2022 CIO Agenda: An Asset-Intensive Manufacturing Perspective

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CIOs in asset-intensive manufacturing industries must enhance agility for resilience during these uncertain economic times. The 2022 CIO and Technology Executive Survey explores their progress and challenges in adopting business composability, a promising approach to business agility.
**Overview**

**Key Findings**

- Companies that adopted modular composable business approaches are twice as likely as asset-intensive manufacturers (AIMs) to rank themselves ahead of their peers in terms of effectiveness at reducing risk and operating costs.
- AIMs are less likely to say they have established continuous and effortless sharing of ideas and access to platforms, tools and know-how across teams and groups than companies in the “high composability” cohort.
- Nearly two-thirds of AIMs stated that, in the next three years, they plan to invest in technologies that enable better IT/OT alignment, and 71% of AIMs are planning to increase their investment in cybersecurity in 2022.

**Recommendations**

Asset-intensive manufacturing industry CIOs seeking to digitally transform and innovate the business must:

- Enable more composable business by identifying those parts of the business where composability is possible and practical.
- Improve their capability for sharing ideas, platforms, tools and know-how by identifying for business leaders where such sharing will improve the business processes and then enabling appropriate technologies to improve sharing.
- Improve IT/OT alignment across physical assets and processes by deploying edge computing, asset performance management (APM), machine learning and digital twins to connect OT with IT.
- Invest in cybersecurity and related preparedness by including OT systems in a cybersecurity plan that encompasses both the IT and the OT technology landscapes.

**Survey Objective**

The 2022 Gartner CIO and Technology Executive Survey was conducted to inform CIOs and other technology executives on how composability can improve business performance during times of volatility.

**Data Insights**

The pandemic exposed the weaknesses of manufacturing companies as they were forced to respond to disruption quickly. For asset-intensive manufacturers, agility is something of a major strategic and practical challenge due to their greater inertia. Factors like a complex geopolitical “chessboard,” natural disasters, pandemics, financial instability and cyberthreats create an increasingly unpredictable future. This means manufacturing companies must build a reset strategy that redefines their structure, processes and governance in a bid to build greater foresight and agility to quickly adapt to changing conditions.
Asset-Intensive Manufacturers Defined

Gartner defines asset-intensive manufacturers (AIMs) as manufacturers in industries where the products are large and complex or the investments in factories and plants are high. Examples of AIM industries include aerospace and defense, automotive, industrial equipment, agricultural and mining equipment, refineries, and chemical plants.

Business composability (see Figure 1) is the combination of:

- Composable thinking
- Composable business architecture
- Composable technologies
Business composability is the mindset, the technologies and the set of operating capabilities that enable organizations to innovate and adapt quickly to changing business needs. Leveraging key principles in modularity enables enterprises to achieve the scale and pace to achieve their ambition. The modularity principles are inherent in composability, expand across business architecture, thinking processes, and technologies.

In practice, this is hard to accomplish among asset-intensive manufacturers because they have a deep dependency on IT-OT integration and where the integration points occur. There is a significant planned interdependence in process design. In this industry sector, reliability, safety and regulatory factors inhibit modular composable business — certainly at the technology level. However, there are other opportunities to benefit from composability such as IT used for sales, marketing, back-office functions and customer service.

**High-Composability Companies Report Greater Business Confidence Than Asset-Intensive Manufacturers**

The asset-intensive manufacturers in this report rate themselves poorer than the high-composability respondents in the four dimensions of business performance shown in Figure 2. Reducing risk of production “downtime” and reducing operating costs have the highest priorities in this category of companies. So, it is likely that the survey participants would grade themselves hardest for these two performance dimensions. In some cases, the asset-intensive manufacturers see themselves as less capable at reducing risk and cost, and in many cases, have already used technology to do so as much as they can. The high-composability group has greater confidence in performance. That confidence may translate to more investment compared to asset-intensive manufacturers who do not rank themselves higher than peers because of a lack of confidence.

**Recommendations**

CIOs must:

- Create a composability working group to gain in-depth understanding of composability concepts and identify companies that have successfully implemented composability with a good ROI.
- Judge the relevance of those examples for their companies as part of building a composability plan for their organizations.
Figure 2. High-Composability Companies Report More Confidence in Key Business Performance Metrics Than Asset-Intensive Manufacturers

Enterprise Business Performance
Percentage of Respondents Ahead or Far Ahead of Peers and Competitors

<table>
<thead>
<tr>
<th>Category</th>
<th>High Composability (n = 143)</th>
<th>Asset-Intensive Manufacturing Industries (n = 271)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Business Performance</td>
<td>63%</td>
<td>+24 pp</td>
</tr>
<tr>
<td>Increase Revenue/Funding</td>
<td>60%</td>
<td>+20 pp</td>
</tr>
<tr>
<td>Reduce Business Risk</td>
<td>23%</td>
<td>+27 pp</td>
</tr>
<tr>
<td>Reduce Operating Costs</td>
<td>47%</td>
<td>+22 pp</td>
</tr>
</tbody>
</table>

n varies by segment. CIOs and technology executives answering, excluding “don’t know”.
Q. Considering the past 12 months, rate your enterprise’s business performance compared with its peers or competitors.
Source: 2022 Gartner CIO and Technology Executive Survey
Note: pp = percentage points
The Nature of Asset-Intensive Manufacturing Undermines the Ability to Adopt Composability

Adopting composable thinking and composable architecture is relatively easy compared to making technology investments actually work. Therefore, asset-intensive manufacturers, on average, have wider use in those two categories of composability than composable technology. As a challenge to composability, asset-intensive manufacturers have a substantial amount of operational technology (OT) embedded in their assets. These manufacturers face high process reliability and integrity risks if they modernize their IT-OT environments. The risks come from the complexity related to interdependence of OT-driven assets and IT-OT interfaces.

Those assets also have long life cycles. OT is harder to change, the investments can be big (often in the $100s of millions) and the assets have long life cycles (+20 years). This makes it harder to quickly transition the technology than to change business architectures and thinking. It is also harder to justify the cost and disruption to the business. Therefore, asset-intensive manufacturers are further behind in adopting composable technology than composable thinking and architecture.

CIOs face at least two major challenges to including OT as part of a composable technology strategy:

1. The resistance or objections from the existing OT support staff
2. The technical characteristics and constraints of the OT systems themselves

CIOs might be able to negotiate the first challenge with OT owners. The success of such a negotiation will vary from company to company. However, the second challenge has technical constraints that cannot be negotiated away (see Figure 3).

Recommendations

CIOs must:

- Gain an understanding of the OT technologies in use and build dialogue with the owners of that technology to understand the opportunities and limits to when composability can be adopted.
- Respect the technical constraints OT requires as part of any composability strategy (see How IT Standards Can Be Applied to OT).
Figure 3. Composable Technology Is Less Used in Asset-Intensive Manufacturers Than Composable Thinking or Business Architecture

**Extent of Composability**

Average Scores on a Scale of 1 (Not at All) to 7 (Extensively Throughout the Enterprise)

- **Composable Thinking:**
  Our culture encourages the continuous exploration and creation of game-changing business capabilities.

- **Composable Business Architecture:**
  Business elements (e.g., capabilities, products, teams, processes, services, etc.) dynamically evolve to create new value.

- **Composable Technologies:**
  Technology assets and capabilities consist of modular components where assembly and reassembly are automated.

<table>
<thead>
<tr>
<th></th>
<th>High Composability (n = 150)</th>
<th>Asset-Intensive Manufacturing Industries (n = 279)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Extensively Throughout the Enterprise</td>
<td>Not at All</td>
</tr>
<tr>
<td>Composable Thinking</td>
<td>6.4</td>
<td>4.1</td>
</tr>
<tr>
<td>Composable Architecture</td>
<td>6.4</td>
<td>4.5</td>
</tr>
<tr>
<td>Composable Technologies</td>
<td>6.2</td>
<td>3.5</td>
</tr>
</tbody>
</table>

n varies by segment, CIOs and technology executives answering Q: To what extent does your enterprise utilize these principles?
Source: 2022 Gartner CIO and Technology Executive Survey
Ingrained Culture at Asset-Intensive Manufacturers Is a Major Inhibitor to Adopting Composability

The culture of asset-intensive manufacturers is not inherently high-trust and empowering. The complex and high-risk nature of business operations undermines cultivation of high trust and employee empowerment. For example, the production environment can be dangerous. Therefore, employees do not make their own decisions. Organizational structure matches the relatively rigid process-oriented environment (see Figure 4.)

Recommendations

CIOs must:

• Cultivate composable thinking within the IT organization to the extent that composability makes sense.
• Educate business leaders in other roles about composability and the benefits it can deliver.

Figure 4. Insufficient High-Trust Culture and Highly Structured Command Structure Inhibit Composable Thinking Practices at Asset-Intensive Manufacturers

Key Thinking Practices to Improve Business Composability

Percentage of Respondents Who Perform It

<table>
<thead>
<tr>
<th>Practice adaptive strategy to spot and respond to opportunities and threats</th>
<th>High Composability (n = 142)</th>
<th>Asset-Intensive Manufacturing Industries (n = 259)</th>
</tr>
</thead>
<tbody>
<tr>
<td>64%</td>
<td>30%</td>
<td></td>
</tr>
<tr>
<td>Promote a high-trust culture that empowers employees to independently make decisions</td>
<td>56%</td>
<td>23%</td>
</tr>
<tr>
<td>Empower internal functions, product teams, external allies and/or business partnerships to work together through autonomous, self-organizing networks</td>
<td>51%</td>
<td>21%</td>
</tr>
</tbody>
</table>
A Change in Mindset Can Selectively Increase Composability Adoption

Opportunities to empower employees for composability exist. For example, employees engaged in activities such as R&D, sales, marketing and customer services can be supported in virtual environments as in other industries such as banking or insurance. Composable thinking is a greater possibility for those activities than for manufacturing processes and asset maintenance since those are highly dependent on IT, with less OT involved. Therefore, asset-intensive manufacturers can apply composability selectively (see Figure 5).

Recommendations

CIOs must:

- Work with other C-level executives to identify where composability can be reliably applied to deliver greater business agility.
- Encourage the IT organization to work with business stakeholders to introduce the three dimensions of composability — composable thinking, business architecture and supporting technology.
- Invest in collaboration tools that will enable sharing of ideas and know-how across product and process teams.

Figure 5. Composability Opportunities Exist for Those Activities Less Constrained by the Need for IT-OT Orchestration

<table>
<thead>
<tr>
<th>Key Technology-Related Practices to Improve Composability</th>
<th>Percentage of Respondents Who Perform It</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish iterative development techniques (e.g., DevOps) as the default approach to development</td>
<td><img src="chart.png" alt="Bar Chart" /></td>
</tr>
<tr>
<td>Establish continuous and effortless sharing of ideas and access to platforms, tools and know-how across internal functions, product teams, external allies and/or business partnerships</td>
<td><img src="chart.png" alt="Bar Chart" /></td>
</tr>
<tr>
<td>Create dynamic and easily deployable integration capabilities for connecting data, analytics and application components</td>
<td><img src="chart.png" alt="Bar Chart" /></td>
</tr>
</tbody>
</table>

n varies by segment, CIOs and technology executives answering Q. Which of these technology-related practices
Source: 2022 Gartner CIO and Technology Executive Survey
Nine Composability Practices Can Enhance Asset-Intensive Manufacturer Business Performance

Composability can improve performance, increase revenue and increase profits for important AIM business activities. For example, composable thinking and business architecture can be applied to overall business approaches. Composable technology can be applied to activities such as R&D, selling, marketing and customer service processes. A composable IT environment can make adaptation to new R&D opportunities, customer-facing reporting, new service bundles, scheduling service calls and financial services more flexible and profitable with greater revenue generation (see Figure 6).

Recommendations

CIOs must:

- Review the nine recommendations in Figure 6, and assess how each one applies to their companies.
- Discuss these nine recommendations with colleagues in leading business roles as part of developing a composability strategy.
- Create workshops or a center of excellence that can educate the workforce about composability and accelerate its adoption.

Figure 6. Apply Composability Practices for Those Activities Where Composability Makes Sense

 Enterprises’ Composability Action Plan

<table>
<thead>
<tr>
<th>Composable Thinking</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Spot threats and opportunities</td>
</tr>
<tr>
<td>• Enable high trust and independent decision making</td>
</tr>
<tr>
<td>• Promote autonomous, self-organizing teamwork</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Composable Business Architecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Focus teams on value, transparency and accountability</td>
</tr>
<tr>
<td>• Design business processes in line with technology capabilities</td>
</tr>
<tr>
<td>• Share accountability between IT and the business</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Composable Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Make iterative development your default approach</td>
</tr>
<tr>
<td>• Establish continuous and effortless idea sharing</td>
</tr>
<tr>
<td>• Create dynamic and easily deployable application and data integration</td>
</tr>
</tbody>
</table>

Source: Gartner
Asset-Intensive Manufacturers Continue Investment Priorities in IT Security, Business Intelligence and Cloud

The major technology investment trends continue with cyber/information security, business intelligence/data analytics and cloud platforms as the top three technologies as they have been during prior years (see Figure 7).

Concerns about cyberattacks motivate cybersecurity investments. Ability to monitor equipment, customer satisfaction, product performance, asset performance and business performance motivate business intelligence investments. Cloud support can enhance some aspects of the business such as sales, marketing and customer service, as can composability. However, adoption of cloud in asset-intensive environments such as factories or utility plants may be more challenging.

Recommendations

CIOs must:

• Consider OT security, as well as IT security. The approach to security should be hybrid IT and OT. This means it considers the interdependencies of IT and OT, which can be complex.

• Weigh the trade-offs of business agility that cloud delivers against the complexity of integrations across business applications that cloud adoption in AIM companies will require. Some of the applications can function well in the cloud, while others will be more secure and perform better on-premises.

• Work with the teams that create and deploy IoT and automation investments to ensure more integrated business intelligence and analytics outcomes that have business value. Work with engineering and operations, which have traditionally been involved in the acquisition and deployment of cyber/physical systems.
Figure 7. Asset-Intensive Manufacturer Investment Trends in Technology for 2022

Changes in Technology Investments
Percentage of Asset-Intensive Manufacturing Industries Respondents

<table>
<thead>
<tr>
<th>Technology Area</th>
<th>Percentage of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyber/Information Security</td>
<td>71%</td>
</tr>
<tr>
<td>Business Intelligence/Data Analytics</td>
<td>53%</td>
</tr>
<tr>
<td>Cloud Platforms</td>
<td>46%</td>
</tr>
<tr>
<td>Enterprise Resource Planning</td>
<td>39%</td>
</tr>
<tr>
<td>Legacy Application Modernization</td>
<td>35%</td>
</tr>
<tr>
<td>Digital Business Transformation Initiatives (including Digital Marketing)</td>
<td>33%</td>
</tr>
<tr>
<td>Integration Technologies/APIs/API Architecture</td>
<td>33%</td>
</tr>
<tr>
<td>Artificial Intelligence/Machine Learning</td>
<td>29%</td>
</tr>
<tr>
<td>Digital Workplace</td>
<td>28%</td>
</tr>
<tr>
<td>Internet of Things</td>
<td>23%</td>
</tr>
<tr>
<td>Hyperautomation</td>
<td>22%</td>
</tr>
<tr>
<td>Total Experience Solutions</td>
<td>20%</td>
</tr>
<tr>
<td>Connectivity</td>
<td>18%</td>
</tr>
<tr>
<td>Business Continuity Management</td>
<td>17%</td>
</tr>
<tr>
<td>Legacy Infrastructure and Data Center Technologies</td>
<td>12%</td>
</tr>
<tr>
<td>Digital Media</td>
<td>11%</td>
</tr>
<tr>
<td>Containerization and Orchestration of Application Workloads</td>
<td>7%</td>
</tr>
<tr>
<td>Product Portfolio Management Tools</td>
<td>7%</td>
</tr>
<tr>
<td>Human Augmentation</td>
<td>6%</td>
</tr>
<tr>
<td>Next-Generation Compute Technology</td>
<td>3%</td>
</tr>
<tr>
<td>None</td>
<td>1%</td>
</tr>
</tbody>
</table>

n varies by question, asset-intensive manufacturing industries respondents, excluding “not sure”

Q: What are the technology areas where your enterprise will be spending the largest amount of new or additional funding in 2022 compared with 2021?
Q: What are the technology areas where your enterprise will be reducing funding by the highest amount in 2022 compared with 2021?

Source: 2022 Gartner CIO and Technology Executive Survey
Top Investment in Technologies Favors Asset Monitoring and OT Integration in the Next Three Years

Composability of legacy manufacturing infrastructure remains a distant possibility. The technologies planned for the next three years might accelerate the progress. APM based on machine learning and IoT will prove to be more configurable and mobile than the legacy environments they might replace. Edge devices and computing where data is collected can make the assets more modular, hence, more configurable. This also raises the importance of IT/OT alignment and integration to be able to take advantage of the data emanating from OT platforms and raises the stakes in terms of OT platforms being well-managed and secured.

These investments can improve employee decision making and competency. However, organizations will need to coordinate these interrelated investments or they will fail to deliver positive ROI. Edge computing can feed APM with equipment data, but only if there is a sound alignment and integration of IT and OT systems and departments. APM investments without a sound basis of EAM will be problematic, which is why we see EAM ranked relatively highly even though it is an older technology class. It will need to be modernized and upgraded to take full advantage of the other concepts (see Figure 8).

Recommendations

CIOs must:

- Assess their organizations’ asset management capabilities and maturity by working with business and IT leads to ensure that the requisite level of people/skills, processes and data are in place as a prerequisite to APM.
- Map the requisite maintenance activities needed to achieve specific business outcomes across asset classes. Work with IT departments and business users to determine a viable asset strategy roadmap to expand the available systems from where they are now to a full capability.
- Evaluate potential vendor products by completing fit-gap analysis focusing on business goals mapping compared to application functionality. This will create a more complete repertoire of maintenance capabilities by asset class across your organization, providing a broad array of skills and tools.
Figure 8. Top Technology Picks Are for Asset/Product Health and Monitoring

Investment Plans for Manufacturing — Specific Technologies

- Asset and Performance Management — ML: 18%, 22%, 27%
- Edge Devices and Computing: 16%, 24%, 26%
- IT/OT Integration Through Platform Alignment: 19%, 22%, 22%
- Digital Workplace With Wearables: 15%, 23%, 20%
- IT/OT Other Alignment: 23%, 21%, 18%
- Digital Systems (Digital Twins): 16%, 25%, 18%
- Machine Learning: 16%, 18%, 20%
- Asset and Performance Management — IoT: 22%, 18%, 17%
- IT/OT Integration Through Data Standards OPC UA: 14%, 16%, 24%
- Model-Based System Engineering: 12%, 16%, 21%
- Enterprise Asset Management: 21%, 11%, 13%
- Digital Thread: 17%, 19%, 10%
- Revenue Growth Management: 20%, 8%, 15%
- 3D Printing in Manufacturing Operations: 6%, 12%, 16%
- Supervisory Control and Data Acquisition: 10%, 12%, 11%
- Manufacturing Execution System: 13%, 7%, 13%
- Building Information Modeling: 6%, 11%, 16%
- Product Life Cycle Management: 15%, 9%, 6%
- Innovation Centers: 8%, 12%, 10%
- Trade Promotion: 9%, 10%, 9%
- Retail Execution: 6%, 7%, 10%
- Engineering Systems: 5%, 6%, 6%

n = 125 asset-intensive manufacturing industries CIOs and technology executives answering
Q. Please indicate your enterprise’s interest or activity regarding investments in the following manufacturing-sector-specific technologies (including totally new investments)

Source: 2022 Gartner CIO and Technology Executive Survey

Note: The values 4% and below are not shown.
Additional Research Contribution
Melissa Rossi Wood

Evidence

Research Methodology
The 2022 Gartner CIO and Technology Executive Survey was conducted online from 3 May 2021 through 19 July 2021 among Gartner Executive Programs members and other technology executives. The total sample is 2,387, with representation from all geographies and industry sectors (public and private), including 279 from asset-intensive manufacturing. The survey was developed collaboratively by a team of Gartner analysts, and was reviewed, tested and administered by Gartner’s Research Data and Analytics team. Disclaimer: Results do not represent global findings or the market as a whole but reflect sentiment of the respondents and companies surveyed.

The 2022 CIO and Technology Executive Agenda report segments respondents based on self-reported extent of utilization of principles of composability. This segmentation allows a group of “high composability” enterprises to be identified as a best practices group to contrast the performance of others.

We define high-composability enterprises (n = 150) as those that utilize the principles of composable thinking, business architecture and technologies “widely” or “extensively throughout the enterprise.”

Low-composability enterprises (n = 316) utilize the principles of composable thinking, business architecture and technologies “not at all,” “rarely” or “somewhat.”

Moderate-composability enterprises (n = 1,921) encompass the rest of the sample.
Actionable, objective insight

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  - Download Now

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  - Download Now

- **Webinar**
  - The Gartner Top Strategic Technology Trends for 2022: Manufacturing
  - The trends shaping the future for manufacturing companies
  - Watch Now

- **Resource Hub**
  - CIO Insights & Tools
  - Drive stronger performance on your most critical priorities
  - Learn More

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