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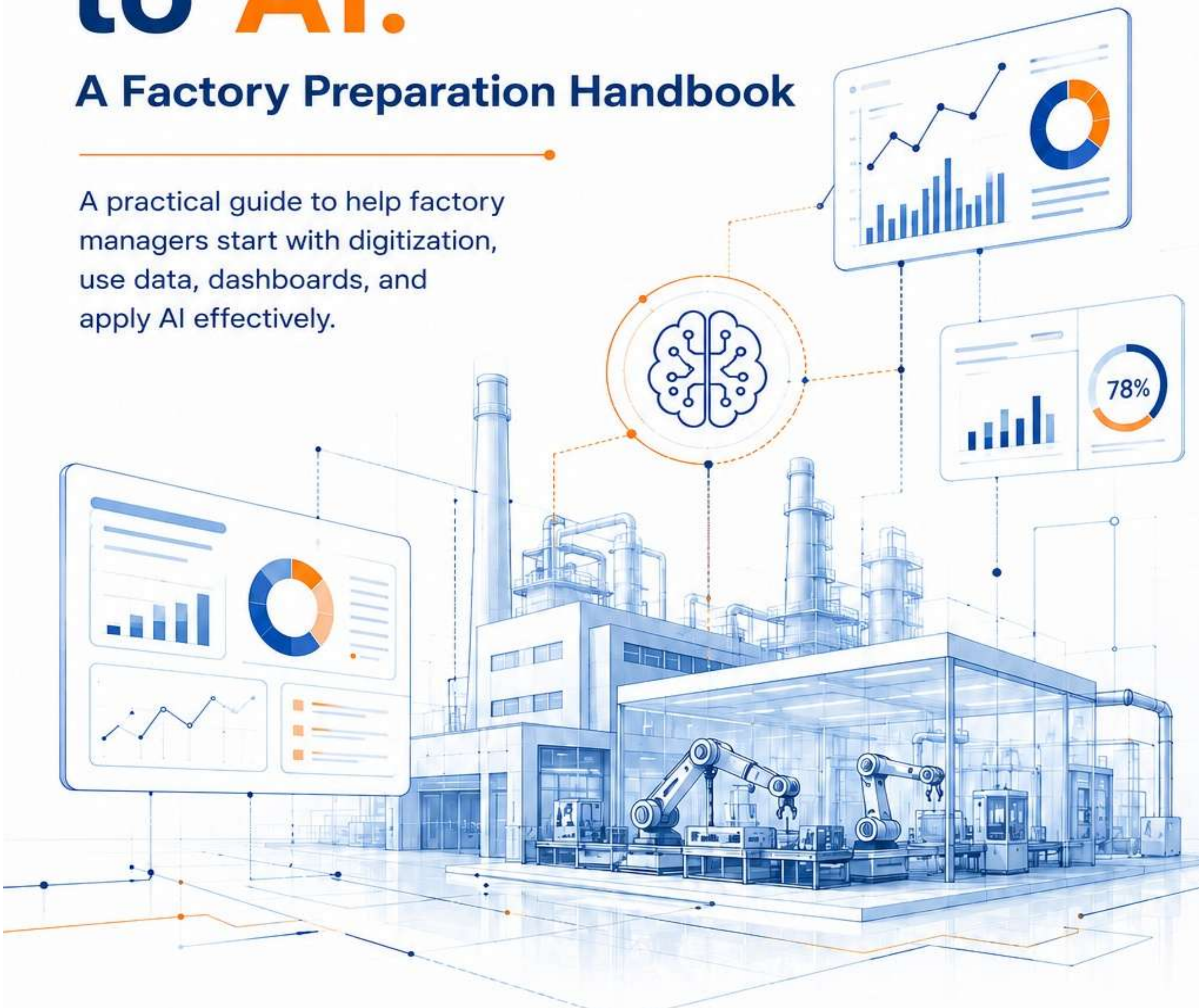
EBOOK

From Digitization to AI:

A Factory Preparation Handbook

A practical guide to help factory managers start with digitization, use data, dashboards, and apply AI effectively.



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Foreword

In recent years, “digitization” and “AI” have become some of the most frequently discussed topics in manufacturing. Almost every factory now hears about digital transformation, data, dashboards, AI copilots, machine failure prediction, production optimization, automatic OEE analysis, abnormality alerts and many other attractive applications.

But for many factory managers, the practical question is not: “Is AI available?”

The more practical question is:

“Where should my factory start?”

If a factory still relies heavily on paper, Excel, manual reports, scattered data and processes that are not consistent across shifts, should it start with AI immediately? If there is no good dashboard yet, should it invest in AI? If the data is not standardized, does all data have to be cleaned first? If operators on the shop floor do not enter data fully, will the system still have value? If the factory invests and people do not use the system, what happens then?

These are very real questions. They are the reason this handbook was written.

From Digitization to AI: A Factory Preparation Handbook is not a technical document about AI. It is not intended to persuade factories to chase a new technology trend. Its purpose is simpler and more practical: to help factory managers understand what needs to be prepared in order to move from manual, fragmented operations to digitization, data-driven management, dashboards and step-by-step AI adoption in operations.

AI can create significant value in factories. But AI does not start with algorithms. AI starts with fundamentals: clearer processes, more reliable data, better-connected systems, dashboards used in daily management, well-organized documents and knowledge, and people who are ready to change the way they work.

A factory does not have to be “perfect” before it can start. But to start well, the factory needs to know where it stands today, where value is being lost, what data already exists, which processes need standardization, which areas should be prioritized and which use case is specific enough to begin with.

This handbook is written in a question-and-answer format, based on the questions that production managers often have when facing the trend of factory digitization and AI adoption. Each question is answered in three parts:

Short answer - to capture the main idea quickly.

Practical explanation - to explain the issue in the context of factory operations.

What managers should do - to suggest a concrete action after reading.

You do not need to read this handbook like a textbook from beginning to end. You can read by groups of questions, starting with the issue closest to your factory: downtime, OEE, maintenance, production, quality, data, dashboards, people, costs, security, AI Copilot or implementation roadmap.

The core spirit of this handbook is:

Do not start from technology. Start from operational problems.

Do not start from AI. Start from proper digitization.

Do not make a large investment immediately. Choose a use case that is specific enough, measurable and expandable after its value has been proven.

When done correctly, digitization is not simply replacing paper with software. A dashboard is not just a set of attractive charts. AI is not just a new feature for demonstration. All of them must serve the same goal: helping the factory operate with more transparency, respond faster, make better decisions and gradually strengthen its competitiveness.

I hope this handbook gives you a clearer view before starting the journey from digitization to AI in your factory.

Chapters and Questions

1. Chapter 1: Why should factories care about digitization and AI?

This chapter is for managers who hear a lot about digitization and AI but still have a very practical question in mind: "Is this really relevant to my factory?"

Before talking about software, dashboards or AI, the factory needs to answer a more fundamental question: why must it change the way it currently operates?

1.1. Question 1: Are digitization and AI really necessary for my factory?

Short answer:

Yes, but the level of necessity depends on the current state and goals of each factory. Not every factory needs to implement AI immediately, but most factories need better digitization if they want more transparent, faster and more accurate operational management.

Practical explanation:

In many factories, operational data is still scattered across paper, Excel, manual reports or the personal experience of a few senior employees. When an incident occurs, management often has to ask many departments before understanding what is happening. When they need to analyze downtime, productivity, quality defects or maintenance costs, the data may be missing, inconsistent or not reliable enough.

Digitization helps the factory record and manage daily operations in a more systematic way. AI is the next step, helping with analysis, suggestions, alerts or decision support once the factory has a sufficiently strong data foundation.

What managers should do:

Do not begin with the question, "Should I implement AI?" Begin with: "Where is my factory lacking transparency, where are decisions slow, and where are we still depending on manual data?"

1.2. Question 2: Is this a real trend or just a fad?

Short answer:

Digitization is a real trend because it solves very practical problems in production management. AI is also a real trend, but if it is deployed before the foundation is ready, it can easily become a fad.

Practical explanation:

A factory that has not digitized well will struggle to control production progress, downtime, maintenance, quality, inventory, energy or traceability. These are not fashionable topics; they are real management needs.

AI is similar. It can support machine failure prediction, downtime cause analysis, technical document search, abnormality alerts and action recommendations. But AI only creates value when it is connected with real data, real processes and real users. If AI is implemented only to demonstrate technology, the project is likely to stop at the demo stage.

What managers should do:

Separate technology trends from operational problems. Invest in digitization or AI only when it helps solve a specific problem such as reducing downtime, increasing OEE, reducing defects, controlling progress or reducing dependence on manual reports.

1.3. Question 3: What risks do I face if I do nothing now?

Short answer:

There are risks. The issue is not only being "behind in technology"; the bigger risk is that the factory continues to operate based on slow, inaccurate data and heavy dependence on people.

Practical explanation:

When a factory has not digitized, many management decisions still rely on end-of-day reports, end-of-week reports or each department's personal judgment. Incidents happen first, then data is summarized later. Downtime becomes long before anyone analyzes it. Quality defects repeat many times before their causes are traced. When experienced employees leave, their knowledge often leaves with them.

In the short term, the factory can still operate. But in the long term, this way of working reduces responsiveness, transparency and improvement capability. When the market requires faster delivery, more stable quality, better traceability and lower costs, factories without a digital foundation will be disadvantaged.

What managers should do:

Check how long it currently takes management to know the real situation of the factory: output, downtime, OEE, quality defects, maintenance status and order progress. If the answer is "we have to wait for someone to summarize it," that is a sign the factory should begin digitizing more seriously.

1.4. Question 4: Are my competitors doing this?

Short answer:

They may be. But the more important question is whether competitors are managing operations faster, more transparently and with better data than you are.

Practical explanation:

A factory may not always know what software its competitors use or how far they have gone with AI. But it can see the results: more stable delivery, better quality control, faster response to changes, less downtime or faster response to customer requirements.

Digitization and AI are not a race to own the newest technology. They are a race in operational capability. The factory that sees problems earlier, analyzes causes faster and acts more consistently will have the stronger advantage.

What managers should do:

Do not only ask, “Are competitors using AI?” Ask instead: “Are competitors controlling downtime, OEE, quality, progress and traceability better than we are?” If the answer is yes, the factory should reassess its digitization capability.

1.5. Question 5: Do customers require factories to digitize, make data transparent and improve traceability?

Short answer:

More and more customers care about traceability, data transparency, process control and operational evidence. Digitization helps factories meet these requirements better.

Practical explanation:

In many industries, customers are not only interested in whether the final product passes inspection. They also care about how the product was made, which machines were involved, which lot was related, where the defect occurred, what corrective actions were taken, whether equipment maintenance was performed properly, and whether quality and safety documents are controlled.

If data is stored on paper or in many separate Excel files, traceability is slow and prone to mistakes. During customer audits or quality incidents, the factory may spend a great deal of time gathering, cross-checking and explaining data.

What managers should do:

Review the audit, traceability and reporting requirements customers often raise. If every audit requires many people to gather documents manually, that is a clear sign that the factory needs better digitization.

1.6. Question 6: Can digitization and AI help increase revenue, or are they only additional costs?

Short answer:

Digitization and AI do not create revenue directly like selling a new product, but they can help the factory increase delivery capability, improve quality, reduce waste and respond to customers better. These factors can support revenue growth over the long term.

Practical explanation:

A better-managed factory can deliver on time more consistently, reduce defects, reduce downtime, respond faster to changes and demonstrate its capability to customers more easily. These factors directly affect customer trust.

If a factory often misses schedules because it cannot see production status clearly, loses orders because it cannot meet traceability requirements, or receives complaints because the same defects repeat, then digitization becomes a foundation for protecting and growing revenue.

What managers should do:

Do not treat digitization only as software cost. Link it to business goals: increasing on-time delivery, reducing customer complaints, increasing production capacity, reducing waste or meeting audit requirements better.

1.7. Question 7: Can digitization and AI really reduce operating costs?

Short answer:

They can, if they are connected to specific operating costs such as downtime, quality defects, emergency maintenance, spare parts inventory, reporting time or energy consumption.

Practical explanation:

Operating costs in a factory are often not located in one obvious large item. They are scattered across many areas: unexpected machine stoppages, technicians spending time searching for documents, preventive maintenance not done on time, repeated quality defects, rework, many hours spent preparing reports, spare parts overstocked but still unavailable when needed.

Digitization helps the factory see these costs more clearly. Dashboards help track them more frequently. AI can support trend detection, abnormality alerts and cause suggestions when the data is good enough.

What managers should do:

Choose two or three types of operating cost that hurt the factory most, such as downtime, defective goods, scrap, overtime, emergency spare parts or report preparation time. Then assess how digitizing data could help reduce those costs.

1.8. Question 8: Can digitization and AI reduce dependence on people, especially long-tenured experts?

Short answer:

Yes, but not by replacing people. Digitization and AI help capture, standardize and share operational knowledge so that the factory depends less on a few individuals.

Practical explanation:

In many factories, when a machine has a problem, everyone looks for “Mr. A” or “Ms. B” because they have the experience to handle it. When the factory needs to know equipment history, old defect causes or how to adjust a machine, the information may exist only in a few people’s memories. This is a major risk.

Digitization helps record work history, incidents, causes, corrective actions and related documents. An AI Copilot or knowledge management system can help new employees find knowledge faster, ask questions in context and learn from recorded experience.

What managers should do:

Identify the areas most dependent on senior experts. Start capturing procedures, common failures, troubleshooting methods, checklists and technical documents so individual experience becomes organizational knowledge.

1.9. Question 9: Can digitization help me manage the factory better, faster and with less subjectivity?

Short answer:

Yes, if the factory builds reliable data and dashboards that fit the way it manages operations. Decisions will no longer depend mainly on personal feelings when reports are missing or delayed.

Practical explanation:

A manager often needs to answer many questions: is today’s production meeting plan, which machine has the most downtime, which order is at risk of delay, which department is overloaded, which defect is increasing, is preventive maintenance overdue?

If these questions must wait for manual summaries, the manager is always behind reality. With good data and dashboards, the manager can see problems earlier. With AI support, the manager can also receive suggestions about trends, abnormalities and possible causes.

What managers should do:

List the ten management questions you need answered daily or weekly. Then check whether they are answered today by automatic data, manual reports or personal judgment.

1.10. Question 10: If we do not implement AI and only digitize, is that enough?

Short answer:

In many cases, good digitization already creates major value. However, if the factory wants deeper analysis, earlier warnings and better decision support, AI becomes the natural next step.

Practical explanation:

Digitization helps the factory record and manage work better. Dashboards help the factory see operations more clearly. But as data grows, managers will need faster analytical support: why downtime is increasing, which equipment is at risk, which defects are repeating, which documents relate to an incident and which actions should be prioritized.

That is when AI can create value. AI does not replace digitization; it develops on top of it. If digitization is weak, AI will be difficult to make effective. If digitization is strong, AI has many opportunities to become a practical operational support tool.

What managers should do:

Think of digitization as the foundation, dashboards as the step that helps the factory see clearly, and AI as the step that supports analysis, recommendations, alerts or prediction. You do not need to implement AI immediately, but you should digitize in a way that prepares for AI in the future.

2. Chapter 2: How are digitization, datafication, dashboards and AI different?

Many factories start talking about AI while their digitization foundation is still unclear. Some think that buying new software is already digital transformation. Others have many Excel reports or dashboards but may still not have data good enough for decisions.

Before investing, managers need to distinguish four concepts: digitization, datafication, dashboards and AI. These are not four separate activities, but four closely connected steps in the journey to improve factory operational capability.

2.1. Question 11: What is digitization? Is it only about removing paper and using software?

Short answer:

Digitization is not only removing paper and using software. It means moving the factory's daily operational work onto a system so data is recorded at the right time, responsibilities are clearer, progress is easier to track and management depends less on paper, Excel or personal experience.

Practical explanation:

If a factory simply turns a paper form into an Excel file or a data-entry screen, but the process remains messy, data is still missing and users enter data just to comply, then this is only a tool change, not true digitization.

Proper digitization must help the factory manage a specific business process better. For example, digitizing maintenance is not only creating maintenance work orders in software. It should show who requested the work, who approved it, who performed it, which machine failed, the cause, downtime duration, spare parts used, whether the work was completed on time and how the equipment history is stored.

Similarly, digitizing production is not only entering end-of-shift output. It should help the factory see the plan, actual output, progress, downtime, reasons for downtime, quality defects and performance by shift, line and product.

What managers should do:

When discussing digitization, do not only ask, "Do we have software?" Ask: "Does this software make the process clearer, the data more complete, responsibilities more transparent and decisions faster?"

2.2. Question 12: How is datafication different from digitization?

Short answer:

Digitization brings work and processes onto a system. Datafication turns those activities into structured, contextual data that can be used for analysis, measurement, alerts or improvement.

Practical explanation:

A factory may already be digitized but not yet datafied well. For example, technicians may create maintenance work orders in a system, but if the description only says “machine broken” or “fixed,” that data is very hard to analyze. The factory cannot know what type of fault it was, what caused it, how long the downtime lasted, which spare parts were used or whether the fault is recurring.

Good datafication means information is recorded in a way that can be reused. Downtime is classified by cause group. Equipment has clear codes. Products, operations, lines and shifts are standardized. Quality defects have defect codes, process step, cause and corrective action.

Digitization helps the factory operate on a system. Datafication helps operational activities become structured data that can be measured, compared and analyzed.

What managers should do:

Review the data being recorded every day. Do not only check whether people enter data. Check whether the data is clear enough to answer management questions such as: why did downtime occur, which defects repeat, which equipment is risky, which shift has low productivity and which products often create problems.

2.3.Question 13: How is a dashboard different from an Excel report?

Short answer:

An Excel report is often data manually summarized on a schedule. A true operational dashboard should be connected to reliable data sources, updated automatically or nearly automatically, and help managers monitor operations regularly for more timely decisions.

Practical explanation:

Excel is useful, but in many factories Excel reports depend heavily on manual work. Staff collect data from many sources, copy, edit, summarize and send by email. By the time the report reaches management, the data may already be hours, days or even a week late.

A good dashboard is not just beautiful charts. A true operational dashboard should help managers see problems closer to real time, track trends continuously and answer important questions: is production meeting plan today, which line is behind, which machine has the most downtime, what are the main downtime causes, is OEE decreasing because of Availability, Performance or Quality, and which maintenance work orders are overdue.

What managers should do:

Choose several of the most important Excel reports today and ask: how long do they take to prepare, are they often wrong, and do they arrive in time for decisions? Reports that are slow, repetitive and important to operations should be prioritized for conversion into dashboards.

2.4. Question 14: How is AI different from conventional management software?

Short answer:

Conventional management software helps record, track and control processes. AI can support analysis, abnormality detection, suggestions, prediction or question answering based on data and knowledge already in the system.

Practical explanation:

Maintenance software can create work orders, schedule preventive maintenance, record spare parts and track equipment history. AI can go further by suggesting which equipment shows repeated failures, which cause groups are increasing downtime or which document a technician should read when handling a specific fault.

Production software can record plans, output, downtime and OEE. AI can help analyze why OEE is dropping, detect abnormal cycle time, warn about schedule risks or suggest which line or process step needs attention.

However, AI does not replace core management software. Without good systems to record data, AI lacks the material needed for analysis and suggestions.

What managers should do:

View management software as the place where data is created and processes are controlled. View AI as a support layer above it that helps exploit data and knowledge better. Do not expect AI to solve issues that the underlying processes and data have not clarified.

2.5. Question 15: How is AI different from a dashboard?

Short answer:

A dashboard helps managers see what is happening. AI helps analyze more deeply, suggest why it is happening, what may happen next and where attention should be focused.

Practical explanation:

A dashboard may show that downtime increased 15% this week, OEE on Line A decreased, defects in packaging increased or a group of maintenance work orders is overdue. But a dashboard usually does not explain the full cause by itself.

AI can support more complex analysis: downtime increased mainly on the night shift, related to a group of equipment, after a product changeover or after a repeated defect type. AI can also allow users to ask questions in natural language, such as "Why did OEE decrease this week?" or "Which equipment has repeated failures in the last three months?"

In simple terms, a dashboard helps the factory see the problem. AI helps the factory understand the problem faster and may suggest action.

What managers should do:

Before thinking about AI, make sure the main operational dashboards already answer "What is happening?" Then ask the next question: "Where do I need AI to support deeper analysis?"

2.6. Question 16: Does having a dashboard mean we already have AI?

Short answer:

No. A dashboard is not AI. A dashboard is a tool for displaying and monitoring data. AI is a tool for analysis, learning from data, making suggestions, prediction or question answering.

Practical explanation:

Many dashboards display very attractive numbers: output, downtime, OEE, quality defects, energy consumption and work order status. These dashboards are valuable, but they are not AI if they only display data using predefined formulas and filters.

AI begins to appear when the system can support tasks such as abnormality detection, trend prediction, cause suggestion, automatic classification, information summarization, answering questions from documents or proposing actions based on data.

This does not make dashboards less important. On the contrary, dashboards are often a necessary step before AI, because they help the factory see the data clearly and identify which problems are worth applying AI to.

What managers should do:

Do not call every dashboard AI. Separate them clearly: dashboards are for seeing and monitoring; AI is for analyzing, suggesting, predicting or answering questions. When a vendor says they have AI, ask exactly what the AI does and where it creates value in the process.

2.7. Question 17: Does buying software with the word AI mean the factory has applied AI?

Short answer:

No. A factory truly applies AI only when AI is used in a specific operational process, with real users, real data and measurable value.

Practical explanation:

Software may advertise many AI features, but if users do not use them, data is insufficient, processes do not change and KPIs do not improve, then the AI has not created real value.

For example, an AI Copilot may answer technical questions, but if machine documents are not standardized, SOPs are not updated, access rights are unclear and technicians do not use it during troubleshooting, the effectiveness will be low.

Similarly, a machine failure prediction model sounds attractive, but if sensor data is insufficient, maintenance history is not standardized and failure causes are not clearly recorded, the prediction will be hard to trust.

AI adoption is not buying a feature. AI adoption is putting analytical or intelligent support capability into daily work.

What managers should do:

When evaluating an AI solution, ask three questions: what data does the AI use, whom does it support in which process, and which KPI measures effectiveness? If these three questions are unclear, do not rush to consider it a valuable AI project.

2.8. Question 18: How are digitization, datafication, dashboards and AI related?

Short answer:

Digitization creates the operational system. Datafication records operational activities as structured data so the factory can measure, compare and analyze. Dashboards help visualize and manage data. AI helps analyze, suggest, alert, predict or support decisions.

Practical explanation:

This journey can be imagined as a chain of capability development.

First, the factory digitizes important processes such as maintenance, production, quality, warehouse or safety. When these activities are properly recorded, the factory begins to have operational data.

Next, data must be standardized for analysis: equipment codes, product codes, defect codes, downtime codes, operations, shifts, causes, time and responsible people. When data is structured, dashboards can display the operational situation clearly.

Once dashboards help the factory see problems, AI can be used for deeper analysis: why the problem happened, what trend is emerging, what risks need attention, which documents are related and which actions should be prioritized.

What managers should do:

View these four concepts as a roadmap, not four separate projects. When investing in digitization today, think about tomorrow's data, the dashboard after that and future AI.

2.9.Question 19: Which step is my factory currently at on this journey?

Short answer:

A factory may be at one of several stages: manual/fragmented operations, partial digitization, datafication, dashboard use, or early AI support. The important thing is to recognize the current state correctly, without overestimating or underestimating it.

Practical explanation:

A factory that still relies heavily on paper, scattered Excel files and manual reports is usually at the manual or fragmented stage. If it already has software for some processes such as maintenance, production or quality, it is at the partial digitization stage.

If data is recorded in a structured way, with standard codes, and can be analyzed by equipment, line, product, shift and cause, the factory has begun to datafy better. If data is displayed on dashboards and used in daily management, the factory has moved a significant step forward.

AI should be considered the next step only when the factory has a clear use case, reliable data and a specific process for use.

What managers should do:

Describe your factory honestly in one sentence: “We mainly manage by paper and Excel,” “We have software but data quality is not good,” “We have dashboards but do not use them consistently,” or “We have data good enough to test AI for a specific problem.” This description will help identify the right next step.

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2.10.Question 20: Should we move step by step, or can we jump directly to AI?

Short answer:

Factories should move step by step, but that does not mean waiting until everything is perfect before thinking about AI. The best approach is to begin by digitizing important processes while ensuring that data is recorded in a structured way, can support dashboards and gradually prepares the foundation for future AI use cases.

Practical explanation:

Jumping directly to AI when data is not standardized, processes are unclear and dashboards are absent often leads to disappointment. AI results may be unreliable, users may not know how to use them and leadership may not be able to measure effectiveness.

However, moving step by step does not mean moving slowly. The factory can start with one area, one line, one equipment group or one specific problem. For example, start by digitizing maintenance for critical equipment, standardizing downtime causes, building MTTR/MTBF/downtime dashboards and then testing AI for repeated-failure analysis or technical document search.

The important point is that each step must create real value and improve the data foundation for the next step.

What managers should do:

Do not set the goal of “AI for the whole factory” from the beginning. Choose a valuable operational problem, digitize the related process properly, build data and dashboards first, then use AI where analysis, recommendations or decision support are truly needed.

3. Chapter 3: Where should the factory start?

After understanding how digitization, datafication, dashboards and AI relate to one another, the next question for most managers is: "Where should my factory start?"

This is an important question because starting in the wrong place can make the project long, costly, poorly adopted and damaging to leadership's confidence in digital transformation. The factory does not have to start with the biggest initiative, and it should not start only because a technology is being widely discussed. The best starting point is usually where three factors meet: the problem is painful enough, the data can be collected and real users genuinely need improvement.

3.1. Question 21: Which department should my factory digitize first?

Short answer:

Start with the department that has the clearest operational problem and can generate useful data for management. Common starting points are maintenance, production, quality or warehouse, depending on the factory's main pain point.

Practical explanation:

There is no single answer for every factory. If the main pain is downtime, unexpected failures, inconsistent preventive maintenance and missing repair history, start with maintenance. If the biggest problem is unclear production progress, low OEE, frequent line stoppages or delayed output reports, start with production.

If the factory faces repeated quality defects, difficulty tracing causes or heavy preparation for audits, quality may be the best place to begin. If the problem lies in inventory, material shortage, poor spare parts control or unclear issuing, warehouse and materials can also be prioritized.

The starting point should not be chosen by feeling or because a department is "easiest to do." It should be chosen where digitization creates data that helps management make better decisions.

What managers should do:

List the three most painful operational problems today. Then identify which department owns each problem, whether it can be measured, where the data is currently stored and who will use the result every day after digitization.

3.2. Question 22: Should we start with production, maintenance, quality, warehouse or energy?

Short answer:

Start where the impact on the factory's key KPI is most direct. For many factories, production and maintenance are the most practical starting points because they directly affect OEE, downtime, productivity and cost.

Practical explanation:

Production creates output, progress and productivity. If the factory cannot see production by shift, line, product and process step, management will struggle to respond when orders are at risk of delay or productivity falls.

Maintenance directly affects equipment availability. If machines fail unexpectedly, preventive maintenance is not performed on time or failure history is unclear, the factory will find it difficult to reduce downtime and improve OEE.

Quality is also critical, especially in industries with strict requirements for traceability, product defects and audits. Warehouse, materials, spare parts and energy may also be good starting points if they create high cost or weak control.

Do not choose by department name. Choose by asking: "If we digitize this area, will the factory make better decisions and reduce clear losses?"

What managers should do:

Link each area to a KPI: production with output, progress and OEE; maintenance with downtime, MTTR and MTBF; quality with defect rate, complaints and traceability; warehouse with inventory, shortages and spare parts; energy with consumption cost. The area with the most painful KPI should be considered first.

3.3. Question 23: If resources are limited, what should we choose first?

Short answer:

Choose a small problem with clear value instead of trying to digitize many departments at once. Prioritize a place with a specific problem, clear ownership and data that can start to be collected.

Practical explanation:

A common mistake is beginning with a project that is too broad: digitizing the whole factory, connecting all systems, building dashboards for every department or implementing AI for many use cases at once. This approach easily overloads the project team, confuses users and delays results.

Limited resources are not a disadvantage if the factory chooses scope well. Instead of digitizing all maintenance, begin with critical equipment. Instead of implementing MES across the entire factory, begin with one line that has high downtime or requires close output tracking. Instead of broad AI, begin with AI-supported document search for one important machine group.

A small successful project builds confidence and data for the next step.

What managers should do:

Select a pilot scope small enough to control: one line, one area, one equipment group, one process or one user group. Set a clear 8- to 12-week goal, such as reducing reporting time, improving completeness of maintenance work orders, making downtime visible or creating a shift production dashboard.

3.4. Question 24: Should we choose an easy problem or a high-loss problem?

Short answer:

Do not choose only because it is easy, and do not immediately choose a problem that is too large and too difficult. The first use case should be balanced: important enough to create value, but feasible enough to implement in a small scope.

Practical explanation:

An easy problem that does not affect operations much will not build confidence in digitization. On the other hand, a very large problem such as “optimize the whole factory” or “predict failures for all equipment” is usually too complex as a starting point.

A good starting point has clear loss, collectible data, users willing to participate and measurable results. Examples include reducing downtime on one line, controlling preventive maintenance for critical equipment, tracking OEE for one area or standardizing quality defect recording for one product group.

What managers should do:

Evaluate each problem along two dimensions: value and feasibility. Prioritize problems that have clear operational impact and can be deployed within a controlled scope.

3.5. Question 25: Should we start with a small pilot?

Short answer:

Yes. A small pilot helps the factory test the problem, data, process, users and solution before expanding.

Practical explanation:

A pilot is not a symbolic trial. A good pilot is a small but real project: real users, real data, real processes and real KPIs. Through the pilot, the factory can discover issues early: data not standardized, data entry difficult for users, dashboards not matching needs or inconsistent processes across shifts.

If the factory starts with a large project, small design mistakes may be multiplied into large mistakes. A pilot helps the factory learn faster, adjust faster and reduce risk before making a wider investment.

What managers should do:

Design the pilot with clear scope: one line, one equipment group, one process or one user group. The pilot must have a timeline, required data, responsible person and specific evaluation criteria.

3.6. Question 26: What does a small pilot look like if it still needs to create value?

Short answer:

The pilot should be small enough to deploy but important enough for the result to matter. If it is too small, the factory will learn little and will struggle to convince users or leadership.

Practical explanation:

A good pilot does not need to cover the whole factory, but it must touch a real operational problem. Tracking downtime on a main line may be more valuable than digitizing a rarely used form. Managing work orders for 30 critical pieces of equipment may be more valuable than a wide rollout with poor data completeness.

The pilot should also create reusable data and lessons. At the end, the factory should know what process needs adjustment, what data must be standardized, what support users need, which dashboards are useful and whether expansion makes sense.

What managers should do:

Before starting a pilot, check five things: is the problem real, will real users use it, can the data be collected, can the KPI be measured, and can the solution be expanded if successful?

3.7. Question 27: If the factory still uses a lot of Excel, how should we start?

Short answer:

Excel is not a problem if it is used with discipline, but it should not be the long-term foundation for factory operations. Start by identifying the most important Excel files and gradually converting them into digitized processes with more standardized data.

Practical explanation:

Many factories have used Excel for years because it is flexible, easy to adjust and familiar. But as scale increases, Excel reveals limitations: many versions, difficulty controlling who changed what, inconsistent data, delayed reports and difficulty linking production, maintenance, quality and warehouse.

Do not reject Excel immediately. Instead, treat Excel as evidence of what information the factory needs to manage. Files updated daily, shared with many people, used in operational meetings or requiring a lot of summarizing are good candidates for digitization.

Examples include downtime files, plan and output files, maintenance work order trackers, quality defect files, spare parts inventory files and inspection checklists.

What managers should do:

List the ten most important Excel files in the factory. For each file, ask who enters data, how long it takes, whether the data is often wrong, who uses it for decisions and whether it overlaps with other files. Important, repeated and error-prone files should be prioritized for digitization.

3.8. Question 28: Can we do anything if the data is not standardized yet?

Short answer:

Yes. The factory can still start, but it should standardize data for a small scope instead of trying to clean all data at once. Unstandardized data is not a reason to stand still.

Practical explanation:

Very few factories have perfect data at the beginning. Equipment codes may be inconsistent, downtime causes recorded freely, product names different across systems, maintenance history incomplete and quality defect data lacking context.

If the factory waits for perfect data before starting, it may wait a very long time. A more practical approach is to choose a specific use case and standardize the data related to it. If the goal is downtime analysis, standardize equipment lists, lines, downtime cause groups, start/end time recording and confirmation responsibility. If the goal is maintenance, standardize equipment codes, work types, failure causes, spare parts and work order status.

Data standardization should follow operational needs, not be treated as a separate data exercise.

What managers should do:

Choose the first use case, then ask: what data must be standardized to solve this use case? Standardize only that group first, then expand gradually.

3.9. Question 29: Do we need to clean all factory data first?

Short answer:

Do not try to clean all data at the beginning. The factory should clean data by priority, starting with data that serves the most important operational problem.

Practical explanation:

Cleaning all factory data sounds correct, but in practice it is time-consuming and can easily drain motivation. A factory may have thousands of equipment codes, products, materials, defect codes, transaction histories, Excel files and documents. If everything must be cleaned before value appears, the project may become a long background task.

A better approach is layered cleaning. The first layer is important master data: equipment, lines, products, operations, shifts, defect codes and downtime codes. The next layer is transaction data: maintenance work orders, downtime, output, quality defects and spare parts. But even these should be prioritized by use case.

If the factory wants to reduce downtime, prioritize data that answers where downtime happened, why it happened and how it was handled. If it wants to reduce quality defects, prioritize data that shows which product, operation, shift, cause and corrective action were involved.

What managers should do:

Avoid broad goals such as "clean all data." Set specific goals instead: "standardize downtime data for Line A," "standardize the list of 100 critical assets" or "clean maintenance work order history for the last 12 months."

3.10. Question 30: Should we hire a consultant to assess the current state before investing?

Short answer:

Yes, if the factory is unsure where it currently stands, where to start or how to avoid wrong investment. A good current-state assessment helps reveal gaps in process, data, systems, people and implementation roadmap.

Practical explanation:

Many factories start by asking vendors, "How much does this software cost?" or "What can your AI do?" This approach can lead to buying a solution before understanding the problem.

A good assessment should start from operations: where is the factory hurting, what data exists, which processes are fragmented, which systems are in use, whether users are ready and which KPIs need improvement. Only then should it recommend where to digitize, which dashboards to build and which AI use cases can come later.

Consulting does not have to be a long and expensive project. It can start with a short assessment focused on a few priority areas such as maintenance, production, data and dashboards.

What managers should do:

Before making a large investment, conduct a structured current-state assessment. The goal is not a beautiful report; it is to answer three questions: where the factory is today, which problem to start with and what must be prepared for successful implementation.

You can use Vietsoft's free assessment by visiting: https://assessment.vietsoft.com.vn/assessment?lang=1

4. Chapter 4: Which operational problems can digitization, datafication, dashboards and AI improve?

After understanding the difference between digitization, datafication, dashboards and AI, the next question is: which operational problems can these four layers improve?

This is very important. Factories should not begin from new technology; they should begin from operational problems that are costing money, time, productivity, quality or control.

This chapter covers common operational questions: downtime, OEE, productivity, maintenance, quality, production progress, spare parts inventory, meeting time and the decision-making capability of managers.

4.1. Question 31: Can downtime be reduced?

Short answer:

Yes, if the factory records downtime fully, classifies causes clearly and uses the data for improvement. Digitization records downtime in the system; datafication gives it structure; dashboards analyze downtime from many angles; AI can help detect trends and repeated causes to warn about risks.

Practical explanation:

Downtime is often one of the largest losses in a factory, but many factories do not record it clearly enough. Some record only total downtime, without knowing whether the cause is equipment, operation, material, changeover, waiting for planning or quality issues. Others record reasons as free text, so every shift writes differently and later analysis becomes very difficult.

Digitization helps downtime be recorded in the system instead of on scattered paper or Excel. Datafication turns downtime events into structured data: which machine stopped, from when to when, which cause group, who confirmed and how output was affected. With good data, dashboards can show top downtime machines, top causes, downtime by shift, line, product or operation.

AI can support the next step by detecting repeated causes, suggesting risky equipment groups and analyzing relationships between downtime and shifts, products, materials or maintenance schedules. But AI is valuable only when downtime data is recorded consistently.

What managers should do:

Start by standardizing the downtime cause list and how downtime time is recorded. Then build a dashboard by machine, line, shift and cause group. Once downtime is visible, choose the one or two largest cause groups for improvement or for AI-supported analysis.

4.2. Question 32: Can OEE be improved?

Short answer:

Yes, if OEE is measured correctly and used for improvement. Digitization records OEE-related activities; datafication structures the data; dashboards track Availability, Performance and Quality; AI can support deeper cause analysis and suggest improvement priorities.

Practical explanation:

When discussing OEE, the important point is not only whether the number is high or low. The factory must understand which factor is affecting OEE: Availability, Performance or Quality.

To analyze OEE well, the factory needs correct input data: production plan, run time, downtime, downtime reason, good output, defective output and standard cycle time. Datafication structures these inputs so OEE can be measured and compared by line, shift, product, machine or operation.

Dashboards help managers see how OEE changes and which factor pulls it down. When data is sufficient, AI can analyze deeper patterns. It may detect that OEE decreases mainly on the night shift, with a certain product group, due to changeover time or because a group of machines often runs below standard speed.

What managers should do:

Before setting a goal to increase OEE, check whether the current OEE calculation is consistent. Then break OEE into Availability, Performance and Quality to identify which part should be improved first. Do not simply demand "higher OEE" without knowing what is pulling it down.

4.3.Question 33: Can we understand why productivity is low?

Short answer:

Yes, if the factory records the factors affecting productivity with enough structured data. Digitization records production activities; datafication makes production data measurable and comparable; dashboards show productivity by shift, line, product or operation; AI can detect trends and causes that are hard to see manually.

Practical explanation:

Low productivity rarely has only one cause. It may be affected by downtime, slow running, waiting for materials, labor shortage, quality defects, product changeover, unstable planning or inconsistent operations between shifts.

Without clear and reliable data shared by all departments, meetings easily become arguments based on feelings. Production may say machines fail often. Maintenance may say operators do not run correctly. Warehouse may say materials arrive late. Quality may say the product is difficult. Each department may hold part of the truth, but management needs enough data to see the main cause.

Productivity data should not stop at end-of-shift output. The factory needs output by time, line, product, operation and shift; run time; downtime; downtime reason; standard speed; actual speed and defects. When data is standardized and connected, dashboards show where productivity is lost and under what conditions.

What managers should do:

Do not look only at end-of-shift output. Analyze productivity by shift, line, product, operation, run time, downtime, speed, downtime reason and quality defect. To improve productivity, first know where productivity is being lost, under which conditions and from which cause group.

4.4.Question 34: Can the system show which machines break down most often?

Short answer:

Yes. If maintenance work orders, failure history and downtime are recorded properly, the system can show which machines fail often, fail for long periods, fail repeatedly and cause the largest impact on production.

Practical explanation:

The question “Which machine breaks down most often?” seems simple, but many factories cannot answer it accurately. Operators remember machines that caused trouble recently. Maintenance remembers machines that required many repairs. But without complete data, the factory cannot know which machine truly causes the most loss.

One machine may fail many times but each stop is short. Another may fail less often but cause very long downtime. Some machines do not fail frequently, but when they fail they stop an entire line. Therefore, the factory should look at number of failures, total downtime, MTBF, MTTR, maintenance cost, spare parts used and production impact.

AI can help analyze failure history to identify repeated faults, common cause groups and signs that require deeper inspection. But the foundation remains well-recorded maintenance and downtime data.

What managers should do:

Create a critical equipment list and monitor the number of failures, total downtime, MTTR, MTBF, maintenance cost and production impact. Do not only ask “Which machine fails most?” Ask “Which machine causes the greatest loss?”

4.5.Question 35: Can it help control preventive maintenance better?

Short answer:

Yes. Digitization helps plan, remind, track progress and store preventive maintenance history. AI can help analyze which jobs are often delayed, which equipment needs cycle adjustment and which area has higher risk.

Practical explanation:

Preventive maintenance often fails not because the factory does not know it is important, but because schedules are not controlled well, tasks are postponed, spare parts are missing, manpower is limited or production does not allow downtime at the right moment. If managed by Excel or paper, tracking hundreds of periodic tasks is easy to get wrong.

Digitization helps automatically generate PM schedules, assign work, send reminders, record results and store checklists, photos, spare parts and work time. Dashboards show which tasks are on time, overdue, skipped and which areas have low completion.

AI can support more advanced analysis. If equipment still fails often despite scheduled PM, the content or frequency of PM may need review. If certain jobs are often postponed, maintenance and production may need better coordination.

What managers should do:

Check the on-time PM completion rate, postponed tasks, reasons for postponement and equipment that still fails after PM. The goal is not merely to have a PM schedule, but to make sure PM truly reduces operational risk.

4.6.Question 36: How can quality defects be reduced?

Short answer:

Quality defects can be reduced if they are recorded fully, structurally and linked to product, operation, machine, shift, cause and corrective action. Digitization records and traces defects; datafication classifies them clearly; dashboards track trends; AI can detect repeated defects and suggest hidden relationships.

Practical explanation:

Quality defects are not only the responsibility of QC. They may relate to materials, equipment, process parameters, operator actions, environment, previous operations, product changeover or machine setup. If defect data only says "NG," "product defect" or "not OK," the factory cannot find the real cause.

To analyze quality better, defects must become structured data: what defect, which product, which lot, which operation, which line, which machine, which shift, severity, initial cause and corrective action. Dashboards can then show which defects are increasing, which repeat often, which products are risky and which operations need tighter control.

When data is good enough, AI can support deeper analysis. It may detect that a defect increases after a material change, after maintenance, after changeover, on a specific shift or under certain operating conditions. AI does not replace the quality team; it helps them see trends and relationships faster.

What managers should do:

Standardize defect codes and how quality causes are recorded. Do not only write “NG” or “product defect.” Record what the defect is, where and when it occurred, which product, operation, machine or shift is involved and what action was taken.

4.7. Question 37: Can it help trace defect causes faster?

Short answer:

Yes. When production, quality, maintenance, material and equipment data are connected, the factory can trace and narrow down causes much faster than searching records manually.

Practical explanation:

When a quality defect or customer complaint occurs, the factory must answer many questions: which lot, which production date, which line, which machine, which shift, which materials, who operated, whether parameters were abnormal, whether equipment was maintained recently and whether similar defects happened before.

If data is scattered across paper, Excel, ERP, QC software and departmental notes, root tracing can take hours or days. Digitization connects these data sets better. Once connected, dashboards and analytical tools can narrow the search faster.

AI can support pattern search across data or documents, but it cannot replace correct data recording from the beginning. If the original data is missing or wrong, traceability remains difficult.

What managers should do:

Choose a recent quality defect and try to trace all related information backward. If it takes too long to identify lot, machine, shift, material, parameters, maintenance history and corrective action, the factory should prioritize digital traceability.

4.8. Question 38: Can it help control production progress in real time?

Short answer:

Yes, if production progress is updated quickly and with enough detail. Digitization updates plans, output, work order status and progress; datafication structures information by order, product, line, operation and shift; dashboards detect schedule risks early; AI can forecast plan completion when data is strong enough.

Practical explanation:

In many factories, management only knows whether production meets plan after the end-of-shift or end-of-day report. By then, if progress is already behind, response is late. Causes may include material shortage, machine downtime, plan change, manpower shortage, quality defects, slow running or long changeover time.

To control progress better, the factory needs near real-time status for each production order: waiting, running, paused, completed or at risk of delay. Data should be linked to product, line, operation, shift, planned output, actual output, remaining time and reasons for delay.

When data updates quickly enough, dashboards show which order is late, which line may miss plan, which product has issues and where intervention is needed. With more data, AI can forecast plan completion based on current progress, speed, downtime, quality losses and remaining capacity.

What managers should do:

Check how long it takes the factory to detect schedule delay: during the shift, at the end of the shift, at the end of the day or at the end of the week. If delay is often discovered too late, prioritize a progress dashboard updated fast enough for intervention within the shift.

4.9. Question 39: Can it help control spare parts and materials inventory better?

Short answer:

Yes, if inventory is managed based on usage, criticality and shortage risk rather than only total inventory value. Digitization records receipts, issues and balances; datafication links materials and spare parts to production, equipment and work orders; dashboards detect slow-moving, high-usage or frequently missing items; AI can support demand forecasting when data is good.

Practical explanation:

Inventory often has two opposite problems: some items are overstocked but rarely used, while others are missing exactly when needed. For maintenance spare parts, the problem is harder because demand depends on equipment condition, preventive maintenance plans, unexpected failures, machine criticality and procurement lead time.

If managers only look at total inventory value, they cannot judge whether inventory is good or bad. A low inventory value that frequently lacks critical spare parts is risky. A high inventory value with expensive, rarely used or obsolete parts is a hidden cost.

Digitization records receipts, issues, balances, minimum levels, lead times, costs and usage history. Datafication links parts to equipment, maintenance work orders, repair history and PM plans. Dashboards show high-consumption parts, slow-moving parts, frequently missing parts and spare part cost by equipment group.

AI can support demand forecasting based on usage history, maintenance plans, failure trends and purchasing lead time. But if inventory records are inaccurate or parts are not linked to equipment and work orders, forecasts will be unreliable.

What managers should do:

Start by linking spare parts with equipment and maintenance work orders. Then track important groups: high-consumption parts, slow-moving parts, frequently missing parts, parts for critical equipment and spare part cost by equipment group. Do not judge inventory only by total value.

4.10.Question 40: Can it reduce meeting time and subjective arguments?

Short answer:

Yes. When operational data is recorded clearly and displayed on a shared dashboard, meetings can focus on causes and actions instead of arguing about which number is correct.

Practical explanation:

Many production meetings are long because each department brings its own numbers. Production has output data, maintenance has downtime data, quality has defect data, warehouse has material data and planning has order data. If these numbers are not consistent, the meeting turns into a debate.

Digitization helps departments record data in one system or according to a shared data standard. Dashboards give everyone the same picture: progress, downtime, OEE, defects, maintenance work orders, materials and main causes. When data is clearer, meetings shift from "who is right" to "what is the problem and what should we do next."

AI can summarize the situation, detect abnormalities or suggest issues to discuss. But the first value still comes from unified data.

What managers should do:

Choose one regular operational meeting and define five to seven indicators that must be aligned before the meeting. Build a shared dashboard for that meeting. The goal is to reduce time spent preparing and debating numbers and increase time spent deciding actions.

4.11.Question 41: Can it help shift leaders make decisions faster?

Short answer:

Yes, if data is updated on time and displayed according to shift leaders' needs. Digitization, datafication and dashboards help shift leaders see problems earlier; AI can suggest causes or actions to prioritize.

Practical explanation:

Shift leaders must make many fast decisions: handling downtime, arranging manpower, changing work order sequence, calling maintenance, responding to quality defects, reacting to material shortages or adjusting to meet output. Without timely data, they must rely on personal experience or incomplete information, which can make responses slow and inconsistent.

Digitization records shift information: actual output versus plan, downtime, downtime reasons, defects, problematic machines and related maintenance work. A shift leader dashboard should turn this data into information that is easy to understand, fast enough and action-focused, not overloaded with charts.

AI can help by summarizing issues, reminding about repeated abnormalities or suggesting causes to check. But AI must appear at the right point in the process, not as a separate hard-to-use tool.

What managers should do:

Ask shift leaders: "During a shift, what information do you need in order to make decisions faster?" Then design dashboards or operating screens around those decisions, not only around attractive management indicators.

4.12. Question 42: Can it help the board see the factory overview without waiting for end-of-day or end-of-week reports?

Short answer:

Yes. When data from production, maintenance, quality, warehouse and progress is digitized and connected, the board can see the factory situation faster through management dashboards.

Practical explanation:

The board does not need to see every maintenance work order or every minor defect. What it needs is the overall picture: is production meeting plan today, which line is at risk, is downtime abnormal, is OEE good or bad, are defects increasing, which order may be late and where intervention is needed.

If all information must wait for manual reports, leadership is always behind reality. With management dashboards, key indicators can be updated more frequently so leadership can detect problems earlier and ask the right questions.

AI can summarize operations, highlight abnormalities and suggest where attention is needed. But this requires reliable underlying data from each department.

What managers should do:

Define a factory-level management KPI set including output, progress, OEE, downtime, quality, maintenance and key risks. Then build an overview dashboard for leadership, with the ability to drill down into each area when needed.

5. Chapter 5: How should data be prepared?

When talking about digitization and AI, many people immediately think about data. That is correct, but not sufficient. The issue is not only whether the factory has much or little data. More important is whether the data is correct, contextual, structured, recorded consistently and usable for analysis, decision-making or operational improvement.

A factory may have many Excel files, many forms and much machine data, but still not be ready for dashboards or AI if the data is scattered, unstandardized and cannot be linked to equipment, products, operations, shifts or operational causes.

This chapter helps managers understand how data should be prepared before expecting value from dashboards, advanced analysis or AI.

5.1. Question 43: What types of data does my factory need?

Short answer:

A factory needs data about equipment, production, maintenance, quality, downtime, materials, operational staff, energy and technical documents. However, not all data must be collected from the start. Prioritize data that supports the most important operational problem.

Practical explanation:

Factory data has several layers. The first layer is foundation data such as equipment codes, product codes, lines, operations, shifts, material codes and spare part codes. This data helps the factory name things consistently.

The next layer is daily operational data such as output, plans, downtime, downtime reasons, maintenance work orders, PM schedules, quality defects, spare parts used, repair time, responsible people and order status. This data shows what is happening.

There is also knowledge data such as manuals, SOPs, checklists, troubleshooting instructions, safety documents, LOTO procedures, quality standards and operating experience. This is very important for AI Copilot or internal question-and-answer systems.

What managers should do:

Do not start with “Which data should we collect?” Start with “What problem do we want to improve?” If the goal is reducing downtime, prioritize equipment, downtime, work orders and failure causes. If the goal is increasing OEE, prioritize plans, output, run/downtime, quality defects and standard cycle time.

5.2. Question 44: Can my current data be used?

Short answer:

It may be usable, but quality must be checked first. Usable data is not merely existing data; it must be accurate enough, complete enough, structured, consistent and contextual enough to answer operational questions.

Practical explanation:

Many factories already have data but are unsure whether it can be used. Maintenance history may contain many work orders, but if failure causes are blank or vague, it is hard to analyze. Downtime data may contain total stop time, but if the factory does not know the reason, shift, machine or product, improvement is difficult.

Usable data does not have to be perfect. But it must be reliable enough for decisions. If managers look at a dashboard and do not trust the number, or if every department has a different number, the data is not yet good enough as an AI foundation.

The key question is not "Do we have data?" The key question is "Does this data help us make better decisions?"

What managers should do:

Take one important data set, such as downtime or maintenance work orders from the last three months, and check whether key fields are missing, whether the same meaning is written in many different ways, whether it can be linked to machine/line/product and whether it can answer management questions.

5.3. Question 45: Is data in Excel still considered data?

Short answer:

Yes. Data in Excel is still data. But Excel often has weaknesses in version control, standardization, permissions, connectivity and long-term use for dashboards or AI if it is not managed well.

Practical explanation:

Excel is widely used in factories because it is easy, flexible and familiar. Many important data sets may be in Excel: production plans, output, downtime, quality defects, maintenance schedules, spare parts and shift manpower.

The problem is not that Excel is "bad." The problem is that heavy dependence on Excel makes data fragmented. Each department has its own file. Each person names things differently. There are many versions. Data can be changed without knowing who changed it. Summaries require copying, pasting and manual checking.

Excel can be a good starting point to understand what the factory manages. But if an Excel file is updated daily, used in operational meetings, shared widely and affects decisions, it should gradually become a formal digitized process.

What managers should do:

Classify existing Excel files into three groups: reference files, periodic reports and important operational files. Important operational files should be prioritized for data standardization and gradual migration into systems and dashboards.

5.4.Question 46: What should be done with paper-based data?

Short answer:

Paper-based data should gradually become digital data, but not all at once. Prioritize paper forms that affect operations, traceability, maintenance, quality or audits.

Practical explanation:

Many factories still use paper for checklists, inspection forms, maintenance forms, shift handover, defect reports, downtime forms and incident records. Paper is easy to deploy on the shop floor, but it is hard to analyze later. To know which defects repeat, which machines have frequent issues, which shift records many incidents or which checklist items are often skipped, the factory must search records manually.

When digitizing paper data, scanning is not enough. A scanned document is only an image or PDF. To use the data for dashboards or AI, key information must become structured: date, shift, machine, operation, defect, cause, person, inspection result and corrective action.

Do not digitize every paper form at once. Select forms used frequently, prone to errors, time-consuming to summarize or directly linked to KPIs.

What managers should do:

Review paper forms currently in use and choose the five most important ones. For each form, ask whether the data is used for decisions, traceability, summaries or audits. If yes, those forms should be digitized first.

5.5.Question 47: Does machine data have to be collected automatically?

Short answer:

Automatic machine data collection is very useful, but it is not always mandatory at the beginning. Prioritize automation where manual entry is error-prone, fast updates are needed or decisions are strongly affected.

Practical explanation:

Machine data such as run/stop status, speed, output, temperature, pressure, current, vibration and energy consumption can be very useful. Automatic collection is usually faster, more detailed and less dependent on manual input.

However, not every factory needs to connect all machines immediately. Connectivity may require cost, infrastructure, understanding of PLC/SCADA/IoT and system maintenance. If the factory does not know how the data will be used, collecting too much automatically may create a "data pile" without value.

Some data should be automated if possible, such as machine run/stop time, auto-counted output, equipment status, energy indicators or important process parameters. But some data still needs human confirmation, such as downtime cause, defect cause, corrective action or abnormality assessment.

What managers should do:

Identify which data must be fast, accurate and difficult to enter manually. Prioritize automatic collection for those data points. But also design human confirmation steps for cause classification and decision-related information.

5.6. Question 48: Must we connect PLC, SCADA or IoT before we can use AI?

Short answer:

No. PLC, SCADA and IoT are useful for some use cases, but many steps toward AI can begin with process data, maintenance data, production data, quality data and technical documents.

Practical explanation:

Many people think factory AI must start with sensors, IoT, real-time data and complex machine connectivity. This is true for some use cases such as predicting equipment failure from vibration, temperature, current or process signals. But not every AI use case needs that as the starting point.

AI-supported technical document search can begin with manuals, SOPs, checklists and incident history. AI-supported downtime analysis can begin with well-recorded downtime data. AI-supported maintenance work order analysis can begin with maintenance history. AI-supported OEE analysis can begin with plans, output, downtime and quality defects.

PLC/SCADA/IoT data is a powerful layer, but it is not the only condition for beginning the AI journey. The more important conditions are a clear problem and sufficiently reliable relevant data.

What managers should do:

Do not let the absence of IoT stop the factory. Identify the first problem and the data needed to solve it. If it requires automatic data, plan the connection. If it can start with process data or documents, begin there.

5.7. Question 49: If workers enter data incorrectly, will AI also be wrong?

Short answer:

Yes. If input data is wrong, missing or inconsistent, dashboards and AI can both produce wrong or misleading results. Data entry quality is a very important part of digitization.

Practical explanation:

AI cannot magically turn bad data into correct decisions. If downtime causes are entered incorrectly, AI may analyze the wrong cause group. If maintenance work orders lack information, AI cannot learn repeated failures. If output or quality data is wrong, OEE and dashboards will be unreliable.

Incorrect entry is not always caused by careless workers. It may happen because forms are too complex, cause lists are confusing, users do not see the benefit, data-entry devices are inconvenient, confirmation processes are unclear or managers demand entry but never use the data for feedback.

Good data requires data entry to be simple, contextual and valuable to the user. If shop-floor users feel that data entry is only "reporting for the boss," they will enter data defensively.

What managers should do:

Reduce free-text entry. Use standardized lists, short forms and only the data that is truly needed. At the same time, use the data in operational meetings so users see that what they enter has real value.

5.8. Question 50: How do I know whether my data is reliable enough?

Short answer:

Data is reliable enough when users and managers can make decisions from it without needing to re-check too much. It does not need to be perfect, but it must be consistent, have a clear source and reasonably reflect real operations.

Practical explanation:

A sign of unreliable data is that each department has a different number. Production reports one number, maintenance another, quality another and planning another. Another sign is that dashboards exist but nobody trusts them because "the system number does not match reality."

Reliable data needs three elements. First, clear source: who entered it, which system it came from and when it was updated. Second, clear recording rules: when downtime starts, how good output is counted, how quality defects are classified and when a maintenance work order is considered complete. Third, a check-and-feedback mechanism: how wrong data is corrected, who is responsible and whether missing/error rates are monitored.

Reliable data does not appear naturally. It is the result of process, responsibility and the habit of using data.

What managers should do:

Choose the five most important indicators and check their reliability: output, downtime, OEE, defect count and overdue maintenance work orders, for example. For each indicator, identify the data source, responsible person, calculation rule and user confidence level.

5.9. Question 51: How detailed does the data need to be?

Short answer:

Data should be detailed enough to support operational decisions, but not so detailed that it overloads data entry. The right level of detail depends on the problem the factory wants to solve.

Practical explanation:

If data is too general, causes cannot be analyzed. Writing only "machine stopped" does not reveal whether the cause is mechanical, electrical, material shortage, waiting for QC, changeover or cleaning. Writing only "quality defect" does not show the defect type, operation, product or shift.

But if data is too detailed and requires shop-floor users to enter too much, they become tired, skip fields or choose randomly. A downtime form with hundreds of very small causes may push users to select any option. A maintenance work order with too many unnecessary fields wastes technicians' time.

The right detail is the level that supports decisions. For downtime, start with major cause groups and add detail for large groups. For maintenance, record equipment, fault, cause, action, spare parts and time. For quality, record enough to trace product, operation, defect and corrective action.

What managers should do:

For each data type, ask: "If we have this information, what decision will change?" If no decision changes, the detail may not be needed yet. If the missing information prevents cause analysis, add it.

5.10. Question 52: Do machine codes, defect codes, downtime codes and product codes need to be standardized?

Short answer:

Yes. Code standardization is very important. If each department calls the same object by different names, data will be difficult to summarize, analyze, turn into dashboards or use for AI.

Practical explanation:

In a factory, the same machine may have several names: the name on the machine label, the name in ERP, the name used by maintenance and the nickname used by operators. The same defect may also be recorded in many ways: "material jam," "part jam," "blockage," "jam" or "machine stuck." Without standardization, the system treats these as different objects and spreads the data.

Code standardization is not only for neat data. It helps connect information across departments. A standard equipment code links downtime with maintenance work orders, spare parts, maintenance history and costs. A standard product code links planning, output, quality defects and OEE. A standard downtime code helps analyze causes more accurately.

AI also needs standardized data. If one defect has many names, AI may analyze incorrectly or require extra data-cleaning effort.

What managers should do:

Prioritize standardizing foundation lists: equipment, lines, products, operations, quality defects, downtime causes, maintenance work types and spare parts. Not all data must be perfect immediately, but the master data used by the first use case must be standardized.

5.11.Question 53: Who is responsible for data quality?

Short answer:

Data quality should not be IT's responsibility alone. Business departments must be responsible for the meaning and correctness of data; IT supports systems, integration, permissions and technical matters.

Practical explanation:

A common mistake is assigning all data issues to IT. But IT usually cannot know which downtime cause is correct, which quality defect code should be used, whether a maintenance work order has sufficient technical information or whether recorded output reflects reality. These are business questions.

Production should own data on output, progress, downtime and shifts. Maintenance should own equipment, work orders, failure causes, spare parts and PM schedules. Quality should own defect codes, inspection standards, traceability and corrective actions. Warehouse should own inventory, receipts, issues, materials and spare parts. IT should ensure the system records, stores, connects and protects data.

Data quality is shared responsibility, but each major data group must have a clear owner.

What managers should do:

Assign responsible owners for important data groups. For example, the maintenance manager owns equipment and work order data; the production manager owns output and downtime data; the quality manager owns defect codes and QC data. Without ownership, data quality will be difficult to improve.

5.12.Question 54: What if each department uses a different data structure?

Short answer:

The factory needs to agree on several shared lists and definitions first. Not everything must change immediately, but data shared across departments must have common standards.

Practical explanation:

Each department may manage data in its own way. Production names lines by operating habit. Maintenance uses machine codes. Planning uses ERP product codes. Quality uses inspection standards. Warehouse uses purchasing material codes. When these systems do not match, cross-department analysis becomes difficult.

For example, to analyze whether a quality defect relates to a machine, product, shift or maintenance work order, the factory needs common codes or at least mapping tables. Otherwise, every traceability effort requires experienced people to connect data manually.

The factory does not need to force every department to abandon its old way in one day. But it needs a common master data set for important objects: equipment, products, operations, lines, materials, defects and downtime causes. This is the basis for connecting data.

What managers should do:

Hold a cross-department data review for one specific use case, such as downtime analysis or quality traceability. Identify which codes and lists are inconsistent and need to be standardized first.

5.13.Question 55: Can data scattered across ERP, Excel, maintenance software and production software be connected?

Short answer:

Yes, but a clear data strategy is needed. Connection is not only a technical issue; it also requires standard codes, data definitions, processes and access rights.

Practical explanation:

Many factories already use different systems: ERP for orders, materials, purchasing and finance; maintenance software for equipment and work orders; production software for progress, output and OEE; Excel for supporting data; SCADA or machines for operational data. Scattered data is very common.

Data can be connected through APIs, databases, intermediary files, data warehouses or integration platforms. But if equipment codes are inconsistent, product codes differ, time standards are not aligned and indicator definitions are unclear, technical connection alone may still not create meaningful data.

The key is to define what the connection is for. Do not connect everything just because it is possible. Start with data flows that serve a dashboard or specific use case: ERP provides plans, production systems provide output and downtime, maintenance systems provide work orders, and quality systems provide defects.

What managers should do:

Draw a current data map: which data is stored in which system, who owns it, how often it updates and what it needs to connect with. Then choose the one or two most important connections for the first dashboard or use case.

6. Chapter 6: How clear do processes need to be?

Good data does not come only from software. Good data comes from clear processes, clear roles, consistent recording methods and consistent operating habits.

Many factories think that once software is introduced, processes will automatically improve. In practice, the opposite is often true: if current processes are unclear, bringing them into a system will expose the confusion faster. Users do not know what to enter, who approves, who is responsible, when a task is considered complete or which data is official.

Before expecting value from dashboards or AI, the factory needs processes that are clear enough to produce reliable data and make users' work easier rather than more complicated.

6.1. Question 56: Before digitizing, do we need to standardize processes?

Short answer:

Yes, but not every process must be perfectly standardized before starting. The factory needs to clarify at least the main steps, key roles, data to be recorded and important control points.

Practical explanation:

If the current process is too vague, software will not solve it automatically. In maintenance, if it is not clear who can create a request, who classifies priority, who approves, who assigns work and when a work order is closed, the software will create disputes. Users may enter incomplete data, enter incorrect data or bypass the system.

In production, if it is unclear who records downtime, who confirms the cause, how run/stop time is calculated and when output is confirmed, OEE dashboards will lack trust.

However, the factory should not wait for perfect processes before digitizing. Digitization is also an opportunity to review and standardize processes step by step.

What managers should do:

Select the first process to digitize and map the data flow from beginning to end. For each step, define who does it, when it is done, what data is recorded, who confirms it and what output is produced.

6.2. Question 57: If the current process is not good, will putting it into software make things more confusing?

Short answer:

It can. If a messy process is put into software without adjustment, the system may make that mess more visible, more widespread and harder to change.

Practical explanation:

Software does not automatically improve processes if the factory has not agreed on how to work. If every shift records downtime differently, the software will only store the inconsistency. If every technician closes maintenance work orders differently, maintenance data will still be hard to analyze. If departments define “complete,” “downtime,” “defect” or “fixed” differently, the system will create more arguments.

This does not mean digitization should stop. On the contrary, digitization can be a chance to expose and standardize what is messy. The key is not to make software a mechanical copy of the old process. Use the project to reset important operating rules.

What managers should do:

Before configuring the system, organize a process review with all related departments. Agree on basic definitions: when downtime starts, when a maintenance work order is complete, who can edit data and who confirms results.

6.3. Question 58: Should we fix processes first or fix them while implementing?

Short answer:

Do both in a controlled way. The factory needs a basic process framework before implementation, then should adjust it based on real user feedback.

Practical explanation:

If the factory tries to perfect all processes on paper before implementation, it may spend a long time and still not know whether the process fits reality. If it changes processes during implementation without any initial framework, the project may change continuously and users may lose direction.

A better approach is to define a process version clear enough to start. For maintenance, for example: create request, classify, approve, assign, perform, record result, confirm and close. After trial use, the factory will see which steps are unnecessary, which are missing, which data is hard to enter, who is overloaded and where permissions need adjustment.

Good digitization is a learning and improvement process, not a one-time design.

What managers should do:

Treat the initial process as “version 1.0.” After four to eight weeks of trial operation, review it with users and adjust forms, roles, approval steps, data lists and dashboards. Do not freeze the process too early.

6.4. Question 59: Who should decide the standard process?

Short answer:

The business department should decide the standard process, with participation from related departments and sponsorship from leadership. IT or the vendor should not decide operational processes on behalf of the factory.

Practical explanation:

The maintenance process should be owned by maintenance, but production must participate because many maintenance jobs affect machine downtime. Downtime recording should be owned by production, but maintenance, quality and planning must agree because downtime causes can involve many departments.

If one department designs the process alone, the process may be biased. If IT or the vendor configures the system based mainly on technical understanding, the process may not match shop-floor reality. If leadership does not sponsor the process, disagreements between departments can delay the project.

The standard process should reflect how the factory wants to operate, not only how the software works.

What managers should do:

Assign a process owner for each main process. This person is responsible for the standard process but must consult related parties. For major disagreements, leadership must make the final decision.

6.5. Question 60: How can we make all shifts record data in the same way?

Short answer:

Use shared definitions, standard lists, simple forms, clear training and periodic checks. If each shift understands data differently, the data cannot be compared or analyzed accurately.

Practical explanation:

A common problem is that the same event is recorded differently by different shifts. One shift writes "material jam," another writes "machine stopped," another writes "operator issue." When summarized, the factory thinks there are many causes, but they may be the same problem.

This happens when cause lists are vague, users are not trained or forms allow too much free-text entry. For important data such as downtime, quality defects, maintenance work orders, output and checklists, the factory must standardize recording methods.

Standardization does not mean making forms complicated. In fact, forms should be simple and lists should be clear so users can enter correctly.

What managers should do:

Train users with real scenarios. Use several downtime, quality or maintenance examples and ask shifts to classify them. If results differ, revise definitions and cause lists.

6.6. Question 61: How can production, maintenance and quality work on the same data?

Short answer:

They need shared data, a clear coordination process and one official data source. If each department keeps its own version of data, collaboration will be weak.

Practical explanation:

Production, maintenance and quality often look at the same event from different angles. One line stoppage may be production loss to production, an equipment incident to maintenance and a quality risk to quality. If the data is not linked, each department analyzes only one part and arguments arise easily.

A machine incident should be linkable to downtime, maintenance work orders, spare parts, affected output and any quality defects. Then the factory can see the full impact of the incident, not only one piece.

To work on the same data, the factory needs common equipment codes, lines, shifts, products, downtime causes, work statuses and confirmation rules. Shared dashboards help departments see the same operational truth.

What managers should do:

Choose one cross-department process, such as downtime handling or quality defect response. Define what each department must enter, who confirms it and which data is the official source. Then build a shared dashboard for that process.

6.7. Question 62: If users do not enter data fully, will the system still have value?

Short answer:

Its value will be greatly reduced. A system is useful only when data is recorded sufficiently and correctly at important points. If users enter incomplete data, dashboards become wrong and AI cannot give trustworthy recommendations.

Practical explanation:

Many digitization projects fail not because the software lacks features, but because users do not enter data correctly. Maintenance work orders lack failure causes, downtime has no reason, quality defects have no codes, checklists are done superficially, spare parts are used but not recorded. The system still has data, but not enough for management.

Users often do not enter data fully for practical reasons: forms are too long, operations are difficult, devices are inconvenient, data is not reused, managers do not give feedback or users do not see the benefit. If the factory only forces entry by command, data may exist formally but be low quality.

To improve completeness, data requirements must be minimal, easy and useful to the user's own work.

What managers should do:

Define the "minimum required data" for each process. For maintenance, this may include equipment, work type, cause, action, time and spare parts. For downtime, it may include machine, time, cause and confirmer. Do not require many unused fields.

6.8. Question 63: Will digitization increase work for shop-floor employees?

Short answer:

It may increase work at the beginning if poorly designed. But if done correctly, digitization should reduce paperwork, reduce manual reporting, reduce information searching and make shop-floor work clearer.

Practical explanation:

Shop-floor users often worry that digitization means more data entry. This concern is valid if the system requires too many fields, is difficult to use, data is not used, or paper and Excel still run in parallel.

A good digitization project must replace manual work, not add another layer on top. If a technician records maintenance results in an app, he should not have to write the same thing on paper and later re-enter it into Excel. If a shift leader confirms downtime in the system, the shift report should be generated automatically.

The early stage may create extra work because users are learning a new method, data must be standardized and processes adjusted. Managers need to explain benefits and remove duplicated steps.

What managers should do:

Ask the project team to review all paper forms, Excel files, reports and manual tasks in the process. For each item, decide whether to remove it, keep it temporarily or replace it with the system. Without this decision, digitization easily becomes additional work.

6.9. Question 64: How can digitization reduce paperwork instead of adding work?

Short answer:

Design digital processes around the principle “enter once, use many times.” Data entered on the shop floor should automatically serve reports, dashboards, traceability and analysis instead of being entered again elsewhere.

Practical explanation:

A key principle of digitization is that data should be recorded at the source, at the time it happens, by the person closest to the event. Then the same data should be reused for many purposes: shift reports, management dashboards, downtime analysis, equipment history, quality traceability and KPI calculation.

If a technician enters a maintenance work order but the team leader still summarizes Excel, the manager still makes a report manually and leadership still receives a separate file, digitization has not reduced work. It has only created another data-entry layer.

To reduce paperwork, the system must replace old forms, automatically summarize numbers, reduce copy-paste work and generate useful information for each management level. The factory must also be willing to remove paper forms once digital data is reliable.

What managers should do:

Review every paper form or Excel file after digitization. Decide whether to remove it, keep it temporarily during transition or integrate it into the system. After a period of time, paperwork and manual reporting must truly decrease.

7. Chapter 7: People and habit change

Digitization and AI are not only about software, data or technology. In a factory, the deciding factor is often people: operators, technicians, shift leaders, middle managers, IT, maintenance, production, quality and leadership.

A good system will create little value if users do not enter data, do not trust the data, do not use dashboards and do not change working habits. Conversely, a small project with real users, close management attention and continuous feedback can succeed.

This chapter answers practical questions about habits, psychology, training and human roles in the journey from digitization to AI.

7.1. Question 65: Will operators, technicians and shift leaders use the system?

Short answer:

They will use it if the system makes their work clearer, faster or less troublesome. If it only creates more data entry without practical benefit, they will use it defensively or not use it.

Practical explanation:

Shop-floor users are practical. They do not care much about terms like digital transformation or AI. They care whether the system helps them work better: report incidents faster, find documents more easily, know assigned tasks, reduce paper, reduce phone calls and reduce arguments during shift handover.

If technicians enter maintenance work orders in a system but still have to write paper and prepare Excel reports, they will see the system as a burden. If shift leaders update downtime but no one uses the data for feedback or improvement, they will see it as data entry for managers. But if their data is used in operational meetings, helps detect problems, protects their decisions and reduces manual reporting, motivation improves.

What managers should do:

Before implementation, ask shop-floor users: "Which task consumes the most time or causes the most trouble?" Then design the system to solve part of that pain. Do not only ask them to enter data; show them how the data helps their own work.

7.2. Question 66: Can older or less technology-savvy employees use the system?

Short answer:

Yes, if the system is simple, fits the work context and is trained using real situations. Do not assume people who are less familiar with technology will resist; many only need tools that are easy to understand and proper guidance.

Practical explanation:

Factories often have people with strong operating experience but little software habit. If the interface is complex, has many steps or uses technical terms, they will hesitate. If the system is simple - for example, choose machine, choose defect, take photo, add short note and submit - adoption will be much higher.

Training should also be practical. Do not train only with long slides or technology language. Use situations they meet every day: creating a maintenance request, recording downtime, confirming a checklist, finding a troubleshooting guide or checking assigned work.

Older or less technology-savvy employees often hold valuable operational knowledge. If involved properly, they are not only users but also a source of knowledge for standardizing processes and building data.

What managers should do:

Choose simple interfaces with few actions and train through real scenarios. Provide on-site support in the early stage, especially for groups less familiar with technology. Do not leave them to figure things out after one short training session.

7.3.Question 67: What if employees are afraid of being controlled?

Short answer:

This concern is normal. Managers need to communicate clearly that digitization is not about "catching individuals," but about seeing operational problems, improving processes and supporting better decisions.

Practical explanation:

When a system is introduced, many things become more transparent: who did what, when, how long it took, which task was late, which defect repeated and which shift had more downtime. This can make employees feel watched or afraid of blame.

If managers use data from the beginning to criticize individuals, users will avoid the system, enter data defensively or fail to record problems fully. Data quality will decline and the digitization project will lose trust.

The right approach is to use data first to improve the operating system: are processes unreasonable, does equipment fail often, are instructions missing, are spare parts late, does the plan change too much or are people overloaded? When users see data solving problems rather than only assigning blame, they will cooperate more.

What managers should do:

In the early stage, communicate data-use principles clearly: prioritize process improvement and do not use raw data to punish individuals before analyzing causes. Use dashboards to ask “Where is the problem?” before asking “Who is at fault?”

7.4.Question 68: If middle managers do not support the project, will it fail?

Short answer:

It is very likely to fail. Middle managers determine whether the system becomes part of daily operations. If they do not support it, shop-floor users will not change habits.

Practical explanation:

Leadership may approve the investment, IT may deploy the system and vendors may provide training, but the people who decide whether data is used every day are middle managers: production managers, maintenance managers, quality managers, supervisors and shift leaders.

If middle managers still request old Excel reports, do not view dashboards, do not check system data and do not respond when users enter incomplete data, the system will be treated as a side task. Shop-floor users follow what their direct managers require, not what a digital transformation slogan says.

Conversely, if middle managers use data in meetings, ask questions based on dashboards, assign work through the system and track KPIs in the system, users understand that the new way is serious.

What managers should do:

Involve middle managers from the beginning. They should participate in selecting the problem, designing the process, deciding indicators and using dashboards in operational meetings. Do not train them only after the system is already configured.

7.5.Question 69: Is a lot of training needed?

Short answer:

Training is needed, but the more important point is training correctly. Training should be short, practical, role-based and repeated during the early implementation stage.

Practical explanation:

A common mistake is holding one long training session for all users and expecting everyone to use the system well afterward. In reality, each user group needs different knowledge. Technicians need to receive work, record results, take photos and enter spare parts. Shift leaders need to record downtime, confirm output and view alerts. Managers need to read dashboards, understand KPIs and check data quality.

Training should not only explain which button to click. Users need to understand why data must be entered, how it is used and what happens if it is entered incorrectly. When they understand the meaning, they take data entry more seriously.

The early stage should include close on-site support. Users will encounter mistakes, forget steps, discover unsuitable forms and suggest improvements. This feedback is very valuable.

What managers should do:

Design training by role: data entry users, confirmers, managers, analysts and system administrators. After training, provide on-site support and evaluate again after a few weeks.

7.6. Question 70: Who should lead change in the factory?

Short answer:

There should be a person or team leading change, backed by leadership and supported by business departments. This should not be an IT-only task.

Practical explanation:

Leading digitization is not only deploying software. It changes how users record data, handle work, view reports, conduct meetings and make decisions. The change leader must understand both operations and data well enough to connect departments.

If assigned entirely to IT, the project may become a technical project. If assigned entirely to one business department, it may lack integration and data standardization. Without leadership sponsorship, conflicts between departments may delay progress.

The change leader does not need to be an AI expert. More important is understanding factory problems, listening to users, coordinating departments and following through until the system creates real results.

What managers should do:

Create a core team with representatives from production, maintenance, quality, IT/OT and a leadership sponsor. This team tracks progress, resolves obstacles and ensures the system is used in real operations.

7.7. Question 71: Do we need an internal digital transformation team?

Short answer:

It is recommended, even if small. An internal team helps the factory avoid total dependence on vendors and maintain improvement after go-live.

Practical explanation:

Vendors can deploy software, advise processes and provide technical support. But the people who understand daily operations best are inside the factory. Without an internal team, after deployment the system may be used at a minimum level, data may not improve and dashboards may not evolve with new needs.

An internal digital transformation team does not need to be large. It can start with a few people who understand production, maintenance, quality, IT and continuous improvement. The team connects users, leadership and vendors. It collects requirements, checks data, retrains users, proposes improvements and tracks KPIs after implementation.

This team is also the foundation for moving from digitization to dashboards and AI.

What managers should do:

Build a small team with cross-department authority. Do not choose only IT people. Choose people who understand operations, have credibility on the shop floor, like improvement and can work with data.

7.8. Question 72: Does IT understand operations well enough?

Short answer:

Not always, and that is normal. IT needs to work closely with production, maintenance, quality and business departments so systems meet operational needs.

Practical explanation:

IT is often strong in systems, infrastructure, security, integration, permissions and technical support. But IT may not understand all operational details: why downtime is hard to record, why shift leaders need progress shown in a specific way, why technicians cannot fill long forms, or why a quality defect must be traced across many operations.

If IT deploys a system without business input, the solution may be technically correct but difficult to use on the shop floor. Conversely, if business departments do not understand technical limits, they may make scattered, constantly changing or hard-to-integrate requests.

Successful digitization requires a shared language between IT and operations. IT does not need to become a production expert, but it must be close enough to the shop floor to understand how the system will be used.

What managers should do:

Ask IT to join shop-floor surveys, attend operational meetings and listen directly to users' problems. At the same time, each business department should appoint a contact person to work with IT and turn operational needs into clear system requirements.

7.9. Question 73: Do production, maintenance and quality understand data well enough?

Short answer:

They may not yet, but they can learn if data is connected to real operational problems. Do not turn data into a distant technical topic; make it a tool for better management.

Practical explanation:

Many department heads are strong in operations but unfamiliar with data thinking. They know which machine often fails, which shift is weak, which product is hard to run and which defect repeats, but much of this knowledge is experience-based. With digitization, they need to learn how to turn that experience into structured data: defect codes, cause groups, downtime time, corrective actions, KPIs and dashboards.

This does not mean they must learn complex analytics. They need to understand which data matters, which questions it answers, how to read dashboards and how to check whether data makes sense. When data is connected to real problems such as downtime, OEE, quality defects or maintenance backlog, it becomes familiar.

AI is similar. Before talking about models and algorithms, talk about what AI will help them ask, see, detect and decide faster.

What managers should do:

Train department heads in data thinking using the factory's own data. Use downtime, OEE, maintenance work orders or quality defects for joint analysis. The goal is to help them ask better questions, not turn them into data scientists.

7.10. Question 74: How can users see real benefits and not treat it as "data entry for the boss"?

Short answer:

Users see value when the data they enter is used to solve their own problems: reducing manual reports, reducing search time, reducing arguments, solving incidents faster and receiving better support.

Practical explanation:

If users only enter data into a system but receive no value back, they see it as work for managers. This is one of the biggest causes of poor data quality.

For example, if technicians enter repair history but cannot find it later when handling a similar fault, they will see no benefit. If shift leaders record downtime but meetings still rely on feelings, they lose motivation to record accurately. If operators do digital checklists but still sign paper forms, they see digitization as extra work.

Conversely, if the system helps technicians view machine history, helps shift leaders see progress, helps managers reduce reporting and helps quality trace issues faster, users see real value.

What managers should do:

Design “value returned” for each user group. Technicians need machine history and easy document search. Shift leaders need shift dashboards. Managers need automatic reports. Quality needs fast traceability. When each group sees its own benefit, the system will be used more genuinely.

8. Chapter 8: Cost, ROI and investment effectiveness

Digitization and AI are not only technical topics. For managers, they are investment decisions. Any investment must answer practical questions: how much it costs, how long it takes to see results, how results are measured, whether we can start small, what is lost if it fails and how to avoid buying a large system that is not fully used.

A good digitization or AI project does not necessarily begin with a very large budget. The more important points are choosing the right operational problem, defining a reasonable scope, measuring effectiveness and expanding step by step after results are proven.

This chapter helps managers see digitization and AI as operational investments, not only software costs.

8.1. Question 75: How much does digitization and AI cost?

Short answer:

Cost depends on scope, complexity, number of users, systems to connect, data standardization and the type of AI to deploy. A factory should not ask "How much does it cost?" before clarifying "What problem do we want to solve?"

Practical explanation:

A small digitization project for one process is very different from a whole-factory implementation. Digitizing maintenance requests for critical equipment is very different from implementing a full CMMS across many factories. Building a dashboard from existing data is very different from connecting ERP, MES, SCADA, PLC and cleaning a large data set.

AI also varies greatly. An AI Copilot for technical document search differs in cost and complexity from a machine failure prediction model based on sensor data. AI downtime analysis from structured data is different from AI-powered production planning optimization for the whole factory.

Cost questions must follow scope and value questions. If the problem is unclear, quotations can be misleading: too low because work is underestimated, or too high because the vendor proposes too much.

What managers should do:

Before asking for price, describe the problem clearly: scope, users, required data, related systems and KPI to improve. Once scope is clear, cost comparisons become meaningful.

8.2. Question 76: What costs are included: software, equipment, implementation, training, integration and maintenance?

Short answer:

Cost is not only software purchase. A digitization or AI project often includes software, implementation, configuration, data cleaning, integration, training, infrastructure, maintenance, support and the cost of changing operating habits.

Practical explanation:

Many factories look only at license or software purchase cost, but this is usually not the full cost. If the system must connect with ERP, machines, SCADA or existing files, integration cost is needed. If master data is not standardized, data cleaning and standardization are required. If users are unfamiliar, training and shop-floor support are needed.

There are also internal costs: the time of department heads, technicians, IT, production and quality teams who participate in surveys, testing, process standardization and system operation. This cost is often underestimated but strongly affects success.

For AI, there may be additional costs for cloud, data storage, document processing, embeddings, language models, security, answer quality monitoring and knowledge updates.

What managers should do:

When evaluating investment, ask vendors to separate cost groups: software, implementation, integration, data, training, infrastructure, annual maintenance and internal resources. Do not compare only software price if service scope differs.

8.3.Question 77: How long does it take to see results?

Short answer:

It depends on scope, but a good project should show early signals of effectiveness within a few months, at least through reduced reporting time, clearer data, more transparent processes or faster visibility of operational problems.

Practical explanation:

Not every benefit appears immediately as direct money saved. Early benefits may include no longer summarizing reports manually, knowing downtime by cause, seeing overdue maintenance work orders, seeing which line is behind or standardizing equipment data.

These early benefits are the foundation for larger benefits such as reduced downtime, higher OEE, fewer defects, fewer emergency spare parts and improved on-time delivery. If a factory expects full financial ROI within a few weeks, it may underestimate the value of foundation work.

However, projects should not run too long without producing anything. If after several months there is still no better data, useful dashboard or real system usage, scope and implementation should be reviewed.

What managers should do:

Separate benefits into two groups: early benefits and operational benefits. Early benefits include less manual reporting, better data completeness and clearer processes. Operational benefits include reduced downtime, higher OEE, fewer defects and lower cost. Measure both.

8.4.Question 78: How should effectiveness be measured?

Short answer:

Effectiveness should be measured by specific operational KPIs, not only by whether the software has gone live. KPIs may include downtime, OEE, MTTR, MTBF, PM completion rate, reporting time, defect rate, production progress or system usage.

Practical explanation:

A digitization project should not be considered successful simply because the system is live. Go-live is only the beginning. The real question is whether the system helps operations improve.

For maintenance, metrics may include complete work order rate, on-time PM rate, overdue work orders, MTTR, MTBF, equipment downtime, spare part cost. For production, metrics may include plan completion, OEE, downtime by cause, reporting time and on-time progress updates. For quality, metrics may include defect rate, traceability time, repeated defects and CAPA handling time.

For AI Copilot, effectiveness may be measured by document search time, answer accuracy, number of uses, user satisfaction, reduced troubleshooting time or reduced dependence on senior experts.

What managers should do:

Before implementation, choose three to five main KPIs. Each KPI needs a current baseline, improvement target, measurement method and owner. Without KPIs from the start, effectiveness is hard to prove later.

8.5.Question 79: Can we start small to reduce risk?

Short answer:

Yes, and this is recommended. Starting small lets the factory test value, learn from reality, adjust processes and reduce risk before expansion.

Practical explanation:

Large projects at the beginning carry many risks: broad scope, many departments, unstandardized data, unfamiliar users, complex integration and high expectations. If results are unclear, leadership may lose confidence in digitization or AI.

Starting small does not mean a superficial trial. A good pilot still has a real problem, real users and real KPIs. Examples include digitizing maintenance for 50 critical machines, building a downtime dashboard for one line, deploying AI Copilot for technical documents of one machine group or tracking OEE in one production area.

With small scope, the factory can deploy faster, receive feedback faster and see what works or does not work. Then it can expand to more lines, departments or factories.

What managers should do:

Choose a pilot with clear limits: scope, time, users, data and KPI. Define expansion criteria before starting: what result triggers expansion, and what will be adjusted if the target is not reached.

8.6. Question 80: What is lost if a pilot fails?

Short answer:

If a pilot is small and controlled, the loss is usually limited. The important point is to learn why it did not succeed: wrong problem, poor data, unclear process, low user adoption or unsuitable solution.

Practical explanation:

Not every pilot succeeds immediately. But a pilot that misses expectations can still be valuable if it reveals bottlenecks. The factory may discover that downtime data is unreliable, cause lists are confusing, technicians do not record results fully, dashboards do not answer managers' questions or AI Copilot answers poorly because documents are not standardized.

The biggest risk is not an imperfect pilot. The bigger risk is failing to learn, or concluding too quickly that "digitization does not work" or "AI is useless" when the real issue is use case selection and preparation.

A small pilot failure is better than a large project failure after much cost, time and internal trust have been spent.

What managers should do:

Define evaluation criteria before the pilot. If the pilot does not meet targets, conduct a cause review: data, process, people, technology or scope. Do not judge the pilot only by general feeling.

8.7. Question 81: Is there a way to prove value before a large investment?

Short answer:

Yes. The factory can begin with an assessment, proof of concept, small pilot or sample dashboard using existing data to prove value before making a large investment.

Practical explanation:

A factory does not always need to sign a large project immediately. A practical approach is to start with a current-state assessment to identify the main issues. Then choose a use case with relatively available data and test it in a small scope.

For example, use six months of downtime data to build a cause analysis dashboard. Use maintenance work order history to find the top failing equipment. Use a set of machine documents to test AI Copilot search. Use output and downtime data from one line to analyze OEE.

These tests help show whether current data is usable, whether users find the result useful, which KPIs can improve and whether the solution fits the factory.

What managers should do:

Require a value-proving step before expansion. It does not need to be large, but it must use real data, a real problem and real users. Avoid attractive demos unrelated to your factory's data.

8.8. Question 82: Should we outsource, buy software or build internally?

Short answer:

It depends on internal capability and implementation goals. Factories can build some dashboards or small tools internally, but for critical operational systems such as CMMS, MES, data integration or AI Copilot, it is usually better to combine a professional solution with an internal team that understands operations.

Practical explanation:

Building internally is flexible, familiar and may have lower initial cost. But it carries risks: dependence on a few people, difficult maintenance, weak permissions, weak security, limited scalability and integration challenges.

Buying software provides a ready foundation, more standardized processes, technical support and scalability. But if the internal team is not involved, the system may have features but not fit actual operations.

Outsourcing or using a vendor can accelerate the project, especially when the factory lacks experience in deployment, data, integration or AI. But the factory must still own the objectives, data and processes.

What managers should do:

Classify what should be built internally, bought or outsourced. As a principle, build small, flexible, low-risk tools internally; use professional solutions for core processes; and always build internal capability so the factory is not completely dependent on external parties.

8.9. Question 83: What is the annual maintenance cost?

Short answer:

Annual maintenance cost depends on the solution type, number of users, infrastructure, support, software maintenance, upgrades, data storage and AI usage. The factory should calculate ongoing cost from the beginning, not only the initial implementation cost.

Practical explanation:

After go-live, the system still needs operation: user support, bug fixing, version upgrades, data backup, account management, dashboard changes, new reports, master data updates, process changes and new integrations.

For cloud solutions, cost may include software subscription, storage, data processing, internet and AI services. For on-premise solutions, cost may include servers, infrastructure maintenance, backup, security and IT manpower. For AI Copilot, cost may include knowledge updates, answer quality control, model usage and document processing.

If maintenance cost is not calculated, the factory may deploy the system but fail to maintain quality after six to twelve months.

What managers should do:

When budgeting, ask for both first-year cost and recurring annual cost. Also define who inside the factory is responsible for operating the system, updating data and working with the vendor when support is needed.

8.10.Question 84: Besides software, what other costs can AI create?

Short answer:

AI may create costs for data, storage, AI models, cloud infrastructure, security, permissions and quality monitoring. These costs can be controlled if scope, data and usage are defined clearly from the beginning.

Practical explanation:

AI is not simply a button in software. Depending on the type of AI, the factory may need to prepare data, store documents, create search indexes, connect systems, call AI models, control access rights, log usage, check answers and update knowledge regularly.

For AI Copilot, costs may come from document processing, knowledge base storage, semantic search, language model usage and data security. For AI prediction or production analysis, costs may come from data infrastructure, computing, historical data storage and integration with operational systems.

The key is not to deploy AI too widely at the beginning. If the factory starts with a specific use case, such as document search for critical equipment or downtime analysis for one line, costs are easier to control.

What managers should do:

When evaluating AI, ask clearly: where data is stored, where the model runs, whether cost is based on users, storage, number of questions or processing resources, and whether a budget limit exists. AI should have cost control from the beginning.

8.11. Question 85: How do we calculate ROI for a dashboard, CMMS, MES or AI Copilot project?

Short answer:

ROI should be based on operational improvement: reduced downtime, reduced reporting time, higher OEE, fewer defects, lower inventory, faster troubleshooting, better maintenance compliance or improved on-time delivery. Do not calculate ROI only from software cost.

Practical explanation:

Each project type has a different ROI logic. For CMMS, ROI may come from reduced downtime, fewer emergency repairs, better PM completion, lower spare part cost and less time searching equipment history. For MES or SmartTrack, ROI may come from higher OEE, reduced output reporting time, earlier schedule-risk detection and fewer production recording errors.

For dashboards, ROI often comes from faster decisions, less reporting work, fewer arguments about numbers and earlier visibility of problems. Although this may be harder to convert to money immediately, it is the foundation for operational improvement.

For AI Copilot, ROI may come from reduced document search time, faster troubleshooting support, faster training for new staff, reduced dependence on senior experts and standardized operational knowledge.

The best method is to define baseline indicators before implementation and compare before and after.

What managers should do:

Before implementation, record the baseline: downtime, OEE, report preparation time, document search time, PM on-time rate and repeated defects. After three to six months, compare again to calculate actual benefits.

9. Chapter 9: Technology, systems and infrastructure

Managers do not need to understand every technical detail of digitization and AI, but they do need to know enough to ask the right questions, avoid wrong investments and avoid total dependence on vendors.

Good technology is not the most complicated technology. Good technology fits the factory's current state, connects with necessary systems, is easy to use, safe enough, scalable and serves operational objectives.

This chapter answers common questions about current systems, ERP, IoT, cloud, internet loss, scalability, vendor dependency, software lifetime and phased implementation.

9.1. Question 86: Do we need to replace all current systems?

Short answer:

Not necessarily. In many cases, the factory does not need to replace everything. It needs to supplement, connect or standardize existing systems so they serve operational objectives better.

Practical explanation:

Many companies already have digital foundations such as ERP, accounting software, SCADA, timekeeping systems, warehouse software, Excel or internal tools. When the factory wants deeper shop-floor digitization or AI readiness, the first step is to assess which data can be reused, which systems need connection and what operational gaps need to be filled.

The important question is what each current system does well and what it lacks. ERP may manage orders, purchasing, inventory and finance well, but may not be detailed enough for shop-floor operations. Excel may be flexible but lacks control. SCADA may have machine data but is not linked to plans, downtime or maintenance work orders.

A good roadmap usually begins by reviewing systems and data, identifying reusable data, needed connections and missing operational capabilities. This helps the company extend digital capability to the factory without disrupting existing management systems.

What managers should do:

List current systems, what data each manages, who uses it, which data can be reused, which data needs connection and which operational gaps remain. The goal is to understand the current digital foundation before building the next layer for the factory.

9.2. Question 87: Can the new system connect with the existing ERP?

Short answer:

Usually yes. ERP and new systems can exchange data through APIs, databases, intermediary files or suitable integration mechanisms. The actual level of integration depends on data standards, access rights and the scope of connection.

Practical explanation:

ERP is often the core system for data such as orders, plans, product codes, materials, warehouse, purchasing and finance. But ERP is not always detailed enough for shift production, downtime, OEE, maintenance work orders, checklists, quality defects or shop-floor data.

Therefore, systems such as MES, CMMS, SmartTrack or dashboards often exchange data with ERP in both directions. ERP may provide master data and plans such as product codes, material codes, BOMs, production orders or production plans. Production systems may send back actual output, progress, order status or consumption data; maintenance systems may send spare parts used, maintenance cost or related work status. Two-way synchronization helps management data in ERP reflect factory reality more closely.

The challenge is not only technical connection. It also lies in whether product codes, equipment codes, material codes, units, time and business rules are consistent.

What managers should do:

When selecting a new system, ask clearly what data must be received from ERP, what data must be sent back, synchronization frequency, who owns master data and which system is official if data differs.

9.3. Question 88: Do we need to buy more machines, sensors or IoT devices?

Short answer:

Not always immediately. Sensors and IoT are very useful when the factory needs automatic, fast and accurate equipment data, but they should be purchased for specific problems, not purchased first and then looking for uses later.

Practical explanation:

IoT and sensors can collect data such as run/stop status, output, temperature, pressure, current, vibration, energy consumption and environmental conditions. These are important for use cases such as equipment monitoring, abnormality alerts, performance analysis and failure prediction.

However, not every digitization problem requires IoT. If the problem is managing maintenance work orders, maintenance history, checklists, spare parts, technical documents or downtime cause confirmation, the factory can start with processes and software. Human-confirmed data remains important for causes, actions and field assessments.

Buying sensors without knowing which KPI they will improve can create a lot of data without value. If the factory knows what must be measured and which decision will change because of that data, IoT becomes useful.

What managers should do:

Do not start by asking “Which sensors should we buy?” Ask: “Which data do we need faster or more accurately to make better decisions?” If that data cannot be entered manually reliably or must be updated continuously, then consider sensors, PLC, SCADA or IoT.

9.4.Question 89: What infrastructure should factory systems use?

Short answer:

There are usually three options: internal servers, a private cloud server in a data center or cloud provider, and cloud software as a service. For new projects, cloud server or cloud software is often more flexible; internal servers should be considered only when there are clear infrastructure, security or internal policy requirements.

Practical explanation:

An internal server, or on-premise server, means the company invests in and operates servers internally. This gives high control, but the company must manage servers, security, backup, upgrades, monitoring and IT manpower. For many new projects, this is no longer the default option.

A cloud server means the company has a dedicated server environment located in a data center or cloud provider. The system can still be deployed separately for the company, while the infrastructure is usually more professional with security, backup, monitoring and scalability.

Cloud software as a service means the company uses software already operated by the vendor on cloud. The company does not manage servers or backup deeply, but focuses on using the software, configuring business processes, managing permissions, data and integrations.

What managers should do:

Do not begin by asking “Do we need to buy a server?” Begin by defining who the system serves, whether data is sensitive, which systems it must connect with, security and backup requirements, internal IT capability and how much infrastructure control the company wants. For most new projects, consider cloud server or cloud software first; choose internal server only when there is a clear reason.

9.5.Question 90: Is cloud safe?

Short answer:

It can be safe if the cloud model is designed, configured and governed properly. The risk is not simply using or not using cloud; it lies in how data, permissions, encryption, backup, access logs and responsibilities between factory and vendor are controlled.

Practical explanation:

Many factories worry about cloud because they fear leakage of production, equipment or operational data. This concern is reasonable, especially when systems involve production, maintenance, quality, formulas, machine parameters or internal documents.

However, an internal server is not automatically safe just because it sits in the factory. If passwords are weak, permissions are unclear, backups are missing, security updates are not applied, access logs are absent or no one owns operations, risk remains high.

With a private cloud server, the company usually has a dedicated environment at a data center or cloud provider. It can be secure if network, accounts, permissions, encryption, backup, monitoring and administration rights are set up properly. With cloud software as a service, the vendor takes more responsibility for infrastructure, operations, backup and platform security, but the factory must clarify where data is stored, whether customer data is separated, who has admin access, whether logs exist, how backup works and how data is returned or deleted when service ends.

For AI Copilot, security must be even clearer: which documents are uploaded, what is indexed, which users can see which answers, whether AI respects document permissions, whether chat logs are stored and whether factory data is used to train general models.

What managers should do:

Do not ask only "Is cloud safe?" Ask the vendor to explain whether the model is private cloud server or cloud software service, where data is stored, who can access it, how permissions are controlled, whether data is encrypted, how backup works, whether access logs exist, whether customer data is separated and what the AI data policy is.

9.6. Question 91: If internet is lost, can the factory still operate?

Short answer:

It depends on where the system runs and whether backup options exist. If the system runs on cloud, internet loss may prevent users in the factory from accessing the cloud database. If the system runs on an internal server, internet loss may not stop the system as long as the local network, server and internal infrastructure still work.

Practical explanation:

When discussing "network loss," distinguish between losing internet and losing the internal factory network. In many factories, a well-designed local network can still operate when the internet connection is down. The more common concern is losing internet when production, maintenance, dashboards or AI Copilot are deployed on cloud.

If the system runs on cloud, users usually need internet to access it. When internet is lost, data entry, dashboard viewing, work order updates or information search may be interrupted unless there is a backup internet line or offline capability.

If the system runs on an internal server, internet loss may not stop it. Users can still access the system inside the factory if the local network, server, network devices and power remain available. However, functions requiring external connection, cloud synchronization, remote access or external AI services may be affected.

Some cloud systems support partial offline use, such as temporary data recording on devices and synchronization when internet returns. But offline capability increases complexity and cost because the system must store temporary data, sync later and handle conflicts.

What managers should do:

Ask the vendor what users can still do if internet is lost, what must stop, where temporary data is stored, how synchronization works when internet returns and whether a backup internet line is needed. If certain processes must work offline, state this requirement from the beginning.

9.7.Question 92: Is the system easy to expand?

Short answer:

A good system should scale by line, department, factory, number of users, data volume, dashboards and AI use cases. Scalability should be considered from the beginning, even if the project starts small.

Practical explanation:

A factory may begin with one line or one equipment group, but if successful it will want to expand. The system must be flexible enough to add users, equipment, processes, dashboards, integrations and even multiple factories.

If the system is custom-built too narrowly for a small scope, expansion may be difficult. For example, equipment hierarchy is missing, data codes are not standardized, permissions do not support many departments, dashboards are hard-coded, APIs are absent or data is not separated by factory/line.

Scalability does not mean buying a large system immediately. It means starting small without locking the factory into a small architecture.

What managers should do:

During a pilot, ask: if we later expand to five lines, three factories or 500 more users, can the system handle it? Check scalability in data, permissions, configuration, integration and cost.

9.8.Question 93: Will we become dependent on one vendor?

Short answer:

This can happen if the system is too closed, data is hard to export, integration is limited or technical documentation is unclear. The factory should choose a sufficiently open solution and retain control of its own data.

Practical explanation:

Vendor dependence is not always bad. A good vendor can be a long-term partner, understand operations and support system development. The problem is being dependent to the point where the factory cannot access its own data, connect other systems, change reports or expand without excessive cost.

A closed system creates long-term risk: data can be viewed only on the screen and not exported, APIs are absent, data structure is unclear, even small dashboard changes require vendor work or connecting ERP/AI is difficult.

The factory should balance using a professional solution with owning its data, processes, documents and internal capabilities.

What managers should do:

When selecting a vendor, ask whether data can be exported, whether APIs exist, whether integration documentation is available, who owns data if the contract ends, whether other systems can connect and what the internal team can configure by itself.

9.9.Question 94: Can the software be used long term, or will it need replacement after a few years?

Short answer:

Software can be used long term if it fits core processes, is scalable, is updated, supports standardized data and has a capable vendor behind it. If selected only for short-term needs, replacement after a few years becomes likely.

Practical explanation:

A system may satisfy a small initial requirement, but as the factory grows, needs expand: more users, more data, more dashboards, more processes, more integrations, higher security requirements, AI Copilot and advanced analytics.

If software cannot scale, lacks good data standards, lacks APIs, is hard to use, has no upgrade roadmap or the vendor does not understand manufacturing, the factory may need replacement after a few years. Replacing software is costly because of historical data, user habits, integrations and processes.

A good system does not need to be perfect at the start, but it must have a solid enough foundation to grow with the factory.

What managers should do:

Do not select software only for today's requirements. Ask about the next three to five years: more factories, more lines, new modules, dashboards, ERP integration, machine connectivity, AI Copilot and multi-level permissions. The software roadmap should fit those needs.

9.10.Question 95: Does AI require very powerful infrastructure?

Short answer:

Many factory AI applications do not require extremely powerful infrastructure. Early use cases often can start with standard infrastructure, cloud servers or existing AI services. What is needed is a cloud server, data storage, connectivity, user permissions, security and the ability to call suitable AI services.

Practical explanation:

When people think about AI, they often imagine powerful servers, GPUs, data centers and high infrastructure cost. This is true for special problems such as training custom AI models, real-time image/video processing, very large data analysis or continuous high-speed processing.

For many early factory AI use cases, infrastructure does not need to be large. Tasks such as report summarization, document search, cause suggestions or small-scope operational data analysis often do not need dedicated GPUs or big servers. What is more important is a stable architecture for storing data, connecting with current systems, calling AI services, controlling access and expanding later.

However, "not very powerful" does not mean careless. Infrastructure still needs storage, permissions, security, backup, connections with existing systems, acceptable response time and scalability as users or data volume increase.

The correct question is not "Does AI need a powerful server?" but "What data does this AI use case process, how many users are there, how fast must the response be, how sensitive is the data and which deployment model will be used?"

What managers should do:

Start from the use case: who AI serves, what data it uses, response time, data sensitivity and initial user count. Then work with IT and the vendor to choose suitable infrastructure. At the beginning, prioritize a secure, sufficient and scalable architecture instead of over-investing before value is proven.

9.11. Question 96: Can we implement in phases?

Short answer:

Yes, and phased implementation is often the most suitable approach. The factory can deploy by process, line, equipment group, dashboard or AI use case.

Practical explanation:

Phased implementation helps control risk. Instead of doing everything at once, the factory can start with critical maintenance equipment, one production line, one quality defect group, one management dashboard or one AI Copilot for technical documents.

It also helps users adapt gradually. At each stage, the factory learns what works, what data is missing, which process must be adjusted, which training should be added and which dashboard is actually used.

However, phased implementation must not become fragmented. A common architecture and roadmap are needed so later parts connect with earlier ones. If each phase uses different data standards, coding methods or disconnected systems, the factory will struggle to build overall dashboards or AI later.

What managers should do:

Implement in phases but design the overall picture from the beginning. Each phase should have clear scope, KPI, data standard and connection plan with future phases. Start small, but do not work in isolation.

10.Chapter 10: Security and data control

When a factory begins digitization, operational data becomes an important asset. When the factory moves toward dashboards, cloud or AI, questions about security, permissions and data control become even more important.

Managers have good reasons to be concerned. Production data, productivity, quality, defects, equipment, processes, customers, orders, technical documents and operating know-how can all be sensitive. If not managed well, digitization can create new risks.

This does not mean factories should avoid digitization or AI. The right approach is to design security and data control from the beginning: where data is stored, who can see what, who can edit what, what documents AI may use, whether access history is recorded and how data is protected during integration.

10.1.Question 97: Can my production data be leaked?

Short answer:

Data can leak if the system is poorly designed, has poor access control or is poorly operated. But with clear security architecture, proper permissions, access control and data policies, risk can be significantly reduced.

Practical explanation:

Production data may leak through many channels: shared accounts, weak passwords, overly broad permissions, Excel files sent by email, personal devices, uncontrolled vendor access, systems without logs or data sent to cloud/AI without clear policy.

Data is not risky only when using cloud. Even if data is on an internal server, if many people share accounts, role-based permissions are absent, backups are missing or remote access is uncontrolled, risk remains high.

Security is not a single feature. It is the way the factory designs the entire data lifecycle: creating data, storing, accessing, sharing, integrating, backing up and deleting or archiving it.

What managers should do:

Ask IT and the vendor to map sensitive data: what data is important, where it is stored, who can access it, whether logs exist, whether backups exist and how data is protected when shared with other systems.

10.2.Question 98: When using cloud server or cloud software, who controls the data?

Short answer:

Distinguish between private cloud server and cloud software as a service. With a private cloud server, the company usually controls its deployment environment and data. With cloud software as a service, the vendor participates more in operating the system, storage, backup, security and platform management. Therefore, ownership, access rights, storage location, backup and data-use policies must be clarified from the beginning.

Practical explanation:

Cloud should not be understood simply as "putting data outside." In a private cloud server model, the system may be deployed in a dedicated environment for the company, located at a data center or cloud provider. The company can still control data, permissions, security configuration, backup and connections depending on the model and agreement.

With cloud software as a service, the company uses software operated by the vendor. This is convenient because the factory does not manage servers, updates, backup or infrastructure deeply. But the factory must know where data is stored, whether data is separated between customers, who has admin access, what level of access the vendor has and whether data may be used for other purposes.

With AI, this becomes more important. The factory needs to know what data enters the knowledge base, which documents are indexed, who can ask and view which answers, whether chat history is stored and whether factory data is used to train general models.

What managers should do:

Do not ask only "Is data on cloud?" Ask whether the model is private cloud server or cloud software service. Clarify data ownership, storage location, access rights, backup, data return or deletion when service ends and whether data is used by AI outside the permitted scope.

10.3. Question 99: Will AI learn from my factory's private data and share it elsewhere?

Short answer:

This depends on the AI platform, service contract and system configuration. The factory must require clarity on whether data is used to train general models, whether data is separated between customers and whether the data belongs to the factory.

Practical explanation:

This is an important question when using AI. Managers may worry that if documents, production data or maintenance history are added to AI, the system may "learn" them and answer other users. This concern must be handled with policy and architecture, not vague promises.

Enterprise AI solutions can usually be designed so each customer's data is separated, not used to train general models, and AI retrieves only from authorized knowledge bases. But the factory needs to verify this in contracts and technical documents.

For AI Copilot, it is important to understand the difference between "AI answers based on the factory's data" and "AI is trained with the factory's data." Many systems retrieve relevant documents and generate answers without training the general model on customer data. The vendor must explain the exact method clearly.

What managers should do:

When working with an AI vendor, ask in writing whether factory data is used to train general models, whether data is separated by customer, whether data can be deleted when service ends and who owns the data.

10.4.Question 100: Who is allowed to see which data?

Short answer:

Data access should be based on role, department, management level, factory, line and data sensitivity. Do not let everyone see everything just because the system can do it.

Practical explanation:

Different users need different data. Operators may only need tasks, checklists or information related to their shift. Shift leaders need progress, downtime, output and defects in the shift. Department heads need summarized data by area. The board needs overview dashboards. IT needs technical admin rights but may not need to see every sensitive business detail.

If permissions are too broad, leakage risk increases. If permissions are too narrow, users lack the information needed to work. Permissions should follow the principle of "enough to do the job," not more.

With AI Copilot, permissions are even more important. A user should receive answers only from documents and data that he or she has permission to access. Otherwise, AI may accidentally reveal sensitive information through its answer.

What managers should do:

Build a role-based permission matrix. For each role, define what the user can view, create, edit, approve and export. For AI Copilot, also define which document repositories that role can query.

10.5.Question 101: Can access and edit history be controlled?

Short answer:

It should be. Important operational systems should record who created data, who edited it, when, what changed, who approved it and who accessed sensitive data.

Practical explanation:

Factory data is not only for viewing. It is also operational evidence, audit evidence and decision basis. If important data is changed without knowing who changed it, the factory cannot control trust.

Downtime time, downtime cause, quality inspection result, maintenance work order status, checklist results and good/defective quantities may affect KPIs. Without edit history, users may change numbers later without trace, or the factory cannot investigate discrepancies.

Access history is also important for sensitive data. The factory should know who viewed or downloaded important technical documents, quality reports, customer data or sensitive production data.

What managers should do:

Require an audit trail for important data. At minimum, the system should record who created, who edited, what changed, when and who approved if approval exists. For sensitive data, access and download logs should also exist.

10.6. Question 102: If we use AI Copilot, how do we ensure it answers only within permitted documents?

Short answer:

AI Copilot must be designed with user permissions and document permissions. AI should retrieve, read and answer only from documents or data the user is allowed to access.

Practical explanation:

AI Copilot can be very useful in factories: searching manuals, SOPs, checklists, troubleshooting guides, maintenance history, LOTO procedures and quality standards. But if permissions are wrong, AI may answer from documents the user should not see.

For example, a technician in Area A should not be able to ask about sensitive documents in Area B without permission. An external contractor may only see safety instructions and work-scope documents, not all production data. A new employee should not see unapproved or obsolete documents.

In addition to permissions, the source documents must be controlled. AI should prioritize approved documents with clear version, owner and update date. If AI reads old drafts or unofficial files, answers may be wrong.

What managers should do:

When deploying AI Copilot, require three layers of control: user permissions, document permissions and document version control. Answers should also cite or show source documents so users can verify them.

10.7. Question 103: Can permissions be set by department, factory and line?

Short answer:

Yes, if the system is designed with suitable permission structure. The factory should define permission needs by department, factory, line, area, role and management level from the beginning.

Practical explanation:

A small factory may use simple permissions. But with many lines, departments, factories or management levels, permissions become more complex. A shift leader may see only data for his line and shift. The maintenance manager may see all equipment in the factory. The board may see summarized dashboards. Group management may see data across factories but not every detailed work order.

If the system cannot support flexible permissions, the factory faces two problems: users cannot see the data they need, or users see too much irrelevant or sensitive data. Both create risk.

Permissions must also align with data structure. If data is not tagged by factory, line, area, department, role or user group, accurate permissions are difficult.

What managers should do:

Before implementation, describe the operating organization and permission needs. Define roles, factory, department, line and what each role can view, edit and approve.

10.8. Question 104: Can the system meet customer audit requirements?

Short answer:

It can, if the system stores complete data, has permissions, edit history, traceability and document control. Proper digitization can help the factory prepare for audits faster and more reliably.

Practical explanation:

During audits, customers often ask not only for final results. They want evidence: whether procedures were followed, who did the work, when, whether checklists exist, whether approvals exist, how defects were handled, whether equipment maintenance was on time, whether documents were the correct version and whether corrective actions were tracked.

If the factory manages by paper or scattered Excel files, audit preparation takes a lot of time. Staff must search records, check dates, gather signatures, verify document versions and explain inconsistencies. With good digitization, much of this evidence can be retrieved faster and more consistently.

However, digitization does not automatically guarantee good audits. The system must reflect the correct process, data must be entered fully, documents must have version control and permissions must be clear.

What managers should do:

Take the usual customer audit checklist and check whether the current system can provide evidence. If every audit requires manual document gathering, prioritize digitizing the audit-related processes and documents.

11.Chapter 11: What can AI do in a factory?

After the factory understands the role of digitization, data, dashboards, processes, people, cost and security, the next question is: what can AI actually do in a factory?

This chapter looks at AI with balance. AI has great potential, but not every problem should use AI immediately. AI creates value only when it is placed in the right process, uses the right data, supports the right users and is linked to a specific operational KPI.

In factories, AI can support analysis, alerts, recommendations, prediction, knowledge search, information summarization and decision support. But AI should not be seen as a complete replacement for engineers, shift leaders, maintenance experts or managers. It should be seen as a support layer that helps people work faster, more consistently and with better data.

11.1.Question 105: What can AI do in my factory?

Short answer:

AI can support data analysis, abnormality detection, risk prediction, cause suggestion, document search, information summarization and faster decision-making. But AI creates value only when tied to a specific operational problem.

Practical explanation:

In maintenance, AI can analyze failure history, suggest causes, predict equipment risk or help technicians search manuals and SOPs. In production, AI can analyze OEE, detect abnormal cycle time, warn about schedule risks or summarize shift production. In quality, AI can analyze repeated defects, support root-cause tracing, detect abnormalities or support CAPA handling.

AI can also support factory knowledge: answering questions from machine documents, operating procedures, checklists, safety guides, LOTO, HACCP, GMP, HSE and troubleshooting experience.

However, do not begin with “What can AI do?” Begin with: “Which factory problem could be improved by smarter analysis, prediction, recommendations or knowledge search?”

What managers should do:

List operational problems that consume time or cost: downtime, low OEE, repeated defects, slow document search, delayed reporting and dependence on experts. Then identify which problem has sufficiently good data and where AI can support a specific step in the process.

11.2.Question 106: Can AI predict machine failures?

Short answer:

It can, but expectations must be realistic. Predictive maintenance usually requires continuous equipment-condition data from sensors, IoT, SCADA or online monitoring systems. It is a high-cost use case and should be prioritized only for critical equipment where downtime, damage or production impact is truly significant.

Practical explanation:

AI cannot reliably predict machine failures from a few vague repair notes. To predict failures, the factory usually needs to monitor equipment condition using signals such as vibration, temperature, current, pressure, speed, operating load, running hours or other important technical parameters.

These signals are often collected through sensors, IoT, SCADA or equipment monitoring systems. AI or analytics tools can then detect abnormal trends, identify deviations and send early alerts so maintenance can inspect before a failure occurs.

However, predictive maintenance is not cheap. It may require sensors, connectivity devices, data storage, analytics software, integration, sensor maintenance and people to monitor alerts. If applied to non-critical machines, cost may exceed benefit.

Therefore, predictive maintenance should not be the first AI use case for every asset. It fits machines or lines where a stoppage creates high loss: major output loss, delivery impact, quality risk, safety risk, high repair cost or long recovery time.

What managers should do:

Do not begin by asking "Can AI predict machine failure?" Begin with "Which machines cause the greatest loss when they stop?" Choose a few critical assets, estimate downtime cost, identify technical signals to monitor and assess whether the investment in sensors, IoT, data and AI is justified.

11.3.Question 107: Can AI support analysis of recorded downtime causes?

Short answer:

Yes, if downtime data is recorded fully and structurally. AI can help summarize causes, detect repeated patterns and highlight abnormalities in downtime data. However, this analyzes what has already happened; it does not automatically conclude the actual cause on the shop floor.

Practical explanation:

Downtime can come from equipment failure, material shortage, waiting for QC, changeover, long setup, operator error, labor shortage, plan changes or quality problems. If downtime data records machine, line, shift, product, time, cause group and confirmer clearly, AI can analyze it more effectively.

AI may detect that a downtime group often occurs on the night shift, on a specific line, when running a certain product group or after a type of changeover. It can also compare downtime with maintenance, quality or production data to suggest areas requiring deeper investigation.

If downtime causes are free text, each shift writes differently or many stoppages have no clear reason, AI can analyze only in a limited way. AI cannot create correct conclusions from source data that is wrong, missing or not reflective of reality.

What managers should do:

Standardize downtime cause lists first. Then build dashboards for top machines, top causes and downtime by shift, product and line. Once data is good enough, use AI to detect trends, repeated patterns and priority areas for checking.

11.4.Question 108: Can AI support troubleshooting when a machine has a problem?

Short answer:

Yes. AI can help technicians quickly search technical documents, SOPs, checklists, error codes, similar incident history and suggested inspection steps. However, AI is only a support tool; technicians must still inspect and confirm at the site.

Practical explanation:

Troubleshooting focuses on handling an active problem and bringing equipment back to operation. When a machine stops or shows an error code, technicians often need to find documents, review instructions, check common causes and compare with previous incidents.

AI Copilot can speed up this process. When a technician enters an error code or describes symptoms, AI can suggest relevant documents, inspection steps, similar historical failures and parts to check first. This is especially useful when technical documents are numerous, scattered or hard to find.

But AI does not see the field like a technician. It can suggest what to check, but it cannot physically confirm whether a sensor is broken, a mechanism is stuck, a wire is loose or the machine is operating under unusual conditions. Final confirmation must come from field inspection.

What managers should do:

Prepare a strong technical knowledge base for AI: manuals, SOPs, checklists, error codes, troubleshooting guides and maintenance history. Also define clearly that AI supports troubleshooting; it does not replace technician responsibility at the site.

11.5.Question 109: Can AI support root-cause analysis?

Short answer:

AI can support it, but managers should not expect AI to find the root cause by itself. AI can summarize data, related incident history and documents, and suggest analysis directions. The final conclusion still requires the related team to verify.

Practical explanation:

Troubleshooting focuses on fixing an immediate problem. Root-cause analysis, or RCA, goes deeper: why did the problem happen, why did it repeat and what must change to prevent recurrence? The root cause may not be the equipment itself. It may lie in maintenance process, operator practice, production conditions, material quality, training, planning or change management.

AI can support RCA by summarizing similar incidents, maintenance history, downtime data, checklists, incident records, quality data and technical documents. It can help the analysis team ask better questions, see repeated points and identify additional directions to verify.

However, RCA should not rely only on AI. If data is missing, causes are not recorded clearly or field context is not documented, AI suggestions may be incomplete. Human review, cross-department discussion and evidence verification remain essential.

What managers should do:

Use AI as an assistant during RCA: gather related data, list similar incidents, summarize documents and suggest possible contributing factors. But require the team to verify evidence before concluding and defining corrective actions.

11.6.Question 110: Can AI read machine documents and guide technicians?

Short answer:

Yes, if documents are organized and controlled well. AI Copilot can help technicians search manuals, SOPs, checklists and troubleshooting guides faster, then provide step-by-step support based on approved documents.

Practical explanation:

Many factories have a lot of technical documents: equipment manuals, wiring diagrams, error-code lists, maintenance guides, setup instructions and safety procedures. These documents may be stored in folders, paper binders, email attachments or individual computers. When a problem occurs, finding the right document can take too long.

AI Copilot can search across these documents and answer questions in natural language, such as "What should I check when alarm E12 appears?" or "What is the lubrication frequency for this machine?" It can also point to the source document so technicians can verify.

But AI is only as good as the documents it can access. If documents are obsolete, duplicated, unapproved or in many inconsistent versions, AI may give confusing answers.

What managers should do:

Before deploying AI Copilot, organize technical documents by machine, version, owner and approval status. Prioritize critical machines and frequently used documents first. Require AI answers to cite the source document.

11.7. Question 111: Can AI analyze OEE?

Short answer:

Yes. AI can support OEE analysis by identifying patterns in Availability, Performance and Quality losses, suggesting possible causes and highlighting unusual changes. But OEE must be calculated consistently and data must be trusted.

Practical explanation:

A dashboard can show OEE values and the three components. AI can help go further by analyzing relationships across shifts, products, lines, machines, downtime reasons, speed losses and quality losses. For example, AI may show that OEE drops mainly when a certain product runs on a certain line, or that performance loss increases after changeover, or that quality loss is concentrated in a particular operation.

AI can also summarize OEE performance for managers: what changed, which factor had the greatest impact, which line needs attention and what should be investigated first.

However, if the factory calculates OEE differently across areas, records downtime inconsistently or has unreliable output and defect data, AI analysis will be unreliable.

What managers should do:

Standardize OEE calculation and validate input data before using AI. Use dashboards first to show OEE by component. Then use AI to support deeper pattern detection and improvement prioritization.

11.8. Question 112: Can AI detect production abnormalities?

Short answer:

Yes, if the factory has timely and reliable production data. AI can help detect abnormal cycle time, output rate, downtime frequency, defect increase, energy consumption or process parameters.

Practical explanation:

Production abnormalities are often hidden in daily variation. A line may still run, but slower than normal. A machine may not stop completely, but micro-stops increase. Defects may rise slightly before becoming serious. Energy consumption may become unusual before a machine problem is visible.

Dashboards can show indicators, but AI can help detect patterns and deviations faster, especially when there are many lines, products and operating conditions. AI may alert that cycle time is drifting upward, output rate is lower than expected for a product, or a machine has repeated short stops outside its normal pattern.

Abnormality detection requires good baselines. The system must know what "normal" looks like for each line, product, shift or machine.

What managers should do:

Start with a few important abnormalities to monitor, such as cycle time, downtime frequency, output rate or defect rate on a key line. Define normal ranges, validate data quality and use AI only after the baseline is understood.

11.9. Question 113: Can AI support quality inspection?

Short answer:

Yes, in some cases. AI can support quality inspection through image analysis, defect classification, trend detection or document-based guidance. But the appropriate use case depends on product type, defect type, available data and inspection conditions.

Practical explanation:

For visual defects, AI image recognition can detect scratches, missing parts, wrong assembly, surface defects or packaging issues if enough representative images exist. This often requires cameras, lighting, image collection, labeling and model training.

For quality data already recorded in systems, AI can analyze defect trends, repeated causes, affected products, risky processes and relationships with machines, materials or shifts. For document-based quality work, AI Copilot can help users find inspection standards, SOPs, checklists or CAPA history.

AI quality inspection is not always simple. Image AI may fail if lighting changes, product variants are numerous or defect samples are insufficient. Data analysis may fail if defect codes and causes are not standardized.

What managers should do:

Choose the quality AI use case carefully. If it is visual inspection, assess cameras, lighting, sample images and defect diversity. If it is data analysis, standardize defect codes and traceability data first. Start with a narrow and measurable use case.

11.10. Question 114: Can AI replace experienced experts?

Short answer:

Not fully. AI can capture and reuse knowledge, support analysis and help less experienced employees work faster, but it should not be viewed as a complete replacement for experienced experts.

Practical explanation:

Experienced experts understand context that may not be in the data: machine behavior, production habits, hidden process issues, special operating conditions and past decisions. AI can support by searching documents, summarizing history, suggesting possible causes and sharing accumulated knowledge more widely.

The best approach is to use AI to preserve and distribute expert knowledge, not to remove experts from the process. Experienced people should help build the knowledge base, validate AI answers, define troubleshooting guides and train the system's use in real operations.

When experts retire or leave, the factory should not lose all their knowledge. AI Copilot and structured knowledge management can help reduce that risk.

What managers should do:

Ask senior experts to help document common failures, troubleshooting steps, key settings, lessons learned and decision rules. Use AI to make that knowledge easier for others to find and apply, while experts still validate important content.

11.11. Question 115: Can AI make decisions automatically, or only suggest?

Short answer:

In most factory use cases at the beginning, AI should suggest, not decide automatically. Humans should remain responsible for important operational, safety, quality and financial decisions.

Practical explanation:

AI may recommend checking a machine, changing a maintenance priority, investigating a defect trend, reviewing a production plan or searching a document. But automatic decisions can be risky if data is incomplete, context is missing or the consequence is serious.

In factories, decisions often involve trade-offs: production versus maintenance downtime, quality versus delivery, safety versus speed, cost versus risk. AI can support analysis, but managers and engineers must consider context and responsibility.

Over time, some low-risk decisions may be automated, such as sending alerts, classifying documents, suggesting priority or creating draft reports. But high-impact decisions should require human approval.

What managers should do:

Classify AI outputs into three levels: information, recommendation and decision. At the beginning, use AI mainly for information and recommendations. Define which actions require human confirmation before execution.

11.12. Question 116: If AI suggests the wrong action, who is responsible?

Short answer:

The organization remains responsible for how AI is used. AI should be treated as a decision-support tool, not an accountable person. Responsibility must be defined clearly in process and policy.

Practical explanation:

AI can make mistakes because data is wrong, documents are outdated, prompts are unclear or the model misunderstands context. If users blindly follow AI without checking, operational risk can increase.

Therefore, AI recommendations should be accompanied by source data, confidence indicators where possible and clear boundaries. Users should know when AI can be trusted, when to verify and when to escalate to experts.

The factory also needs mechanisms to report wrong answers, correct documents, update knowledge and improve the system over time.

What managers should do:

Create rules for AI use: AI recommendations must be verified for safety, quality or high-cost actions; answers should show sources; users can report wrong answers; and a responsible owner must maintain the knowledge base and data quality.

11.13. Question 117: How can we check whether AI answers are correct?

Short answer:

AI answers should be checked against source documents, operational data and expert review. For important use cases, answer quality should be monitored regularly.

Practical explanation:

For document-based AI Copilot, answers should cite the manual, SOP, checklist or approved document used. Users should be able to open the source and confirm. For data analysis, AI conclusions should be traceable back to the data, filters, time range and calculation rules.

Experts should review sample answers before rollout and periodically after use. Wrong or unclear answers should be logged, analyzed and corrected by improving documents, permissions, prompts or data structure.

AI quality is not a one-time test. It must be monitored because documents change, processes change and user questions become more varied.

What managers should do:

Define an AI answer quality process. Test with real questions, require source citation, collect user feedback, review wrong answers and assign responsibility for updating documents and data.

11.14. Question 118: What kind of data does AI need to work well?

Short answer:

AI needs data that is relevant, reliable, structured enough, contextual and accessible within proper permissions. For document AI, it needs approved and well-organized documents. For predictive AI, it needs sufficient historical and condition data.

Practical explanation:

Different AI use cases need different data. A technical AI Copilot needs manuals, SOPs, checklists, troubleshooting guides and maintenance history. Downtime analysis AI needs downtime events, cause codes, machine codes, products, shifts and time data. Predictive maintenance needs sensor or condition data, failure history and operating context.

Data does not have to be perfect, but it must be good enough for the question asked. Vague work order notes, missing causes, old documents or inconsistent codes will reduce AI value.

AI also needs context. A downtime event without machine, product, shift or cause gives limited insight. A document without version or owner can create confusion.

What managers should do:

For each AI use case, define the required data set and check its quality before implementation. Do not say "we want AI" in general. Say "we want AI to support this process using these data sources."

11.15. Question 119: Which problems should not use AI yet?

Short answer:

Do not use AI yet for problems with unclear objectives, poor data, high safety risk without control, no user process or no measurable KPI. Use simpler digitization, dashboards or process standardization first.

Practical explanation:

AI is not suitable when the factory does not know what problem it wants to solve. It is also unsuitable when too much data is missing, or when the data is inconsistent or untrusted. If users do not know how AI fits their daily work, adoption will be poor. If there is no KPI, value cannot be proven.

Some problems are better solved first by basic management: standardizing downtime causes, completing maintenance work orders, building dashboards, cleaning master data or training users. AI should come after these foundations are strong enough.

In high-risk areas involving safety, quality release, legal compliance or large financial impact, AI must be carefully controlled and should not make automatic decisions without human approval.

What managers should do:

Before applying AI, ask: is the problem clear, is data good enough, who will use the result, which process will change and which KPI will improve? If these answers are weak, strengthen the foundation first.

12.Chapter 12: Factory knowledge and AI Copilot

Many valuable things in a factory are not stored only in ERP, MES or CMMS. They also exist in manuals, SOPs, checklists, troubleshooting notes, training materials, safety procedures and the experience of senior employees.

When this knowledge is scattered, new employees learn slowly, technicians spend time searching, experts are interrupted often and mistakes may repeat. AI Copilot can create value by helping people find and use factory knowledge faster, but it needs documents and knowledge to be organized and controlled.

12.1.Question 120: Can scattered technical documents, SOPs and checklists be used for AI?

Short answer:

Yes, but they should be organized before use. Scattered documents can become the basis for AI Copilot if they are collected, classified, version-controlled and assigned owners.

Practical explanation:

In many factories, documents are stored in many places: shared folders, personal computers, printed binders, email attachments and old systems. Some documents are current, some obsolete and some duplicated. If all are put into AI without control, the AI may answer from the wrong source.

AI Copilot works best when documents have structure: machine, line, process, document type, version, owner, approval status and update date. The factory does not need to organize all documents at once. Start with critical equipment, frequently used SOPs or documents that are hard to find but important to operations.

What managers should do:

Inventory existing documents. Prioritize documents for critical machines, common incidents, safety procedures and frequently used checklists. Mark each document with version, owner and approval status before adding it to AI.

12.2.Question 121: Do documents need to be standardized before building AI Copilot?

Short answer:

They should be standardized at least to a usable level. Documents do not need to be perfect, but they must be clear, current, approved and organized well enough for users and AI to rely on them.

Practical explanation:

If documents are old, inconsistent or unclear, AI Copilot may return confusing or incorrect answers. For example, two SOP versions may give different instructions. A machine manual may be incomplete. A checklist may not state which machine or process it applies to.

Standardization can include file naming, document type, version control, approval workflow, owner, effective date and document scope. For the first AI Copilot pilot, it is enough to standardize a focused document set, such as the manuals and troubleshooting guides for one equipment group.

What managers should do:

Do not upload a large folder of uncontrolled files into AI. First select a limited document group, clean duplicates, remove obsolete files, confirm approval and define document metadata.

12.3. Question 122: Can AI help employees find the right document faster?

Short answer:

Yes. AI Copilot can allow users to ask in natural language and find relevant documents faster than browsing folders manually.

Practical explanation:

In a factory, users often do not know the exact file name or folder location. A technician may remember only an error code, a machine name or a symptom. A new employee may not know which SOP applies. Searching folders or PDF files takes time.

AI Copilot can help by searching based on meaning, not only keywords. A user can ask, “How do I reset alarm X?” or “What checklist is needed before PM on this machine?” The system can return relevant information and point to the source document.

This improves speed, but it also depends on document quality and permissions. AI should search only approved documents the user has permission to see.

What managers should do:

Start with document search for one high-value area: technical manuals for critical machines, safety procedures or maintenance checklists. Measure search time before and after AI Copilot.

12.4. Question 123: Can AI answer questions based on manuals, SOPs and checklists?

Short answer:

Yes, if the AI is connected to an approved knowledge base and answers with references to source documents. This is one of the most practical early AI Copilot use cases in factories.

Practical explanation:

Users can ask questions such as: what are the inspection steps before startup, what should be checked for a specific alarm, what PPE is required for a task, what spare part is listed in the manual or what the SOP says about a condition.

AI can read relevant parts of documents and produce a concise answer. This saves users from reading long manuals or searching multiple files. But the answer must be grounded in source documents. If the source is missing or outdated, the answer may be wrong.

AI should also be limited to what the documents say. If the information is not found, the AI should say it cannot find enough evidence rather than inventing an answer.

What managers should do:

Require AI Copilot answers to cite sources. Train users to verify important answers with the original document, especially for safety, quality or machine adjustment topics.

12.5.Question 124: Who is responsible for updating knowledge for AI?

Short answer:

The business owner of the document or process should be responsible for knowledge content. IT supports the platform, indexing, permissions and technical operations.

Practical explanation:

Knowledge in AI Copilot is not a one-time upload. Machines change, SOPs update, checklists are revised, safety rules change and lessons learned from incidents are added. If no one owns updates, AI will quickly become outdated.

The owner should be the department that understands the content: maintenance for machine manuals and troubleshooting guides, production for operating SOPs, quality for inspection standards, HSE for safety procedures and IT for system administration.

AI knowledge governance should include document approval, version control, update frequency, review responsibility and retirement of obsolete documents.

What managers should do:

Assign knowledge owners by document type or process. Define who can add, approve, revise and remove documents. Schedule periodic review of AI knowledge sources.

12.6.Question 125: Can document versions be controlled?

Short answer:

Yes, and they should be. Version control is essential so AI and users rely on the current approved document, not old drafts or outdated instructions.

Practical explanation:

Factories often have many versions of the same document. An old SOP may remain in a folder. A draft checklist may be shared by email. A manual may be updated but the old copy still exists. If AI indexes all versions, it may answer using the wrong one.

Version control should identify document code, version number, effective date, owner, approval status and replacement relationship. AI should prioritize approved current versions and exclude obsolete or draft documents unless specifically allowed for a controlled purpose.

What managers should do:

Before adding documents to AI, mark current approved versions and remove or archive obsolete ones. Ask the AI vendor how version changes are handled during indexing and search.

12.7.Question 126: Can AI be used to train new employees?

Short answer:

Yes. AI Copilot can help new employees learn faster by answering questions, guiding them to the right documents and supporting scenario-based learning. But it should complement, not replace, formal training and supervision.

Practical explanation:

New employees often need to learn many things: machine operation, safety rules, checklists, maintenance basics, quality standards and escalation procedures. Training usually depends heavily on senior employees, and knowledge may be inconsistent between trainers.

AI Copilot can provide a consistent source of answers based on approved documents. New employees can ask questions without interrupting seniors every time. AI can also summarize procedures and suggest documents to read for a role.

However, factory work involves safety and practical skills. New employees still need hands-on training, supervision and competency confirmation.

What managers should do:

Use AI Copilot as a training support tool. Create role-based knowledge packs and common questions for new employees. Combine AI support with practical training, supervisor review and competency checks.

12.8.Question 127: Can we capture the troubleshooting experience of senior experts?

Short answer:

Yes. Senior experts' experience can be captured as structured troubleshooting guides, lessons learned, incident notes and Q&A content, then made easier to reuse through AI Copilot.

Practical explanation:

Senior experts often know patterns that are not written in manuals: which symptom usually points to which cause, which part to check first, which setting is sensitive or what mistake commonly happens after changeover. If this experience remains only in people's heads, the factory risks losing it.

Capturing experience does not require writing a long textbook. It can begin with short records: symptom, possible causes, checks, actions, warnings and related documents. Past incident reports and maintenance histories can also be converted into reusable knowledge.

AI Copilot can help users retrieve this knowledge when similar issues occur.

What managers should do:

Interview senior experts about common failures and difficult cases. Convert their experience into simple troubleshooting entries. Review and approve the content before adding it to the knowledge base.

12.9. Question 128: Can maintenance history become reusable knowledge?

Short answer:

Yes, if maintenance history is recorded with enough structure and reviewed for lessons learned. Work orders are not only records; they can become a knowledge source for future troubleshooting and improvement.

Practical explanation:

A maintenance work order may contain equipment, symptom, failure cause, action, spare parts, time, photos and notes. Over time, this history can reveal repeated failures, effective fixes, ineffective fixes, parts that often fail and common conditions before incidents.

If work orders only say "fixed" or "done," they have little knowledge value. If they record causes and actions clearly, AI can help search similar incidents and suggest what technicians checked before.

Maintenance history must also be curated. Not every work order is equally useful. The factory should identify representative cases, repeated problems and important lessons.

What managers should do:

Improve maintenance work order recording first. Then periodically review work order history to extract lessons learned and common troubleshooting cases for AI Copilot.

13.Chapter 13: Implementation roadmap

Once the factory knows the concepts, problems, data, people, costs, security and possible AI use cases, the next question is: how should the journey be organized?

A roadmap does not need to be complicated. It should help the factory move from current reality to practical next steps: assess the current state, choose the first use case, standardize data, build dashboards, train users, prove value and then expand.

13.1.Question 129: If we start today, what should the first three months focus on?

Short answer:

The first three months should focus on current-state assessment, use case selection, process and data review, pilot scope definition and quick wins such as a small dashboard or digitized process.

Practical explanation:

The first three months should not be spent buying technology blindly. The factory should understand where it is today: manual processes, Excel files, data quality, current systems, user readiness and key operational pain points.

Then select one use case that is valuable and feasible. Define the process, required data, users, baseline KPI and pilot scope. In parallel, clean key master data such as equipment, lines, products or downtime causes related to the use case.

A useful early result may be a dashboard from existing data, a digitized maintenance process for critical equipment or a standardized downtime recording method for one line.

What managers should do:

Use the first three months to answer: where are we, what problem will we start with, what data is needed, who will use it and how will success be measured?

13.2.Question 130: What results should be achieved in the first six months?

Short answer:

Within six months, the factory should have one pilot running with real users, real data, a useful dashboard and measurable early benefits.

Practical explanation:

Six months is enough to move beyond discussion. The factory should have implemented a focused process or dashboard, trained users and started measuring data quality and operational indicators.

Expected results may include better completeness of maintenance work orders, standardized downtime causes, a shift production dashboard, faster report preparation, clearer PM status or a document search pilot.

The project does not need to transform the whole factory in six months, but it should prove that the new way of working creates value and can be expanded.

What managers should do:

Set a six-month target for one real use case. Measure baseline before and after. Review user adoption, data quality and KPI improvement before deciding the next expansion.

13.3. Question 131: After one year, where should the factory be?

Short answer:

After one year, the factory should have expanded from the first pilot to a broader but still controlled scope, with clearer processes, better master data, regular dashboard use and one or two AI-ready use cases.

Practical explanation:

A realistic one-year goal is not “AI everywhere.” It is a stronger operational foundation. The factory may have digitized key maintenance or production processes, built dashboards used in daily meetings, improved data quality and standardized important codes.

If the first pilot succeeds, expansion may include more lines, more equipment groups, more users, additional dashboards or integration with ERP. The factory may also prepare an AI Copilot for technical documents or AI analysis for downtime or OEE.

The most important sign is that data is no longer only stored; it is used in management routines.

What managers should do:

Define a one-year roadmap with clear phases: foundation, pilot, dashboard use, expansion and AI preparation. Review progress quarterly and adjust based on real adoption and measured value.

13.4. Question 132: Should we build dashboards first or AI Copilot first?

Short answer:

It depends on the problem. If the main need is to see operational performance and trends, build dashboards first. If the main pain is scattered technical documents and slow knowledge search, AI Copilot can be an early use case.

Practical explanation:

Dashboards and AI Copilot serve different purposes. Dashboards help the factory see what is happening in production, maintenance, quality or inventory. AI Copilot helps users find and use knowledge from documents and history.

If the factory lacks visibility of downtime, OEE, progress or PM status, dashboards should be prioritized because they create a data-management routine. If technicians spend too much time searching manuals, SOPs or troubleshooting guidance, AI Copilot may create value even before advanced data analytics.

Both still require preparation: dashboards require structured operational data; AI Copilot requires organized and approved documents.

What managers should do:

Choose based on pain. If management lacks visibility, build dashboards first. If users cannot find knowledge, start with AI Copilot for a controlled document set. In both cases, define users, data/documents and KPIs.

13.5.Question 133: Should we implement CMMS before MES?

Short answer:

It depends on the factory's main problem. If downtime and equipment reliability are the biggest pain, CMMS may come first. If production progress, OEE and shop-floor execution are the biggest pain, MES or SmartTrack may come first.

Practical explanation:

CMMS strengthens maintenance management: equipment master data, work orders, preventive maintenance, repair history, spare parts and maintenance KPIs. MES/SmartTrack strengthens production execution: production orders, progress, output, downtime, OEE, line performance and shop-floor visibility.

Many factories need both, but not always at the same time. The first system should serve the most painful KPI. If equipment failures are causing production loss, CMMS can create immediate value. If management cannot see production status and schedule risk, MES/SmartTrack may be more urgent.

CMMS and MES should not be treated as isolated systems. Equipment downtime, production output, quality defects and maintenance work are connected.

What managers should do:

Compare the current pain: equipment reliability or production execution visibility. Start with the system that addresses the larger measurable loss, while designing data standards so CMMS and MES can connect later.

13.6.Question 134: Should maintenance or production be prioritized?

Short answer:

Prioritize the area that most affects the factory's key KPI. In many factories, maintenance and production should be considered together because equipment availability directly affects production performance.

Practical explanation:

If machines stop often, production cannot meet plan even if scheduling is good. If production does not record downtime accurately, maintenance cannot know which equipment truly causes loss. If maintenance work is not linked to production downtime, the factory cannot calculate the real impact of equipment issues.

Therefore, the priority may be maintenance, production or a combined use case. For example, record downtime in production, create maintenance work orders for equipment-related downtime and analyze MTTR/MTBF and production loss together.

What managers should do:

Select the priority by loss, not department. A good first use case may cross both production and maintenance, such as downtime recording and maintenance response for a critical line.

13.7.Question 135: Should we work on many areas in parallel?

Short answer:

Some parallel work is useful, but avoid spreading resources too thin. The factory can prepare data and processes in several areas while implementing only one or two priority use cases deeply.

Practical explanation:

Working on everything at once creates complexity: many users, many data standards, many systems and many training needs. Results may become slow and unclear.

However, some preparation can happen in parallel. For example, while implementing a maintenance pilot, the factory can review product codes, downtime cause lists or document organization. This prepares later phases without overloading implementation.

The key is to distinguish between "implementation scope" and "preparation work." Implementation should be focused. Preparation can be broader but controlled.

What managers should do:

Choose one or two main implementation use cases. For other areas, limit work to preparation such as data review, process mapping or document organization. Do not promise too many go-lives at once.

13.8. Question 136: When should we expand from one line to the whole factory?

Short answer:

Expand when the pilot has proven value, users are using the system, data quality is acceptable, processes are stable and leadership agrees on the expansion standard.

Practical explanation:

Expanding too early can multiply unresolved problems. If forms are difficult, data is incomplete, dashboards are not useful or users are still confused, expansion will make the problem bigger.

A pilot should create a standard package for expansion: process version, data lists, roles, training materials, dashboard templates, support method and KPI measurement. Once this package is ready, expansion becomes more manageable.

Expansion should still be phased: from one line to similar lines, then to other areas, not necessarily the whole factory at once.

What managers should do:

Before expansion, review pilot KPIs, user feedback, data quality and process stability. Create an expansion checklist and only expand when the pilot is strong enough.

13.9. Question 137: When should we move from dashboards to AI?

Short answer:

Move to AI when dashboards already show problems clearly, data is reliable enough and managers need support for deeper analysis, prediction, recommendations or knowledge search.

Practical explanation:

Dashboards help answer "what is happening." AI is useful when the factory wants to answer more complex questions: why is this happening, what may happen next, which cause is likely, which equipment is risky, which document is relevant and what action should be prioritized.

If dashboards are not trusted, AI will not be trusted. If data is still missing or inconsistent, AI will analyze weak input. If users do not have a process to act on AI suggestions, results will not create value.

A good transition is to pick one AI use case from dashboard pain points. For example, if the downtime dashboard shows repeated causes, use AI to analyze patterns. If the maintenance dashboard shows repeated failures, use AI to search history and documents.

What managers should do:

Use dashboards to identify the first AI use case. Choose a problem with clear data, real users and measurable value. Do not implement AI just because the dashboard exists.

13.10. Question 138: How can we build a roadmap that fits current budget and capability?

Short answer:

Build the roadmap around value and feasibility. Start with assessment, choose a priority use case, define a small pilot, set KPIs, prepare data and expand only after proving value.

Practical explanation:

A roadmap should not be a wish list of technologies. It should show a practical sequence: current-state assessment, foundation data cleanup, first process digitization, first dashboard, user adoption, integration, expansion and AI use cases.

Budget and capability determine pace. A small factory may start with one focused use case and a simple dashboard. A larger company may run several streams but still needs prioritization and common data standards.

The roadmap should include not only software, but also people, process, data, infrastructure, security and change management. Without these, the roadmap will look attractive but be hard to execute.

What managers should do:

Create a 12-month roadmap with phases, scope, KPI, resources and decision points. Review it every quarter based on actual progress, user adoption and measured benefits.

14.Chapter 14: Choosing a vendor

Choosing a vendor is not only choosing software. It is choosing a partner that can understand factory problems, deploy in real operations, support data and integration, guide users and grow with the factory over time.

This chapter helps managers ask the right questions when selecting a vendor and avoid buying based only on emotions, brand size or technology promises.

14.1.Question 139: How should we choose a suitable digitization or AI vendor?

Short answer:

Choose a vendor that understands the factory's operational problem, has relevant implementation experience, can work with real data and can support the factory after go-live.

Practical explanation:

A good vendor is not only one with an attractive demo. The vendor must understand processes such as production, maintenance, quality, warehouse, OEE, downtime, work orders, traceability and user adoption.

The vendor should also be able to explain how the solution uses data, what needs to be standardized, what integration is required, how users will work in the system and how effectiveness will be measured.

For AI, the vendor must be transparent about data security, model usage, permission control, source documents and answer quality.

What managers should do:

Evaluate vendors based on operational understanding, implementation capability, data and integration capability, security, support and roadmap - not only on demo attractiveness or low price.

14.2.Question 140: Should the vendor understand technology or manufacturing more?

Short answer:

The vendor needs both, but for factory projects, understanding manufacturing operations is extremely important. Technology without operational understanding can easily create a system that is hard to use.

Practical explanation:

A vendor may be technically strong but still fail if it does not understand shop-floor reality: shift work, downtime recording, maintenance response, OEE calculation, quality traceability, spare parts control and user habits.

On the other hand, operational knowledge without technology capability is also insufficient. The vendor must be able to build, configure, integrate, secure and maintain the system.

The best vendor combines manufacturing domain knowledge with technical capability and practical implementation experience.

What managers should do:

During selection, ask vendors to explain your real operational problem, not only their product features. See whether they can map process, data, users and KPIs clearly.

14.3. Question 141: Should we choose a large company for safety?

Short answer:

A large company may provide stability and resources, but size alone does not guarantee project success. Fit with the factory's problem and implementation capability matter more.

Practical explanation:

Large vendors may have strong brand, broad service network and mature processes. But they may also be more expensive, less flexible or less focused on a specific factory's operational details.

Smaller specialized vendors may be more agile, closer to users and deeper in certain manufacturing processes. But they need to prove capability, support capacity and long-term reliability.

The decision should not be based only on company size. It should be based on evidence of ability to implement the specific use case successfully.

What managers should do:

Ask all vendors, large or small, to show relevant experience, implementation method, support plan, team capability and how they will handle your data and process challenges.

14.4. Question 142: Is a small company with deep operational understanding worth considering?

Short answer:

Yes, if it has clear expertise, a suitable solution, implementation discipline and the ability to support the factory long term.

Practical explanation:

A smaller company that deeply understands maintenance, production, OEE, shop-floor data and user behavior can sometimes create better practical results than a larger vendor with a generic solution.

However, the factory should still check risk: team size, project references, product maturity, documentation, support capacity, data export capability and continuity plan.

A good small vendor should not only be flexible; it should also work in a structured way, with clear scope, timeline, responsibilities and deliverables.

What managers should do:

Consider specialized vendors, but evaluate them professionally. Require a clear proposal, pilot plan, support plan, data ownership terms and references from similar projects.

14.5. Question 143: How do we know a vendor is not only good at demos but also good at real implementation?

Short answer:

Ask for evidence from real projects, implementation methodology, user adoption approach, data preparation plan and post-go-live support. A good demo is not enough.

Practical explanation:

Demos are often prepared with clean data and ideal workflows. Real factories have incomplete data, changing processes, busy users, legacy systems, network issues and internal resistance.

A vendor that can implement for real should discuss messy data, user training, process alignment, integration, permission setup, pilot evaluation and continuous support. It should be able to say what the factory must prepare and what risks need to be managed.

If a vendor promises everything is easy without asking about data, users, process or KPIs, be careful.

What managers should do:

Ask the vendor to walk through a real implementation plan: discovery, process review, data preparation, configuration, testing, training, go-live, support and KPI measurement.

14.6. Question 144: What should we require the vendor to prove before signing?

Short answer:

Require the vendor to prove understanding of your use case, data requirements, implementation plan, integration approach, security controls, support capability and expected KPI impact.

Practical explanation:

Before signing, the factory should not only review price and feature list. It should ask the vendor to show how the solution will work in the factory's actual process. For example, how downtime is recorded, how work orders are created, how dashboards are calculated, how ERP integration works and how permissions are controlled.

For AI, the vendor should prove how data is protected, whether data is used to train models, how answers cite sources, how wrong answers are handled and how documents are updated.

A proof of concept or pilot may be the best way to verify these points.

What managers should do:

Create a vendor evaluation checklist including process fit, data fit, technical fit, security, user experience, implementation team, support and KPI. Do not decide only by price.

14.7. Question 145: Should we require a pilot first?

Short answer:

For important or uncertain projects, yes. A pilot helps test the vendor, solution, data and users before a larger commitment.

Practical explanation:

A pilot gives the factory a chance to use real data and real users. It can reveal whether the system fits the process, whether users accept it, whether data can be collected and whether dashboards or AI outputs are useful.

The pilot must have clear scope and evaluation criteria. It should not become an endless free trial, nor should it be so small that it proves nothing.

A vendor willing to run a structured pilot usually has more confidence in its implementation capability.

What managers should do:

Define pilot scope, timeline, data, users, KPI and decision criteria. Agree in advance what result will lead to expansion and what result will require redesign.

14.8. Question 146: How should KPIs be included in the contract?

Short answer:

KPI binding should be realistic and linked to responsibilities. The vendor can commit to deliverables, system performance, implementation quality and support, while operational KPI improvement also depends on factory processes, users and data.

Practical explanation:

It is tempting to ask the vendor to guarantee outcomes such as 10% OEE increase or 20% downtime reduction. But these results depend not only on software. They depend on user adoption, process changes, maintenance actions, production discipline and management follow-up.

A fair contract can include clear deliverables: system modules, dashboards, integrations, training, go-live support, data migration, response time and defect fixing. Operational KPIs can be included as joint targets, with assumptions and responsibilities clearly stated.

For AI, contract terms should cover data security, accuracy review process, source citation, permission control and support for correcting wrong answers.

What managers should do:

Separate vendor delivery KPIs from factory operational KPIs. Define both, but make responsibilities explicit. Avoid vague promises that cannot be measured fairly.

14.9. Question 147: How do we avoid buying a large system that we do not use fully?

Short answer:

Start from operational priorities, implement in phases and buy according to proven value. Do not buy every module at once just because it is available.

Practical explanation:

A system may have many modules, but the factory may use only a small portion if processes, users and data are not ready. Buying too much at the beginning increases cost, complexity and adoption pressure.

It is better to choose the core module needed for the first use case, implement it well, prove value and then expand. For example, start with maintenance work orders and PM before adding advanced analytics. Start with production progress and downtime before advanced scheduling. Start with AI document search before predictive models.

Phased buying also helps the factory learn what it really needs.

What managers should do:

Ask vendors to propose a phased roadmap and license plan. Buy what is needed for the first phase and define criteria for adding more modules later.

14.10. Question 148: How do we avoid being locked into a platform that cannot expand?

Short answer:

Choose a system with clear data ownership, export capability, APIs, integration documentation, scalable permissions and a roadmap that fits future needs.

Practical explanation:

Platform lock-in becomes a problem when the factory cannot export data, cannot connect other systems, cannot change reports, cannot add users or cannot extend the solution without high cost.

A future-ready platform should support standard data structures, APIs, flexible configuration, role-based permissions, multi-site expansion and integration with ERP, MES, CMMS, dashboards or AI services.

The factory should also keep internal documentation and capability so it understands how the system is configured and how data flows.

What managers should do:

Before choosing a platform, ask about data export, API, integration, permissions, scalability, roadmap and exit plan. Make data ownership and handover terms clear in the contract.

15.Chapter 15: After reading this handbook, what should you do next?

The final chapter focuses on action. The goal is not to do everything immediately, but to help the factory know the first step: where to check, whom to ask, which data to review, how to choose a use case and when an assessment is needed before investment.

15.1.Question 149: Where should I begin checking the current state?

Short answer:

Begin with the most painful operational areas: downtime, production progress, quality defects, maintenance, manual reporting and data reliability.

Practical explanation:

A current-state check should not start from technology. It should start from operations. Where does the factory lose the most time, money or control? Which reports are slow? Which decisions are based on feelings? Which data is often disputed? Which process is inconsistent between shifts?

The purpose is to identify the gap between current operations and the desired level of transparency, speed and control.

What managers should do:

Create a simple assessment covering process, data, systems, people and KPIs. Interview production, maintenance, quality, warehouse, IT and leadership. Capture the top five pain points.

15.2.Question 150: What questions should I ask department heads?

Short answer:

Ask questions that reveal pain, data, process and decision needs. Avoid asking only what software they want.

Practical explanation:

Department heads often know where the real problems are. Production may know where progress is unclear. Maintenance may know which equipment causes the most trouble. Quality may know where traceability is slow. IT may know which systems are hard to connect.

Useful questions include: What takes the most time? Which data do you not trust? Which report is prepared manually? Which decision is delayed because data is missing? Which problem repeats but is not solved? Which dashboard would help you manage better?

What managers should do:

Hold short interviews with each department head and use the same question set. Compare answers to find cross-department problems and shared data gaps.

15.3. Question 151: Which data should I review first?

Short answer:

Review data connected to the first operational problem. Common starting data includes equipment list, downtime records, maintenance work orders, production output, quality defects and key Excel reports.

Practical explanation:

If the problem is downtime, review equipment codes, downtime time, cause codes, line, shift and product. If the problem is maintenance, review work orders, PM schedules, failure causes, repair actions and spare parts. If the problem is quality, review defect codes, lot traceability, process step, cause and corrective actions.

Do not review all data in the factory at once. Review data needed for the first use case and check whether it is complete, consistent and useful for decisions.

What managers should do:

Select one data set from the last three to six months. Check missing fields, inconsistent names, duplicate codes, vague descriptions and whether it can answer the management question.

15.4. Question 152: How should I choose the first use case?

Short answer:

Choose a use case that is valuable, feasible, measurable and expandable. It should be painful enough to matter and small enough to implement.

Practical explanation:

The first use case should sit between high value and high feasibility. It should not be a trivial form with little impact, nor an overly ambitious project that requires perfect data and massive integration.

Good examples include downtime recording for one line, maintenance management for critical equipment, OEE dashboard for one area, quality defect traceability for one product group or AI document search for critical machine manuals.

The use case should have real users and a clear KPI.

What managers should do:

Score candidate use cases by value, feasibility, data availability, user readiness and KPI measurability. Select one use case that can show results in a controlled scope.

15.5. Question 153: Whom should I assign to take responsibility?

Short answer:

Assign a business owner for the use case, a project coordinator and supporting members from IT/OT and related departments. Do not assign the project only to IT.

Practical explanation:

The business owner understands the problem and can make process decisions. IT/OT supports systems, infrastructure, connectivity and security. Related departments contribute data, users and coordination. Leadership provides sponsorship and removes obstacles.

Without clear ownership, projects drift. Users do not know whose decision is final, data quality has no owner and vendors receive inconsistent requirements.

What managers should do:

For each use case, define the owner, project lead, data owner, IT owner, key users and leadership sponsor. Make responsibilities visible from the start.

15.6. Question 154: How should initial KPIs be set?

Short answer:

Initial KPIs should be simple, measurable and directly connected to the use case. Include both adoption/data KPIs and operational KPIs.

Practical explanation:

At the beginning, operational improvement may take time. Therefore, measure early indicators such as percentage of complete records, number of users active, report preparation time, dashboard usage and data update timeliness.

Also measure operational indicators such as downtime, MTTR, PM completion, OEE, defect rate, traceability time or on-time production progress, depending on the use case.

KPIs should have baselines before implementation. Without baseline, improvement cannot be proven.

What managers should do:

Select three to five KPIs. For each, define baseline, target, measurement method, owner and review frequency. Keep KPIs practical, not too many.

15.7. Question 155: Should I do an assessment first or start a pilot immediately?

Short answer:

If the factory is unclear about the starting point, do an assessment first. If the pain point, data, users and scope are already clear, a pilot can begin directly.

Practical explanation:

Assessment helps when leadership is unsure where value is lost, departments disagree, data quality is unknown or investment risk is high. A short assessment can prevent choosing the wrong use case.

A pilot is suitable when the problem is clear and feasible, such as a known downtime issue on a line or a clear need to search technical documents. But even then, the pilot should include a quick process and data check before implementation.

Assessment and pilot are not opposites. A good assessment often leads to a well-designed pilot.

What managers should do:

If you cannot clearly answer where to start, run an assessment. If you can clearly answer problem, data, users and KPI, design a pilot and start small.

15.8. Question 156: What should I prepare before inviting a consulting or solution provider?

Short answer:

Prepare basic information about factory operations, current systems, key pain points, sample data, reports, process descriptions and expected KPIs.

Practical explanation:

A provider can give better advice if the factory shares real context. This does not require perfect documents. Useful materials include production flow, key equipment list, current Excel reports, downtime or maintenance samples, quality defect samples, system list and audit requirements.

Also prepare internal expectations: why the factory wants to do this, which problem matters most, what budget range is realistic, who will participate and what timeline is expected.

Without preparation, vendor discussions easily stay at the feature-demo level.

What managers should do:

Before meeting providers, prepare a simple brief: factory overview, top problems, current systems, sample reports/data, target KPIs and decision timeline.

15.9. Question 157: How do I know how ready my factory is for AI?

Short answer:

AI readiness depends on problem clarity, process maturity, data quality, system connectivity, document organization, user readiness, security and leadership commitment.

Practical explanation:

A factory is not AI-ready simply because it has data or software. It is AI-ready when it can define a specific use case, has relevant and reliable data or documents, has users who will use AI in a process, can control permissions and can measure results.

Readiness may differ by area. Maintenance documents may be ready for AI Copilot, while predictive maintenance is not ready because sensor data is missing. Production may have dashboards ready for AI analysis, while quality data still needs standardization.

Therefore, AI readiness should be assessed by use case, not only at the whole-factory level.

What managers should do:

Assess readiness across six dimensions: use case, data, process, people, technology and security. Then classify use cases as ready now, ready after preparation or not suitable yet.

15.10. Question 158: What is the smallest valuable step I can take in the next 30 days?

Short answer:

Choose one operational pain point, review the related data and build a small baseline or dashboard. This is often the smallest valuable step toward digitization and AI readiness.

Practical explanation:

The factory does not need to start with a large project. In 30 days, it can choose one problem such as downtime, PM delay, slow reporting or quality traceability. It can gather recent data, check quality, standardize a small list and create a simple view of the situation.

This step creates clarity. It shows whether data exists, whether it is reliable, what is missing and which use case should be prioritized. It also gives leadership and users a concrete discussion point.

A small step with real data is better than a large discussion about AI in general.

What managers should do:

In the next 30 days, select one problem, collect three to six months of related data, clean the most important fields, create a simple baseline and review it with the relevant department heads. Use the result to decide the first pilot.

16.Conclusion: AI does not start with algorithms

AI can create great value for factories. It can help managers see problems earlier, analyze data faster, detect abnormalities, suggest causes, search documents, support troubleshooting, preserve expert knowledge and improve decisions.

But AI does not start with algorithms.

AI starts with a factory that understands its operational problems.

A factory that does not know where value is being lost will find it hard to choose the right AI use case. A factory that does not trust its data will find it hard to trust AI outputs. A factory whose processes are unclear will find it hard to embed AI into daily work. A factory whose users do not use dashboards will likely not use AI well either.

Therefore, instead of asking:

"Should we implement AI?"

Factories should start with more practical questions:

Where are we losing the most value?

Which data is not yet reliable?

Which processes are still fragmented?

Which reports are too manual?

Which dashboard would help managers make decisions faster?

Which knowledge is still stored only in the heads of a few senior people?

Which use case is small enough to start but important enough to create value?

Once these questions are answered, the factory will no longer see digitization and AI as a technology fad. It will see them as a roadmap to improve operational capability.

From manual operations to digitization.

From digitization to datafication.

From datafication to dashboards.

From dashboards to AI-assisted operations.

This is not a path that must be rushed. But it is a path that should be taken systematically, practically and with clear goals.

AI does not start with algorithms.

AI starts with a factory that knows clearly what it needs to improve.

We wish your company success in production and business.

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Better Management, Better Work, Better Profit

Appendix: Glossary

Term	Full form	Meaning / short explanation
AI	Artificial Intelligence	Technology that enables systems to support analysis, recommendations, question answering or prediction.
AI Copilot	Artificial Intelligence Copilot	An AI assistant that helps users search, analyze, ask questions or receive suggestions in their work.
AI Readiness	Artificial Intelligence Readiness	The level of readiness to apply AI.
AI Readiness Assessment	Artificial Intelligence Readiness Assessment	An assessment of a factory's readiness to apply AI.
API	Application Programming Interface	An interface that connects software systems.
Audit	-	Assessment, inspection or audit required internally, by customers or by standards.
Audit Trail	-	History showing who created, edited, approved or accessed data.
Baseline	-	Initial measurement before improvement or project implementation.
CAPA	Corrective and Preventive Action	Actions to correct problems and prevent recurrence.
Checklist	-	A list of steps to check or perform.
Cloud	-	Computing infrastructure or services located in a data center or cloud provider and accessed through a network.
Cloud server	-	A dedicated server environment hosted in a data center or cloud provider and managed according to agreement.
Cloud software as a service	Software as a Service	Software operated by the vendor on cloud; the company uses it as a service and must clarify data rights, security, backup and permissions.
CMMS	Computerized Maintenance Management System	Software system for maintenance management.

Term	Full form	Meaning / short explanation
Cycle Time	-	The production cycle time or time to complete one operation/product.
Dashboard	-	A control panel showing important indicators for monitoring and managing operations.
ERP	Enterprise Resource Planning	Enterprise resource planning system.
GMP	Good Manufacturing Practice	Good manufacturing practice.
Go-live	-	The point when a system is officially put into use.
HACCP	Hazard Analysis and Critical Control Points	Hazard analysis and control of critical points.
HSE	Health, Safety and Environment	Health, safety and environment.
IoT	Internet of Things	In factories, usually device or sensor connectivity for data collection.
IT	Information Technology	Information technology.
OT	Operational Technology	Operational technology, including systems and equipment that support production operations.
IT/OT	Information Technology / Operational Technology	The combination of information technology and operational technology.
KPI	Key Performance Indicator	A performance measurement indicator.
LOTO	Lockout/Tagout	Locking and tagging hazardous energy sources before maintenance or intervention.
Manual	-	User, operating or maintenance instruction document.
MES	Manufacturing Execution System	Manufacturing execution system.
MTBF	Mean Time Between Failures	Average time between failures.
MTTR	Mean Time To Repair	Average time to repair.
OEE	Overall Equipment Effectiveness	Overall equipment effectiveness.
Availability	-	Equipment or line availability within OEE.

Term	Full form	Meaning / short explanation
Performance	-	Speed or performance level within OEE.
Quality	-	Good product rate within OEE.
On-premise	-	Deployment on the company’s internal infrastructure.
Offline	-	Ability to work without network connection and synchronize later when connection returns.
Pilot	-	A small-scope trial before expansion.
PLC	Programmable Logic Controller	A programmable controller used in machines or lines.
PM	Preventive Maintenance	Preventive maintenance.
Predictive Maintenance	-	Maintenance based on equipment condition data and abnormal signals to predict failures.
RCA	Root Cause Analysis	Root-cause analysis to prevent recurrence.
ROI	Return on Investment	Investment effectiveness or return on investment.
SCADA	Supervisory Control and Data Acquisition	Supervisory control and data acquisition system.
Server	-	Server.
Setup	-	Preparation, setting or adjustment before production.
SmartTrack	-	Vietsoft’s solution for tracking production, progress, productivity and shop-floor performance.
SOP	Standard Operating Procedure	Standard operating procedure.
Troubleshooting	-	Checking and resolving an active problem to return equipment or a process to normal operation.
Use Case	-	A specific application problem.

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