



Best Practices in Developing an Enterprise AI Roadmap



A proven methodology for identifying, evaluating, and prioritizing Enterprise AI application use cases and building the AI roadmap

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Introduction: Plan Your AI Program

Digital transformation is an enterprise-wide undertaking with broad implications for how new information technologies will be implemented and business processes will be changed to drive value. As a core enabler of their digital transformation programs, organizations will develop and deploy tens or hundreds of enterprise AI applications across their operations.

This powerful new class of enterprise business software presents new challenges, both technical and organizational in nature. To succeed at developing and deploying enterprise-scale AI applications, organizations must take a rigorous, systematic approach to planning, creating, and executing their AI roadmap. Such an approach will help ensure efficient and effective processes that deliver significant measurable business impact and economic value.

This guide provides a proven methodology and best practices for building an effective AI roadmap that identifies, evaluates, and prioritizes high-value AI use cases. The methodology is derived from C3.ai's more than 10 years of experience in working with leading organizations globally to develop and deploy AI and IoT applications at enterprise scale.

The contents of this document draw from an extensive set of best practice materials that C3.ai has developed and codified in the *C3.ai Application Development Methodology*[™] – a comprehensive, detailed reference available to C3.ai customers that guides them through a complete, end-to-end process, from identification of use cases and creation of an AI roadmap, to the design, development, deployment, and ongoing operation on the C3 AI Suite. The *C3.ai Application Development Methodology* provides numerous templates, worksheets, and other materials essential for developing a sound enterprise AI roadmap.

The guide is organized into four main sections:

- **Analyze the business:** Develop a common understanding of the business across the AI program team that identifies specific use cases that can be meaningfully addressed using AI.
- **Write the business use case:** Document each identified use case with relevant qualitative and quantitative data that can inform the qualification, prioritization, and development activities.
- **Qualify use cases:** Evaluate each use case candidate for its expected ROI and ease of implementation, including required resources and time to value.
- **Build roadmap of AI use cases:** Prioritize use cases and sequence them on a timeline for development and deployment.

The end objectives of this process are to:

- Select at least one use case for application development
- Deliver an AI application roadmap

Analyze the Business

The first step in identifying AI use cases and building your AI roadmap is to develop an understanding of both your industry’s value chain and your business’s specific end-to-end lifecycle. This enables you to categorize use cases and assess the business impact of each use case and its potential economic value. Business analysis encompasses three main steps:

- Understand the business
- Understand the business area
- Identify the challenges and opportunities

As you work through this process, keep in mind the following six criteria that will be used during use case qualification:

- Business value and alignment
- AI addressability (insights the business is equipped to act on)
- Data availability
- Ease of implementation (3-6 months)
- People availability (sponsor and technical subject matter expert)
- Time to value (positive economic ROI within 6-12 months)

Understand the business

It is important that everyone on the AI program team has the same level of understanding of the business. Developing an AI-based application requires a range of skills from all parts of the business. It is likely that not all team members have a unified overview of the business. To create alignment across this diverse team, the first step is to document the end-to-end lifecycle of the business identified through the high-level business units.

Figure 1, for example, depicts the high-level business units for the utilities sector:

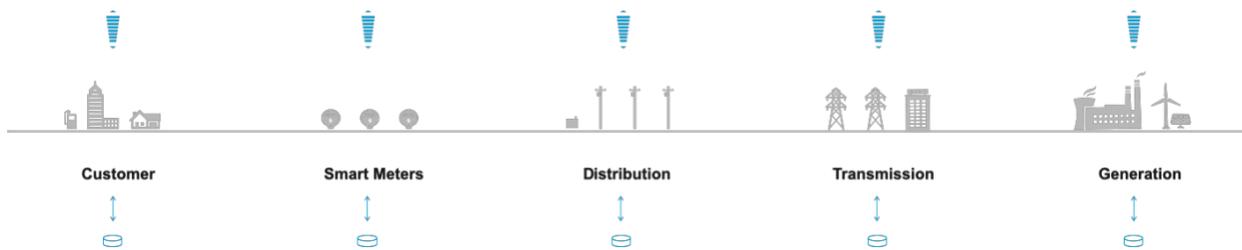


Figure 1: Utilities sector high-level business units

For an organization that participates in multiple industry sectors, this analysis can be applied to each sector or to a specific sector that will be the first focus area for AI implementation.

With this framework, it’s now possible to start identifying use cases that are of potential value for each business unit. In the utilities sector, for example, predictive maintenance is a high-value use case in the generation, distribution, and transmission aspects of the business lifecycle.

Figure 2 shows example use cases for the utilities sector:

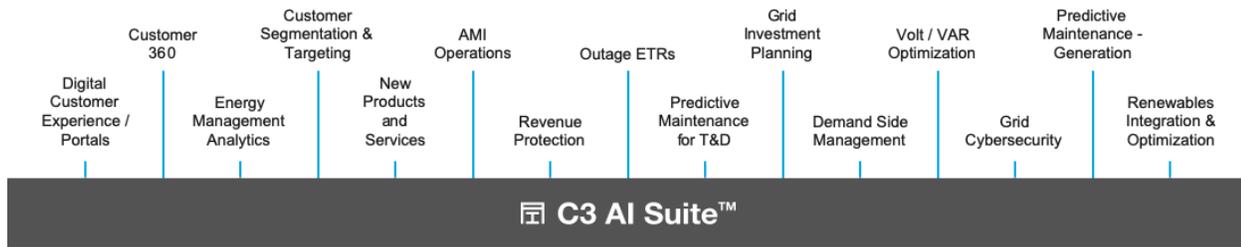


Figure 2: AI use cases can be identified for every part of the business lifecycle

Understand the business area

The previous step provided an understanding of the macro components that form the overall business. The next step is to drill into specific areas within the business to detail how they operate. This means analyzing each business area to understand the tasks that team members within that area perform – whether performed internally within the business or externally for customers. For example, in the utilities sector, team members in the generation area are focused on ensuring assets that are used for generating power continue to function and on forecasting generating capacity to the distribution operations team.

Questions to ask include:

- What are the business area's goals?
- What does “success” mean to that business area?

Identify challenges and opportunities

Understanding both the overall business and the individual business areas provides the foundation to identify potential use cases. The next step is to identify the challenges and opportunities AI-based applications may address. For each identified use case, ask the following questions:

- Can the problem statement for this use case be clearly articulated?
- Can the solution outcome/outputs be clearly articulated?
- Can the business value (economic and/or operational) be clearly articulated?
- Can an Executive Sponsor be identified?
- Is sufficient data accessible?
- Can the operational changes that may be required to deliver this use case be clearly articulated?
- Is there a potential for bias in the data or the outcomes?

Ideally, these questions should be answerable. If not, capture the use case, nonetheless. The next step will provide the opportunity to cull use cases that can't be defined in detail.

Write the Business Use Case

Having a clear definition of each use case is essential to aligning the project and business expectations. The process of defining each use case helps ensure the business objectives are kept front and center. The problem statement, scope, and value should align to the macro business objectives. If at any point the use case deviates from the business objectives, reassess the use case before progressing further.

If the problem statement, scope, and value align to the business objectives, include as much detail as possible in each section of the use case definition. The details will help in the subsequent steps of qualification and prioritization.

A business case should consider each of the following topics, that will assist in providing clarity in the later stages of qualification and development:

- Business overview
- Problem statement
- Business value
- Current process
- Use case scope and objectives
- Functional requirements
- Data sources
- Business team
- Delivery timeline
- User adoption plan
- Known dependencies, constraints, and challenges

Business overview

Provide an overview that includes information on the current and future scale of the business, products, and/or services. This detail is important in providing context to Product Management, Development, and other teams who will build the application addressing the use case.

Problem statement

Describe the associated business problem. Include why and for whom it's a problem; how the business has attempted to solve the problem in the past; and how it is attempting to solve the problem today.

Business value

Understanding the value a use case delivers helps qualify and prioritize it against competing use cases. Business value can be both quantifiable and qualitative. Quantifiable value can generally be captured via economic metrics. Validate the economic numbers through the business SME or stakeholders. Here are six steps to follow:

- Identify the relevant business KPI that this use case can address
- Identify the levers that can be exercised to deliver the positive value gain

- Identify the metrics used in each lever
- Calculate the associated costs
- Calculate the potential value gains from this use case lever
- Document any calculation baseline assumptions

Capturing non-quantifiable business value is generally more challenging since it can be subjective. The simplest way is to:

- Describe the area that the use case will benefit
- Describe the value that can be gained

Here is an example of a non-quantifiable business value:

- Area of benefit: Data quality and transparency
- Value created: Enable effective measurements of performance metrics
- Value created: Reduction in data calculation errors through improved data quality

Current process

Describe the current process that this use case is likely to augment or replace. If there isn't a current process, describe how this use case would be used in the existing processes within the business. Capture all aspects of the overall process where this use case will provide value, including both manual and automated processes.

Use case scope and objectives

Describe the scope this use case will cover with respect to the problem statement and intended objectives. Use the current process as a boundary to help ensure the scope doesn't go beyond what the use case covers. The scope may include business functions and user groups that will be involved. For example:

- Business/Users that will provide inputs for this use case
- Business/Users required to update processes for this use case
- Business/Users that will use the outputs of the use case

Capture any technical scope that this use case should be constrained to.

Functional requirements

List all high-level functional requirements for the application to address this use case. For example:

- From within the application, a user should be able to automatically create a work order in SAP
- A user should be able to analyze historical failure prediction accuracy

Data sources

List the data sources required to solve this problem. A description of each data source system's relevancy – explicit inputs needed for the application or implicit data to understand the overall process – will help prepare the team in focusing on data extraction requirements.

Consider capturing at a minimum these details:

- Software used (e.g., OSI PI, SAP)
- Years of historical data retained
- How does data enter the system?
- Is it proprietary software that requires specific data extraction methods?
- Description of the source system's purpose in the business

Business team

It is important to specify the overall team that will be engaged in the use case, including members beyond the direct project team. Team members that may not be involved day to day still have a pivotal role in driving success of the application and adoption. Team members must include:

- Executive Sponsor
- Product Owner
- Business Project Manager
- Business SMEs
- Data SMEs
- Integration Engineers
- Other Stakeholders

Delivery timeline

Where possible, capture the business's desired delivery time for the application. Include business reasons driving this delivery timeline such as operational changes, new regulatory requirements, or new sensed devices installed. Incorporate business value considerations that may drive the timeline.

User adoption plan

Think through the direct and indirect touch points for this use case. Capture details on how the application can be adopted into the business. Points to consider include:

- Who are the day to day users who need to use this application?
- Which business groups need to provide inputs (data and process) for this use case?
- Which business groups are receiving the outputs from this application?
- What existing processes will require change?
- What new processes need to be created?
- Who are the key stakeholders that need to agree to these process changes?
- What risk mitigation strategies are required when delivering these new processes and application?

Known dependencies, constraints, and challenges

There will inevitably be dependencies, constraints, and challenges that are outside the project team's control. Here are some examples:

- Dependencies: The application needs third-party data A, B, and C, that our business does not currently have permission to use.
- Constraints: We need to explore data to determine if there are signals that can be predicted before a decision can be made to proceed in application development.
- Challenges: Quality of failure data prior to 2018 is known to be very poor.

It is vital to capture these details at this stage so they can be included in the qualification and prioritization step. This will allow the team to assess levers that can be used to overcome these issues.

Qualify Use Cases

Qualifying a use case is critical to help ensure alignment to the overall business objectives and also review AI feasibility. Many use cases can be derived and implemented at small scale. However, when scaling them, required data may be unavailable or the ability to transition into the business operations may be limited or impractical.

The following criteria should be considered in qualifying use cases:

1. Business value and alignment
2. AI addressability
3. Ability to operationalize
4. Ease of implementation
5. People availability
6. Time to value

Each use case should be documented and scored in a qualification matrix, with the primary focus on the business objectives and outcomes. (As part of the *C3.ai Application Development Methodology*, C3.ai provides a Use Case Qualification Matrix template for C3.ai customers.)

Use Case	Business Value \$ Millions	Cost \$ Millions	Net Value (Gross value minus cost) \$ Millions	Strategic Priority	Time to Value	Suitability for C3 AI Suite	Leverages Existing Integrated Data	Data Availability	Maturity	Extension of Existing App?	Stakeholder Engagement	Ability to Execute	Net Value Index	Average Index
Obsolete Inventory Optimization	38	4	34	5	3	3	2	4	3	1	4	1	4	2.9
Supply Network Management	12	1	11	1	5	3	4	4	4	1	3	5	3	3.3
Dynamic scheduling, e.g., paint line sequencing optimization	35	2	33	5	3	3	4	5	1	1	2	5	4	3.2
Predictive machine quality — predict failure likelihood at end of production	27	5	22	5	3	4	4	5	5	5	3	4	4	4.2
Demand Signaling	47	1	46	1	1	4	2	5	1	5	1	1	4	2.3
Order change velocity (reduce variability in orders)	50	5	45	3	2	4	1	1	5	5	4	1	4	2.9
Cost competitiveness with suppliers — cost rationalization (using NLP)	75	5	70	2	5	5	2	4	1	5	1	3	5	3.1
Predictive Maintenance	46	5	41	5	3	5	2	1	4	5	2	3	4	3.3
Production Cost/Quality Optimization	73	3	70	3	1	1	3	5	4	1	2	2	5	2.4
Vehicle Telematics	24	5	19	3	2	4	1	4	5	1	2	2	3	2.7
Anti Money Laundering	45	1	44	3	1	3	5	5	5	1	3	2	4	3.1
Predictive machine quality — predict failure likelihood at end of production	5	3	2	2	5	3	2	4	5	1	1	5	1	3.1
Weld Quality Analytics	53	2	51	3	3	3	4	3	2	5	4	5	5	3.6
Parts Image Recognition —3D models	53	1	52	3	2	4	4	5	4	1	4	1	5	3.1
Cycle Time Optimization	7	3	4	4	5	2	2	5	2	5	5	1	1	3.4
Workforce Optimization	7	2	5	1	4	4	2	4	5	5	1	5	2	3.4
AI-Based Dynamic Work Instructions	59	1	58	1	3	5	3	5	3	1	4	1	5	2.9

Figure 3: As shown in this example, a rubric provides a framework and methodology for prioritizing use cases

Business value and alignment

Businesses have many competing priorities. Understanding business value, strategic priority, and business impact is critical to align the intended use case with an appropriate scorecard rating.

Business value

The use case should address a well-defined problem and have clear metrics to measure the outcome. A suggested framework is to focus on the following criteria:

- Which business KPIs does this use case address?
- What are the value benefits from this use case against business KPIs?
- What costs will this use case add or expend (e.g., costs of false positives)?
- How will the application impact operations/financial performance?
- What operational levers can be engaged?

Alignment

AI use cases at times directly align to a set of strategic priorities within the business. However, if there isn't a specific use case aligned directly to a strategic priority, use cases can start as a tactical priority to build into your strategic roadmap. Even if the use case perfectly aligns to a strategic priority but it's the *first* AI use case an organization is considering, best practice is to prioritize a use case with high impact but low complexity.

AI addressability

AI use cases can be applied to boost innovation, provide insights, and assist in decision making – potentially leading to revenue growth and increased efficiencies. But there are also use cases where AI is not able to provide value – current AI techniques are unable to solve the problem, or there isn't sufficient high quality data. Application of AI for a use case should also factor in the team's ability to build the application and operationalize it into business operations.

The following aspects of AI addressability should be considered:

- Data
- AI explainability
- Ethics
- Performance relative to current system (baseline)

Data

Enterprise-scale machine learning applications need a sufficient volume of quality data and labels (for supervised learning). For each use case identified, you will need to document the following aspects:

1. *Data availability and history*
 - Number of data attributes
 - Granularity of data attributes (e.g., 1-minute data frequency)
 - History of data attributes (e.g., 3 years of history)
 - Other historical data (e.g., CRM, ERP, comments)
2. *Data labels*
 - Quantity
 - Spread (distribution of data labels across asset and time)
3. *Data Quality and constraints*
 - How was data collected?
 - Was the dataset transformed in any way?
 - Are there known problems with the dataset?
 - How are the data connected?
4. *Data Understanding*

Given the volume of data required to develop a robust AI-based application, it's useful to understand in the early stages of qualification the profile of these data sets. Data profiling provides insights into the quality, availability, and spread of the data across the asset and time at the focus of the use case. Ideally, data profiling should be completed on the data set that will be used during model development. Alternatively, a data profile can also be completed on a suitable sample set.

In order to validate the applicability of the proposed analysis and Machine Learning (ML) techniques, ask the project team and lead data scientist these questions:

- Would the proposed ML techniques address this use case?
- Are there existing BI tools or simple statistical data analysis techniques to achieve a similar outcome?
- What level of specificity is required from the use case?
- Are the right signals and data sets available for the use case?
- Are there known contributing factors that require advanced data manipulation and calculations?

AI Explainability

A key aspect of the AI journey is the ability to explain AI outputs/results. Having human interpretable reasoning for AI outputs/results enables these use cases to be tractable. This is even more critical for the initial AI use case or for applications in regulated industries like medical diagnosis systems that require greater levels of explainability and transparency.

If the need to explain the functioning of the AI system is high, it is best to choose simpler, more interpretable algorithms. Choosing complex algorithms like deep neural networks might offer higher accuracy, but these algorithms are inherently “black box” and not easily explainable.

Ethics

For AI applications to be trustworthy and adopted, they must be designed with ethical principles. For the use cases identified, you will need to account for the follow aspects:

- *Data Bias*: Machine learning algorithms are trained from data, and if the training data are biased, the predictions made by the algorithm will also be biased.
- *Societal Implications*: Check the social and economic implications of the use case, and ensure that the overall likely benefits substantially exceed the foreseeable risks and downsides.
- *Robustness and Safety*: Public facing models are susceptible to adversarial attack by bad actors and can be manipulated to produce incorrect predictions. Check the algorithm for accuracy, reliability, and reproducibility. This will help ensure a robust algorithm and minimize unintentional harm.

Performance relative to current system

Demonstrating clear, measurable improvements is essential to validating the success of an AI use case. It is important to select a use case where there are rich metrics about the current system or process – for example if the current system is rules based, measuring the performance and accuracy of the current predictions provides a good baseline. A demonstrated improvement relative to the current system provides the organizational buy-in to continue investing and improving the AI application while it iteratively improves its absolute performance.

Ability to Operationalize

In the lifecycle of incorporating machine learning into the business, operationalizing accounts for 70% of the time and effort. The remaining 30% accounts for the actual development and testing of the AI-based application. Operationalizing requires a strong change management program and alignment with business executives sponsoring the project.

In architecting the application, it's important to keep in mind how the outputs will be integrated into the business. Outputs can be in the form of:

- Risk score outputs via exports or API
- C3 UI visual
- Dashboard

Integrating the outputs into the business operations requires an in-depth understanding of how the business operates. Characteristics may include:

- Time constraints: How much lead time does the analytics output provide the business to be able to act or incorporate into existing business practices?
- Scope of the data science model (i.e., windowing)
- Resource constraints: What is the current business resource capacity? Does it have capacity to onboard new ways of working?
- Business owners and their key operational KPIs
- Who are the key stakeholders required to buy into the new processes that will be implemented?
- What are the processes in place?
- What are the current standard operating procedures?
- Are the success criteria for the machine learning model achievable and realistic?
- Is there an agreed definition of success for the ML model?

Ease of implementation

Can your use case be broken into smaller pieces? If it can be further dissected, the use case is too complex. The key to successful AI implementation is through quick wins. Building on each success will enable more complex problems to be solved. These projects should be implementable within 3-6 months and achieve business value within 12 months of delivery.

If the use case can't be further broken into smaller components, look at segregating it into areas, groups, or class of asset. For example, start with one location (e.g., a single factory).

A known challenge of AI-based applications is the need to aggregate large amounts of data from a variety of data sources. Where possible, using existing data integration processes will minimize the time taken to implement the use case. If there are no existing processes in place, you should engage your data integration team or IT to assess the complexity of aggregating the required data sources for the use case. This will inform the ability to deliver the application and assist with the qualification scorecard.

People availability

Stakeholder engagement – having sponsorship at all levels – is key. AI applications change how people do their jobs. Visible and consistent sponsorship of the application throughout the organization is key to user adoption. Strong support from the business sponsor, the operations manager, and change management leadership is essential.

The project team also requires the availability and access to SME knowledge and resources. The SME must be integrally involved at the beginning and available throughout the project, albeit less so during the development phase. Take into account all the specific specialties required from SME resources for the use case, in order to help ensure the correct knowledge coverage is available.

Time to value

The days of implementing a system and tracking value 5 years later are long over. It's essential to track, measure, and report value from the moment of go-live throughout the lifecycle. A good use case could unlock significant economic value in as little as 6-12 months.

Build the Roadmap of AI Projects

The last step of the planning phase is to prioritize the individual use cases that have been qualified and create the AI program roadmap.

To prioritize use cases, use the qualification matrix, completed in the previous step, along with three additional inputs:

- Business value, both direct and indirect
- Maturity of implementing AI-based applications
- User adoption

Weighting of these three inputs can vary based on the response to each input. For example, if the use case value can't be tangibly accounted for, but the business has a very low maturity in developing AI-based applications and the user adoption is expected to be high, it may be practical to prioritize this use case higher. Such use cases are sometimes seen as the building block for the overall AI roadmap.

In short, prioritizing AI use cases is not always black and white. Thinking through these three inputs along with the qualification matrix will help guide the prioritization process.

First AI-based use case for implementation

If this is the first AI-based use case your organization will be implementing, consider the following:

- Is there a strong project team (capability and capacity)?
 - Business
 - IT
 - Operations
- Is there strong executive sponsor support?
- Are the overall team objectives and energy aligned in the same direction?
- Is there an agreed value outcome?
- Is there a defined baseline performance of the current process that this use case is addressing?

Create the roadmap

The time spent in analyzing the business and qualifying use cases, as well as capturing the details for each use case, should not go to waste. All of this information helps define the organization's digital transformation with an AI roadmap.

It is important to note that the roadmap is not carved in stone. It will continue to evolve as your AI program matures and as the overall business strategy and objectives evolve. But it provides a documented framework for everyone across the organization to inform intelligent discussion and deliberation.

Example roadmap plan

The roadmap provides a sequencing of use cases against a timeline, informed by the qualification and prioritization of the use cases, as well as an assessment of your organization’s maturity in implementing AI applications. Your team should spend time working through these considerations to create the roadmap.

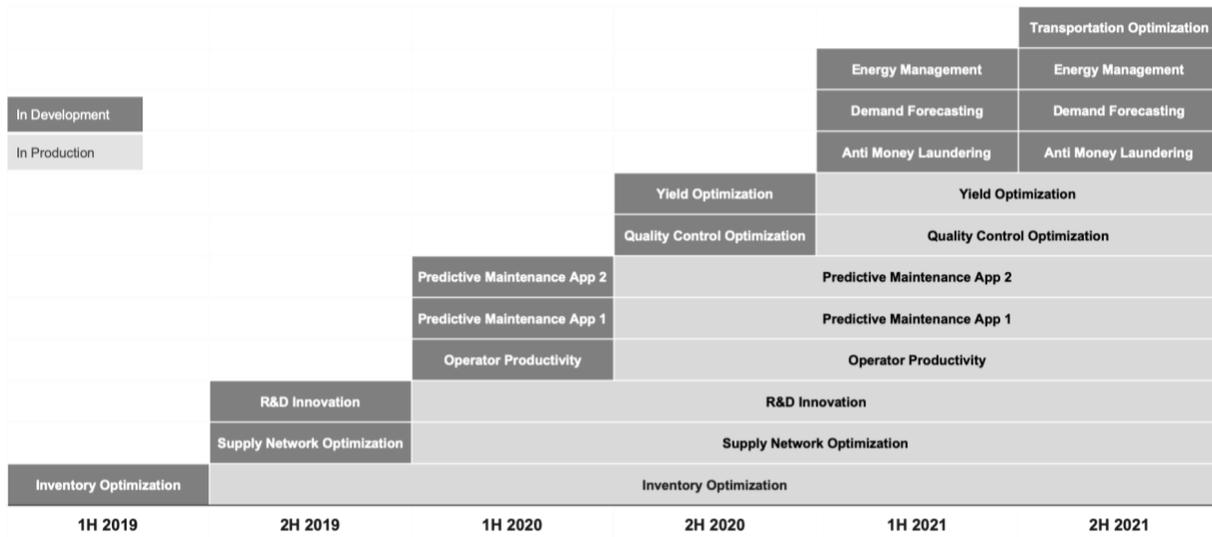


Figure 4: In this roadmap example, applications are expected to take about 6-12 months to complete. Two new applications are started every 6 months, and are supported, updated, and maintained afterwards.

Conclusion

AI-enabled digital transformation is a complex undertaking, requiring extensive cross-functional collaboration and a range of skill sets. The effort invested upfront in identifying, qualifying, and prioritizing AI use cases and creating an AI roadmap is essential to driving positive outcomes and measurable value. The methodology and best practices presented in this paper will substantially accelerate your digital transformation results and success.

The content of this document is adapted from the *C3.ai Application Development Methodology* – a comprehensive reference for developing enterprise AI applications on the C3 AI Suite™ available to C3.ai customers. It provides a detailed set of activities and templates in order to complete the necessary steps to go from an idea to a production application.

To learn more about the C3.ai Application Development Methodology and the C3 AI Suite, contact C3.ai at [C3.ai/get-started](https://c3.ai/get-started).

About C3.ai

C3.ai is a leading AI software provider for accelerating digital transformation. C3.ai delivers the C3 AI Suite™ for developing, deploying, and operating large-scale AI, predictive analytics, and IoT applications in addition to an increasingly broad portfolio of turn-key AI applications. The core of the C3.ai offering is a revolutionary, model-driven AI architecture that dramatically enhances data science and application development.

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