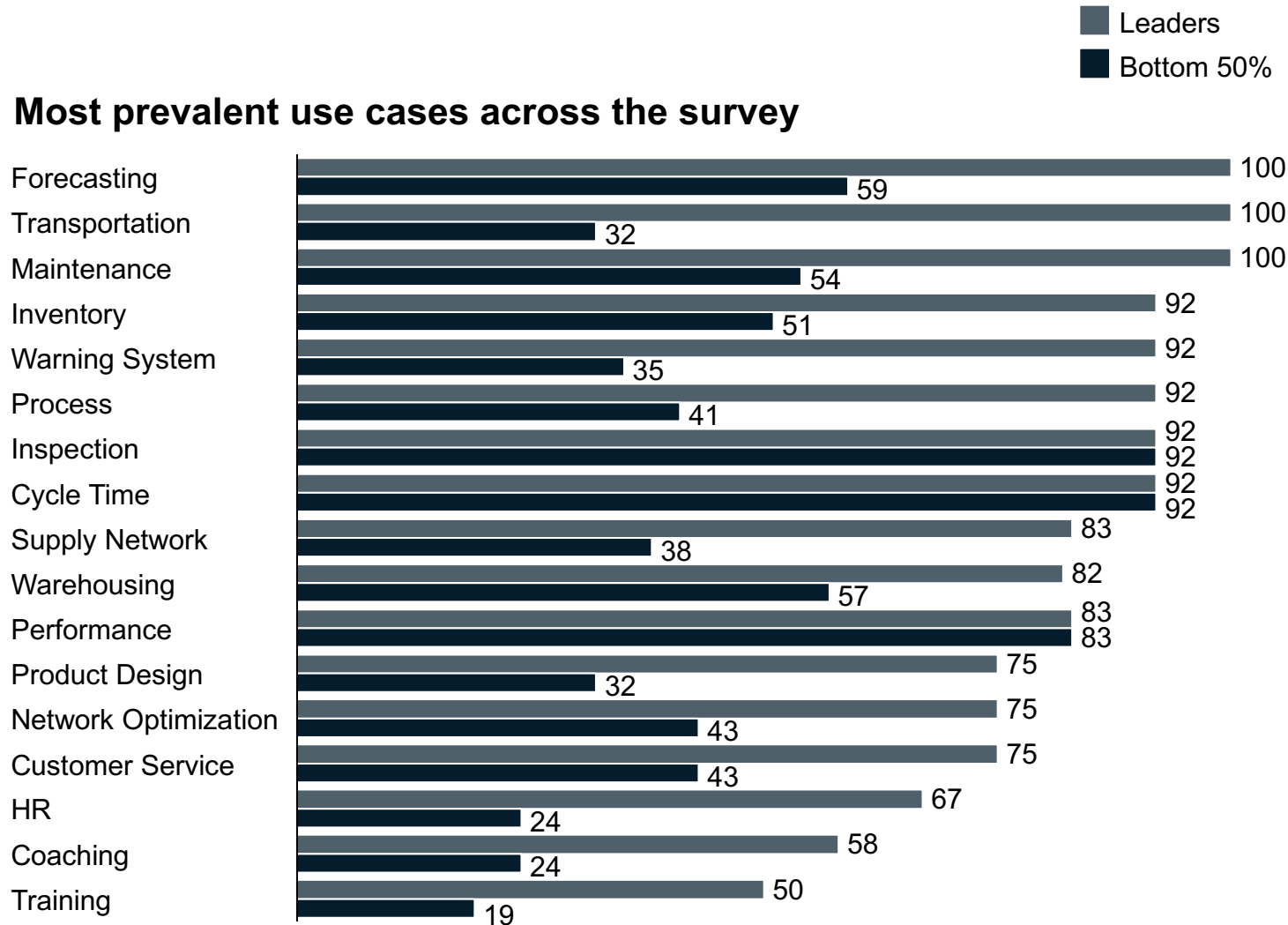


Leaders are committed to continuous improvement in data driven innovation, whereas the rest don't follow/don't have assessment processes

The "lean" mindset of continuous improvement differentiates the leaders across our study

Leaders are also more likely to follow the process regularly and to update it continually as the organization learns more

2: What leaders do well: Governance - processes & capabilities to rapidly scale



There is clear consensus among leaders on where to focus

Forecasting, transportation and maintenance all provide fertile grounds for driving high impact MI applications

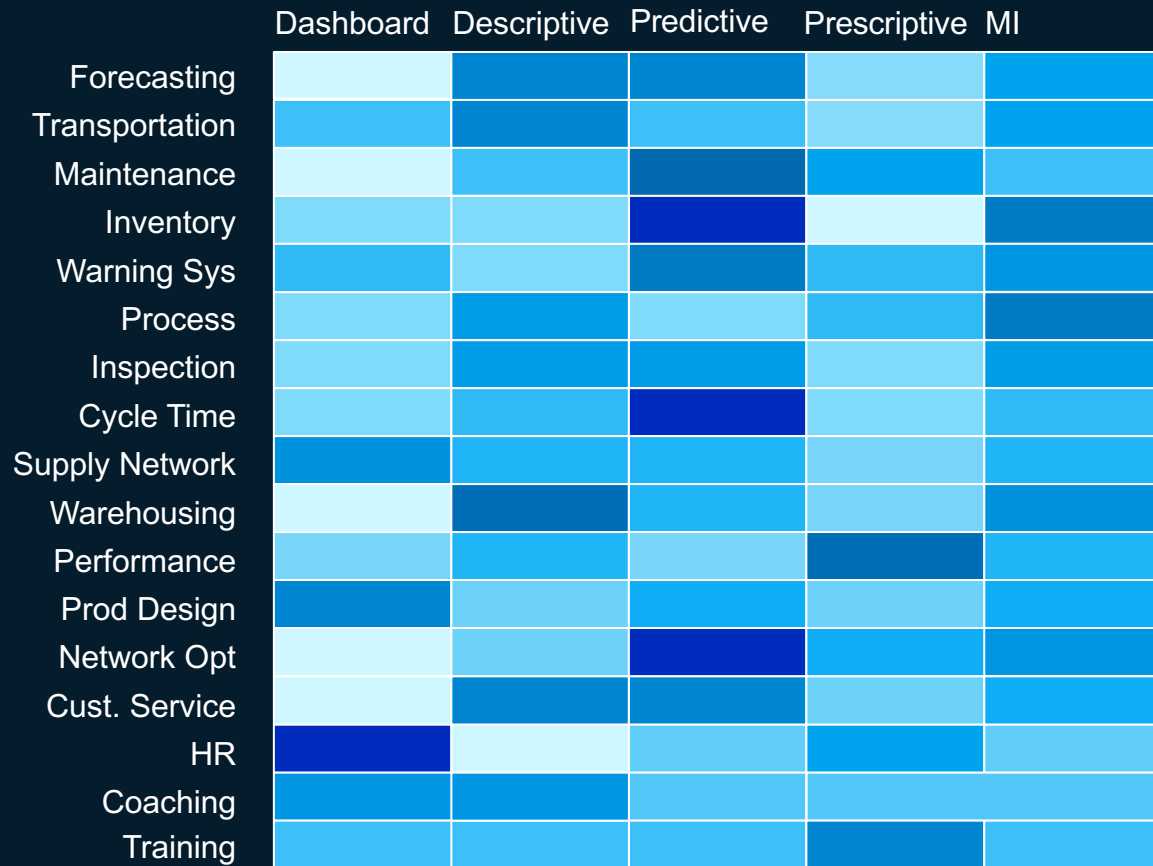
The rest of the participants in our group had a much broader dispersion of their use case prioritizations

2: What leaders do well: Deployment - *Common* vision and advanced methodologies(2/2)

The best use more advanced approaches and yield better results

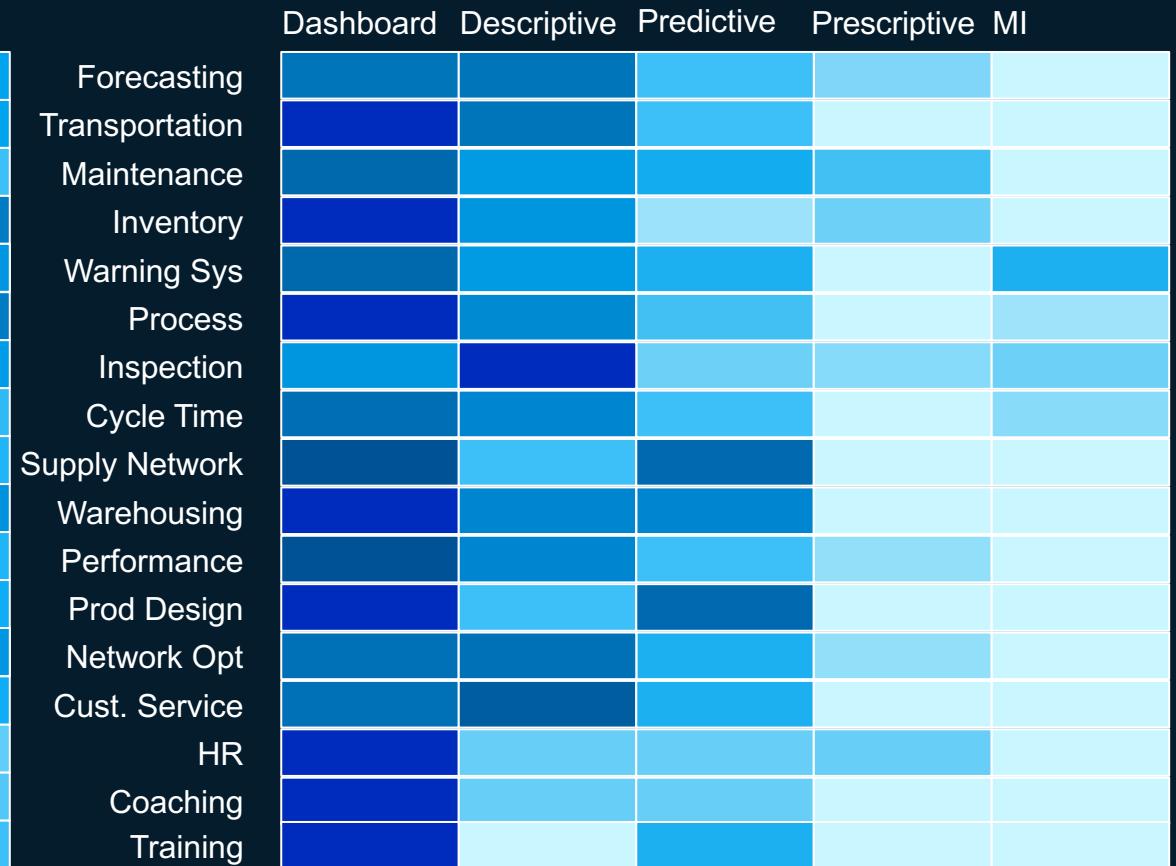
Leaders % of companies

0% 10% 20% 30% 40% 50%

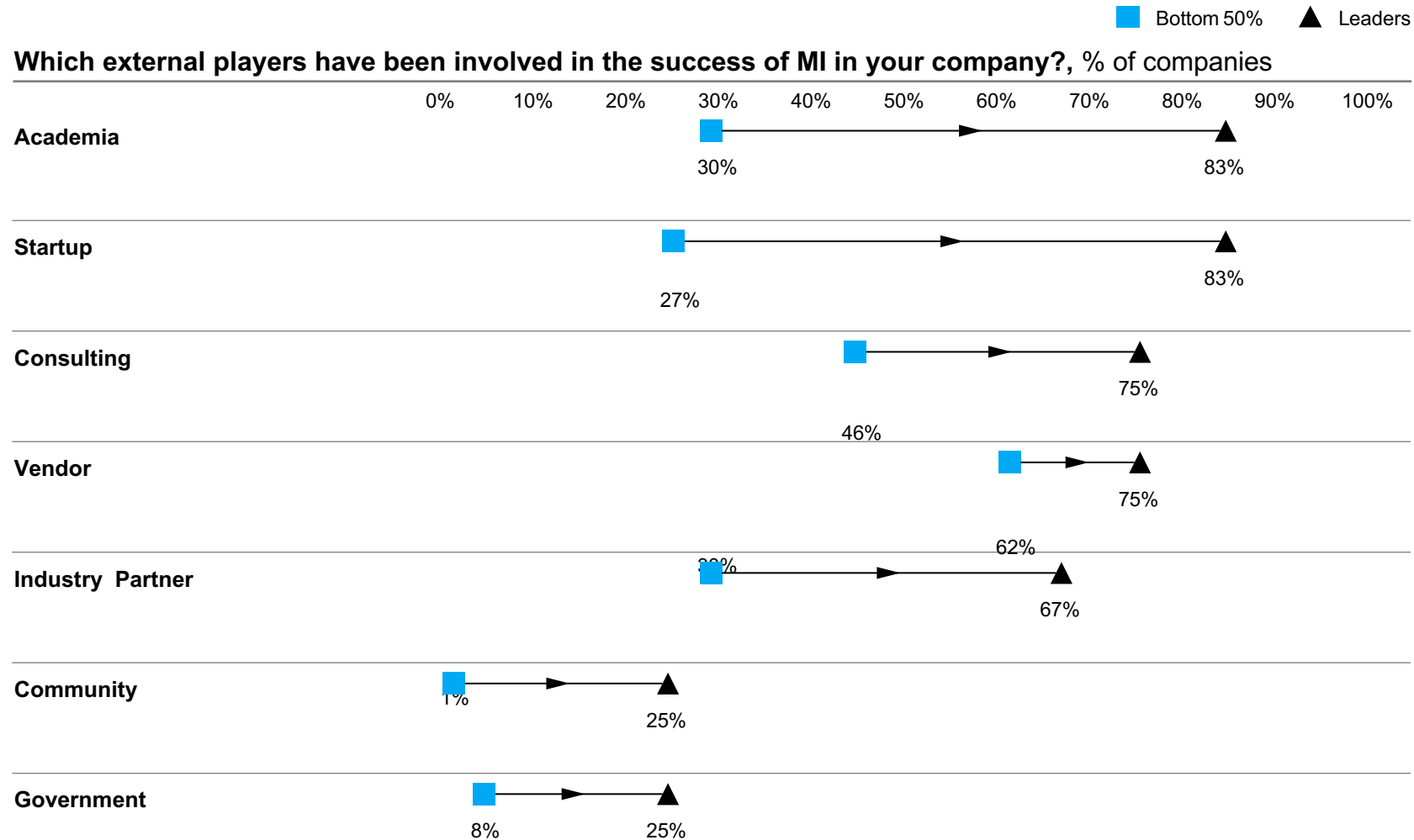


Bottom 50%, % of companies

0% 10% 20% 30% 40% 50%



3: What leaders do well: Partnering - A broad ecosystem of partners



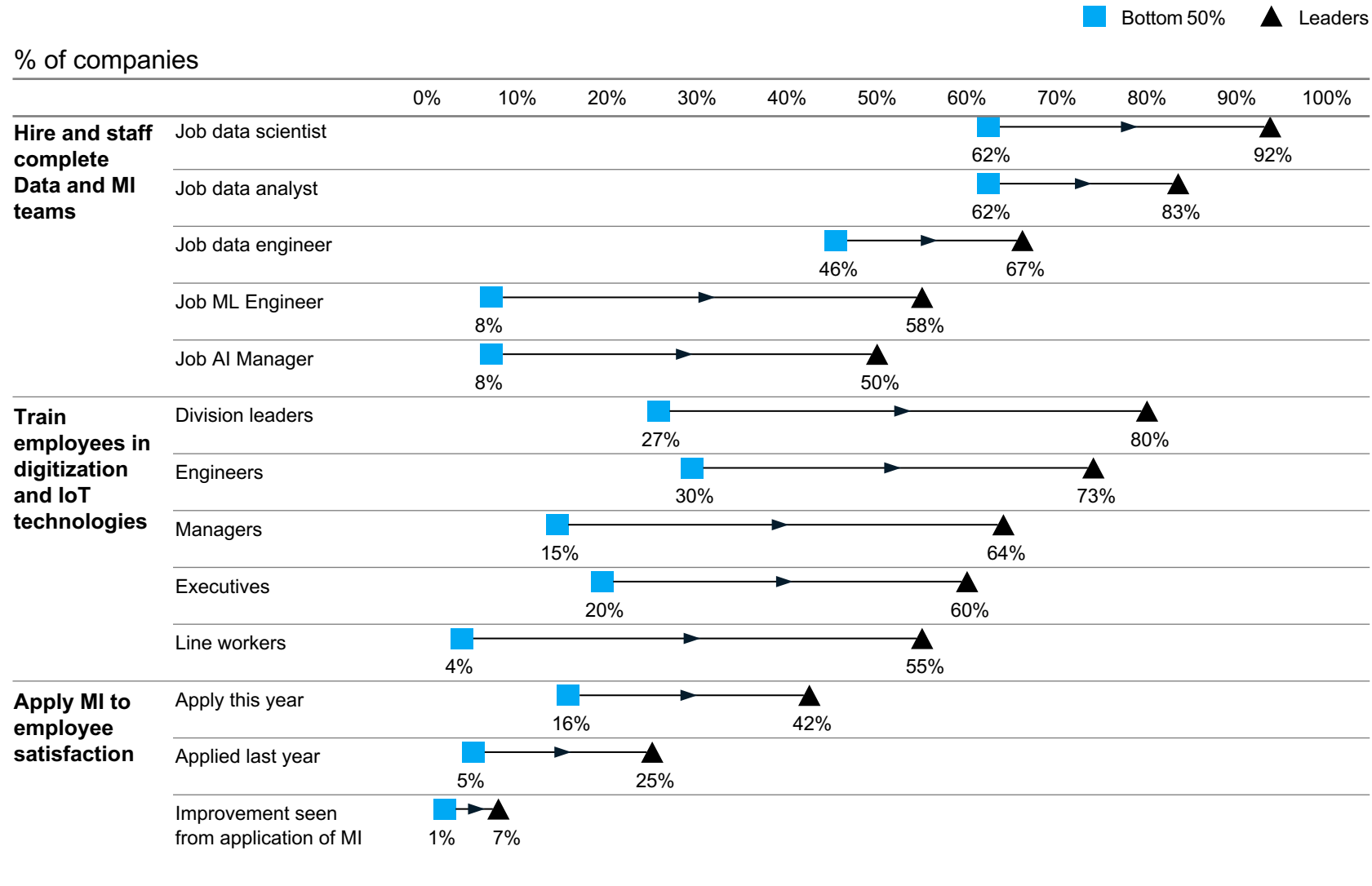
Partnerships are critical no matter the starting point

Leaders have started tackling projects that require more domain expertise, and/or areas which don't have well defined solutions

- They've turned to startups and academia to help them solve these problems

But, across the board, leaders partner with all types of institutions, but mostly focus on private sector and academia

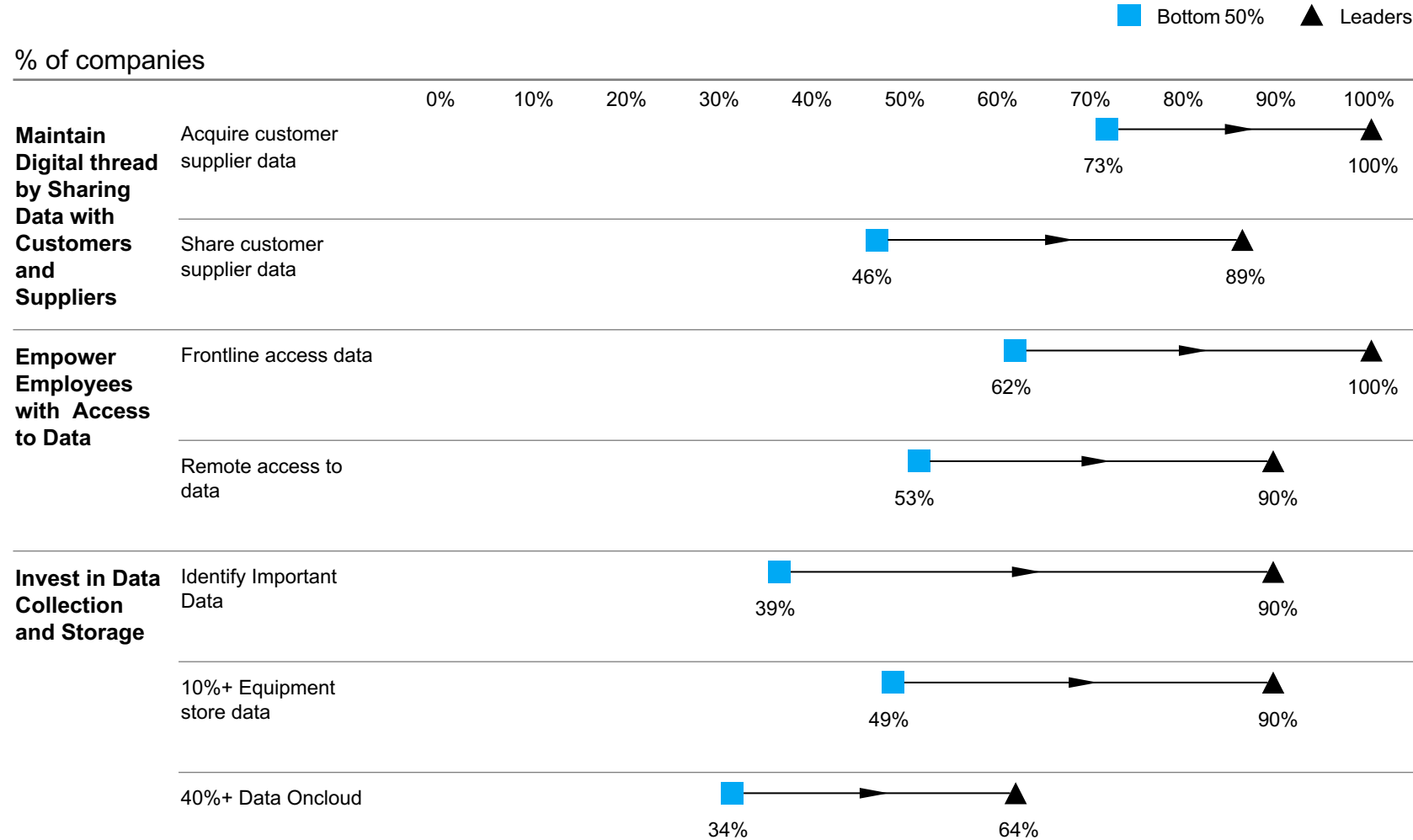
4: What leaders do well: People - Employee empowerment



Leaders hire a full team including ML engineers who maintain the ML application in production and Product managers who ensure that the right problem are addressed, and a complete solution is delivered

More than 50% of leaders train front line workers in ML

5: What leaders do well: Data execution - Data they can use



100% of leaders group give frontline staff access to data, compared to 62% of rest

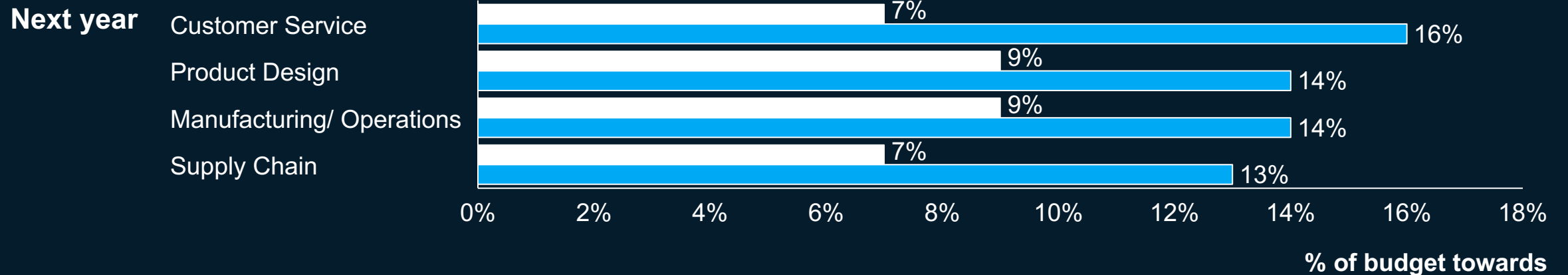
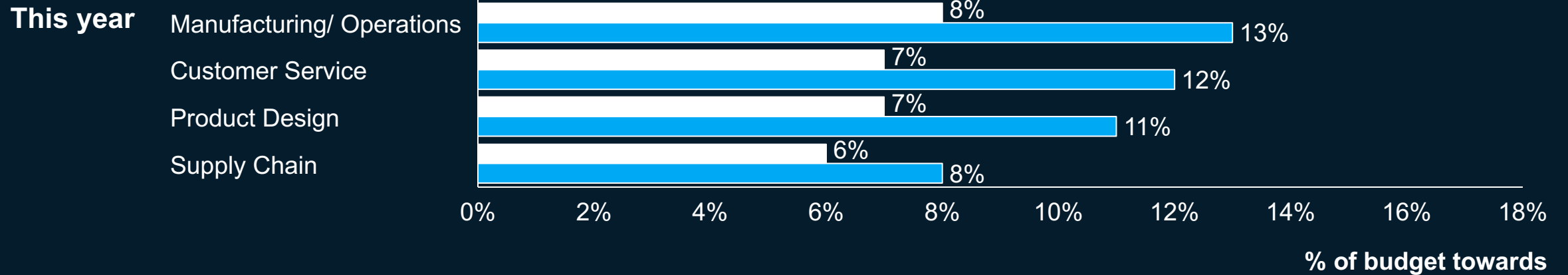
All leaders collect data from suppliers and customers, in addition 89% of them reciprocating in sharing data back with these groups

Leaders invest in data collection up front, they identify what's important and make sure it's properly categorized, organized and stored

Now is not the time for business as usual, leaders continue to invest at rates 2x that of the rest and accelerating

Bottom 50% Leaders

What percentage of your company's budget is devoted to MI projects?



What are the implications for those on the MI journey?



Identify the organization's North Star and conduct a visioning exercise that describes an ideal version of its operations in three or four years' time - this will require looking past legacy infrastructure and skill constraints



Conduct an honest assessment of the organization's starting point across dimensions - companies often over-index on a few dimensions during early successes but find the momentum difficult to maintain without an operating-model change



Scope out a rough transition plan, accounting for barriers to change, critical infrastructure (such as data migration to the cloud), and assigning realistic medium-term targets - most leaders in our survey started by using data to make decisions using tools simpler than MI

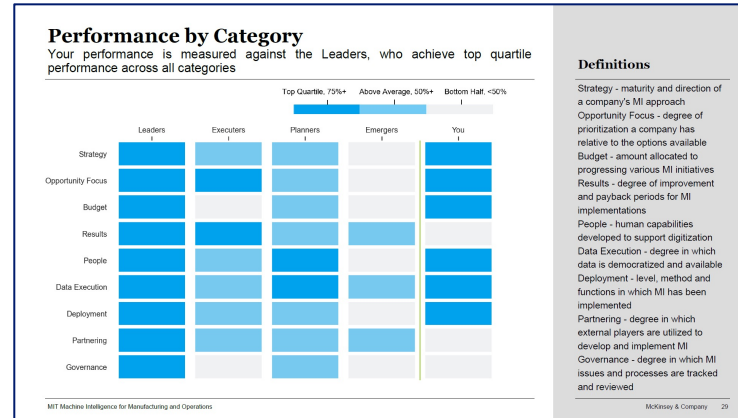


Find a handful of use cases to gain early momentum while at the same time scoping out (and potentially self-funding) the necessary changes in infrastructure, talent, and related supports

MIMO Implementation Playbook

Full participants receive custom 30 page playbook highlighting how they responded vs. others across every dimension of the survey

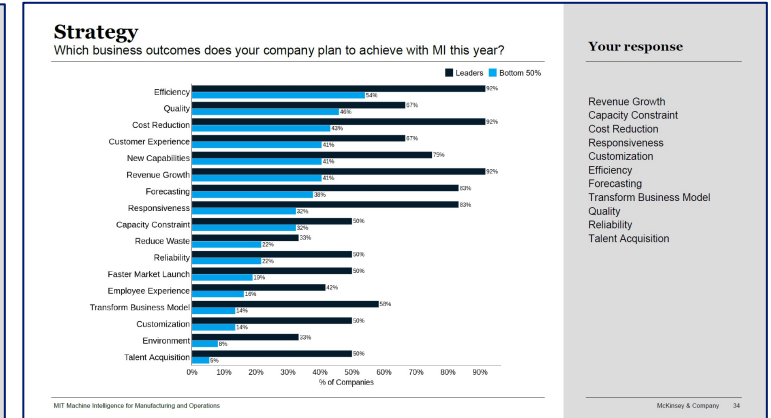
Contains implementation roadmap and best practices.



Definitions

Strategy - maturity and direction of a company's MI approach
 Opportunity Focus - degree of prioritization a company has relative to the options available
 Budget - amount allocated to progressing various MI initiatives
 Results - degree of improvement and payback periods for MI implementations
 People - human capabilities developed to support digitization
 Data Execution - degree in which data is democratized and available
 Deployment - level, method and functions in which MI has been implemented
 Partnering - degree in which external players are utilized to develop and implement MI
 Governance - degree in which MI issues and processes are tracked and reviewed

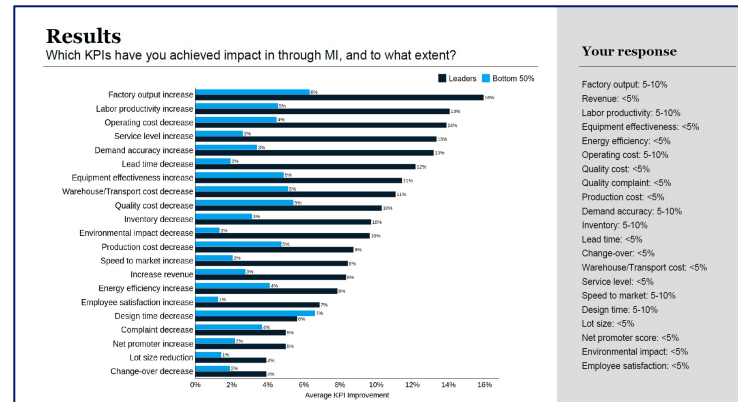
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Your response

- Revenue Growth
- Capacity Constraint
- Cost Reduction
- Responsiveness
- Customization
- Efficiency
- Forecasting
- Transform Business Model
- Quality
- Reliability
- Talent Acquisition

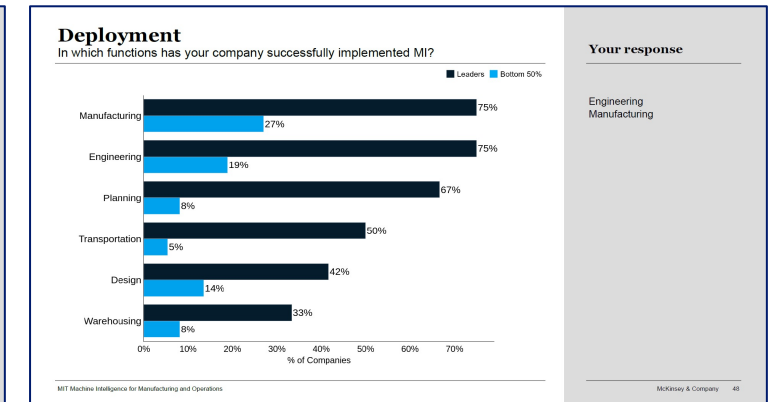
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Your response

- Factory output: 5-10%
- Revenue: <5%
- Labor productivity: 5-10%
- Equipment effectiveness: <5%
- Energy efficiency: <5%
- Operating cost: 5-10%
- Quality cost: <5%
- Quality complaint: <5%
- Production cost: <5%
- Demand accuracy: 5-10%
- Inventory: 5-10%
- Lead time: <5%
- Change-over: <5%
- Warehouse/Transport cost: <5%
- Service level: <5%
- Speed to market: 5-10%
- Design time: 5-10%
- Lot size: <5%
- Net promoter score: <5%
- Environmental impact: <5%
- Employee satisfaction: <5%

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Your response

- Engineering
- Manufacturing

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What's next

- Study Growth Goals
 - Continue to track growth and changes with year over year study
 - Grow the study beyond our 100 founding participants
 - Implement division and conglomerate MI fingerprints and individual playbooks
- What can you do?
 - Read our research
 - Attend our Symposium May 4th, 2022
 - Sign up to participate in this year's study
 - Receive your company's custom Machine Intelligence Implementation Playbook with full participation

Read more about our research:

Harvard Business Review

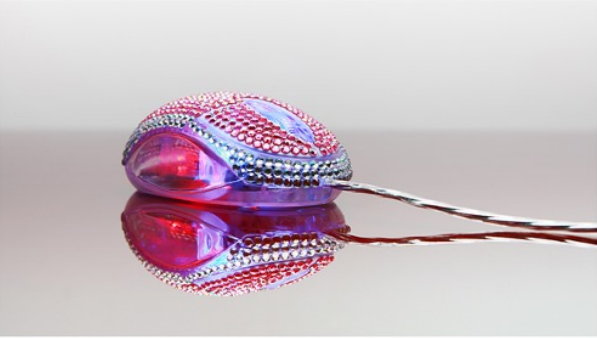
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What Makes a Company Successful at Using AI?

by Vijay D'Silva and Bruce Lawler

February 28, 2022




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Toward smart production: Machine intelligence in business operations

February 1, 2022 | Article

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A detailed study of machine intelligence in industrial and manufacturing operations reveals the surprisingly different paths companies can take. But a group of leaders shares similar characteristics.

McKinsey & Co.

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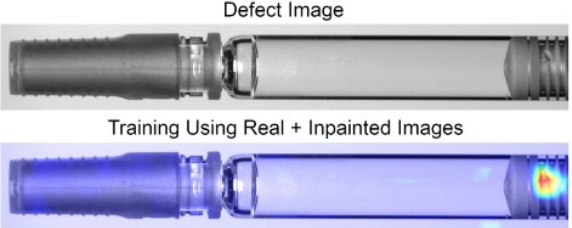
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Study examines how machine learning boosts manufacturing

Researchers surveyed 100 high-performing companies to determine which of them are leading adopters of machine intelligence and data analytics, and how they succeed.

Kara Baskin | Leaders for Global Operations
March 1, 2022



MIT News

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