DESIGNED ANALYTICS
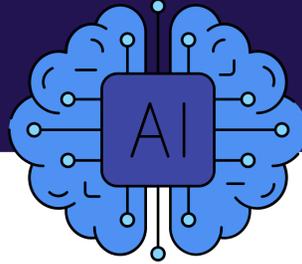
Designed Analytics Report

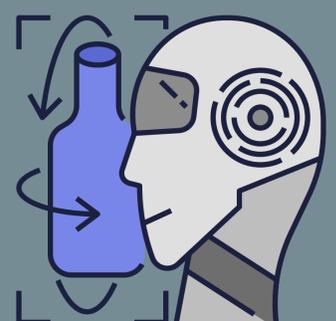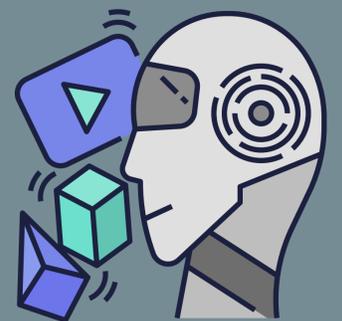# Generative AI in Supply Chain
Key Considerations

Table of Contents

Introduction

There is no doubt that Generative AI has the potential to significantly transform many aspects of business processes, ranging from automation all the way to strategic insights and model building. The more creative we get with technologies, the more opportunities we will create to leverage these technologies to help transform our businesses. However, combining the hype of technologies like Generative AI with some form of cosmetic innovation will lead to prioritizing Generative AI into use cases that do not add as much value as some other use cases.

To effectively use Generative AI, we need to be innovative and tactical. I could have focused this report on listing possible applications of Generative AI across the supply chain. That would have been easy. Pick any five white papers or reports that do this, and the opportunities identified are not only similar but, in many cases, vaguely defined. The real winners in the race to harness the value of Generative AI will be the ones who can first understand the key considerations they need to keep in perspective before they start their journey. This report aims to provide you with some suggestions that you can consider when you plan your Generative AI journey.

Just honest suggestions beyond all the hype!

Kumar singh

Kumar Singh

Designed Analytics LLC

Executive Summary

It is common sense that whimsical applications of Generative AI (like generating a social media post or bio on X) or many creative, subjective output applications, like images, jokes and poems, do not have much practical applications in the world of supply chain. For that matter, with the exception of marketing, these applications, for which majority of us recognize Generative AI, are not very useful in the world of business. But we also know that Generative AI capabilities go beyond these applications.
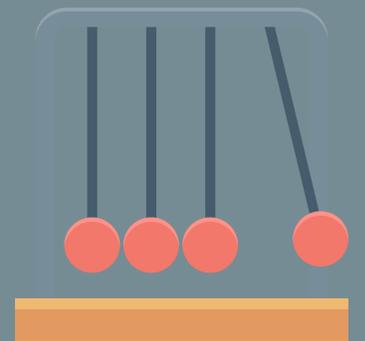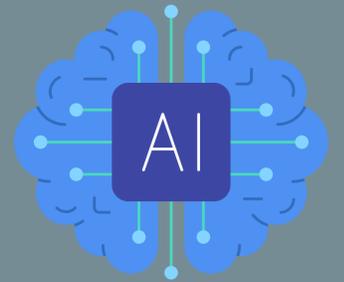
The current AI boom is unprecedented. A semiconductor company that specializes in manufacturing chips for AI applications quadrupling its valuation within a short span should be an indication. There are suggestions that AI should be declared as an Industry in itself. These developments are both exciting as well as scary. Which path this boom actually ends up taking depends on our ability to cut through the hype and be strategic about these capabilities. What will save us from going into a third AI winter is to showcase real-world implementations that match the level of the expectations due to the boom.

If we start listing out the potential applications of Generative AI in the supply chain, or for that matter, any other function, the list can be long. This list is readily available online from hundreds of sources. However, like every other digital transformation opportunity, there is a need to carefully evaluate the impact vs the resources that need to be invested to build specific capabilities.

LLM training is much more extensive than some other ML-based approaches that organizations are currently leveraging. What this means is that there may be scenarios where even though the value delivered may be only slightly more as compared to another use case, the training and other requirements to help make the vision a reality will be more or less the same. This means that developing a roadmap based on a practical evaluation of the capabilities you want to develop becomes important.

When it comes to strategizing about Generative AI opportunities, there are three high-level steps that organizations need to undertake. First, they need to think about expanding the opportunity span. This means thinking about possible opportunities beyond vanilla applications. Next, they need to start documenting opportunities. Then, as a final step, they need to understand how they should evaluate Generative AI opportunities, carefully balancing risk and rewards. This approach is shown in **Figure 1**.

Figure 1 : Three Steps of Strategizing About Generative AI

**Expand
the possibilities**

Understand the realm of possibilities of leveraging Generative AI across the supply chain

**Explore
the possibilities**

Leverage a methodological approach to identify opportunities

**Evaluate
the possibilities**

Evaluate identified opportunities and build a roadmap

The first step is to understand that Generative AI capabilities across the supply chain and many other functions can be categorized into three categories. These three categories are **productive, insightful, and strategic**. Within every business process, you can leverage these three types of implementations.

The second step is the most critical for organizations who want to go beyond the vanilla approach of "I will have what they are having." In this step, you build views of sub-functions that provide you with both the "forest and the trees" view. These views will allow you to explore Generative AI applications and associated nuances that are specific to your business scenarios. This is the only approach to go beyond the hype and build capabilities that you can actually use to turbocharge your business processes, leveraging Generative AI.

The third step is to evaluate the opportunities explored to understand the trade-off for these application opportunities. Despite all the excitement, you have to keep in mind that for some types of applications, the technology may not work perfectly yet, and hence, implementing it in production may involve some risks. While investing more resources can certainly eliminate these risks for these advanced applications, there needs to be a careful examination of the value you will derive from investing additional resources. This is the step where you also chart your capabilities roadmap for the next decade. This roadmap will typically follow the same three levels of capability hierarchy identified above.

The process of translating the strategy into identifying feasible use cases has been illustrated in **Figure 2**.
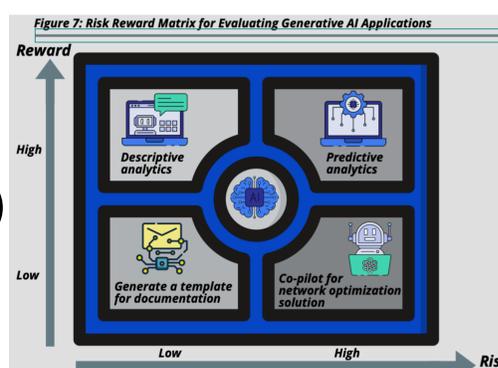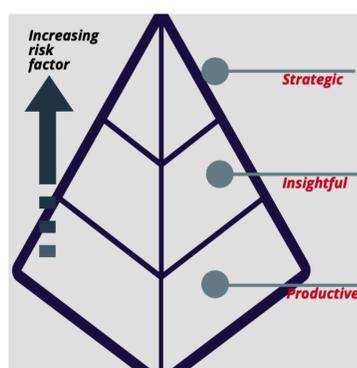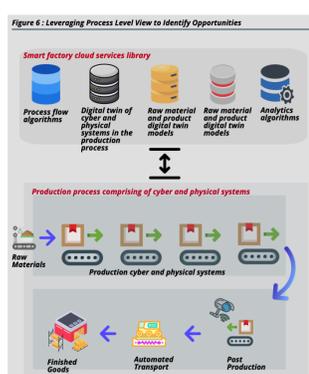
Figure 2 : Roadmap Development Process

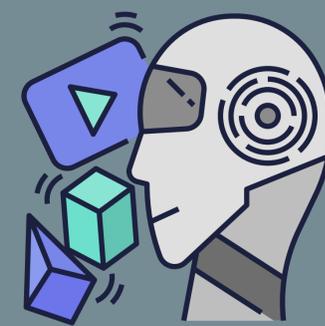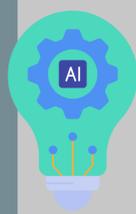

Identify opportunities at a granular level

Categorize opportunities

Evaluate opportunities

Build a roadmap

Evolving The Opportunity Span

Amidst all the hype around the cool images and poems that Generative AI applications can generate, If I ask you to think beyond text and images when thinking about Generative AI, it may seem contrary to the very notion of Generative AI.

But if you look at Generative AI capability with this lens, you can significantly expand how you can think about the possibilities of leveraging this amazing technology in your organization and, in this specific context, supply chain management.

To envision Generative AI this way, you have to keep one central aspect in mind- when you interact with an LLM leveraging text, it needs to translate that text in the backend to understand what you are trying to communicate. The model has been trained to mimic that it can understand English (hence the word "Artificial" in AI) or any other language.

Therefore, you do not always need to initiate an interaction with a LLM using text or voice. You do not always need to initiate a dialogue with the model. The model may trigger a dialogue based on certain triggers. And understanding this aspect is key to understanding the plethora of ways you can leverage Generative AI across your supply chain and think about co-pilots in a whole different way.

As shown in **Figure 3,** when you interact with the model, based on your question, it constructs a query, which gets routed to a specific database. One key highlight of the figure is that the database that is being tapped is not always a vector database. This aspect of the architecture opens the possibility of marrying your structured, graph DB, and vector DB to build unique capabilities.

It is, therefore, critical that when you think about Generative AI, you shake off the notion of images and videos being generated by tools that are available for the public to play with. While you do not need to be a techie, understanding the capability behind the poems and images will help you explore the possibilities in a more practical way. More importantly, explore the insights and analytics-related capabilities that Generative AI can help you build.
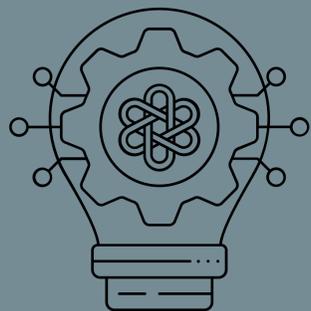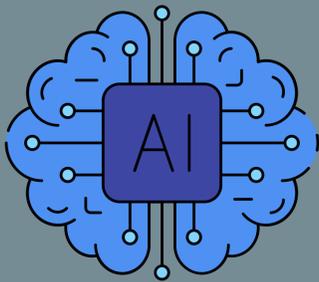
Figure 3 : LLM Model Communication Flow
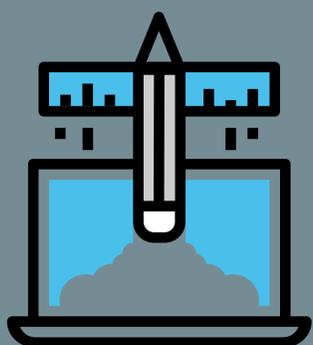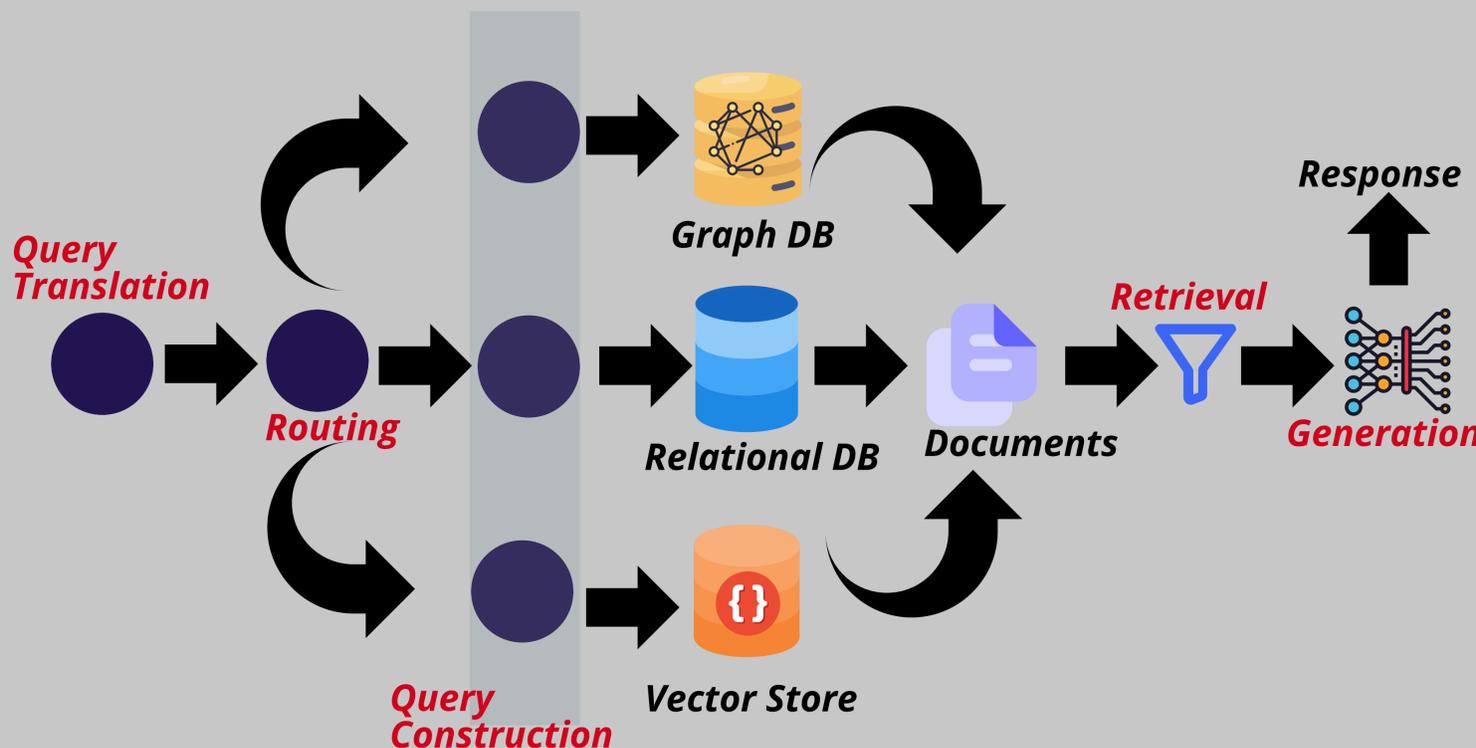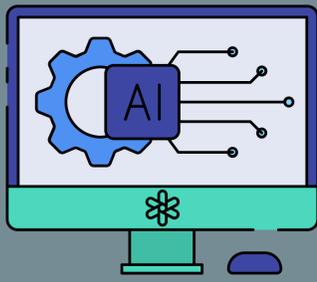
Consider a scenario from procurement that may come to your mind when you think about the conventional approach of leveraging Generative AI for co-pilots. You are reviewing a contract and you can use a co-pilot to understand how the terms and numbers in the document compare with other contracts that are already in the database. This is our conventional view of leveraging Generative AI. We are hence constrained in terms of applications in areas like contract generation, RFP drafting, document review etc.

While this is an extremely powerful application, keeping our perspective of Generative AI constrained only to this view will hurt exploring the realm of possibilities. These are good productivity enhancing opportunities but so are the opportunities beyond automation leveraging Generative AI. Automation is a great foundation and as we will see in Chapter 2, is a necessary milestone in your journey to build Generative AI capabilities, but soon almost every organization will have this foundation. The differentiating factor will be the additional layer built on this automation layer. The layer of Generative AI enabled analytics layers.
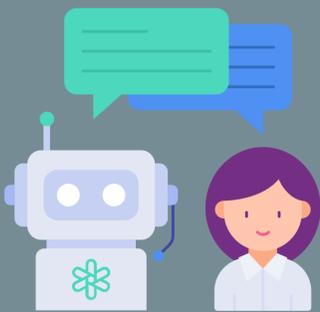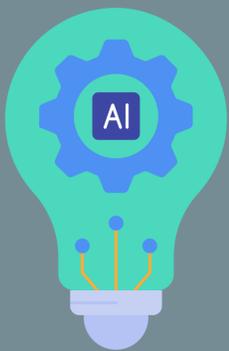
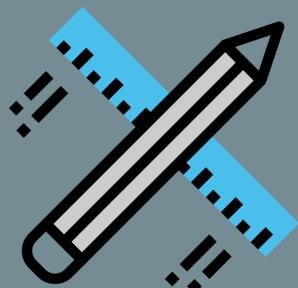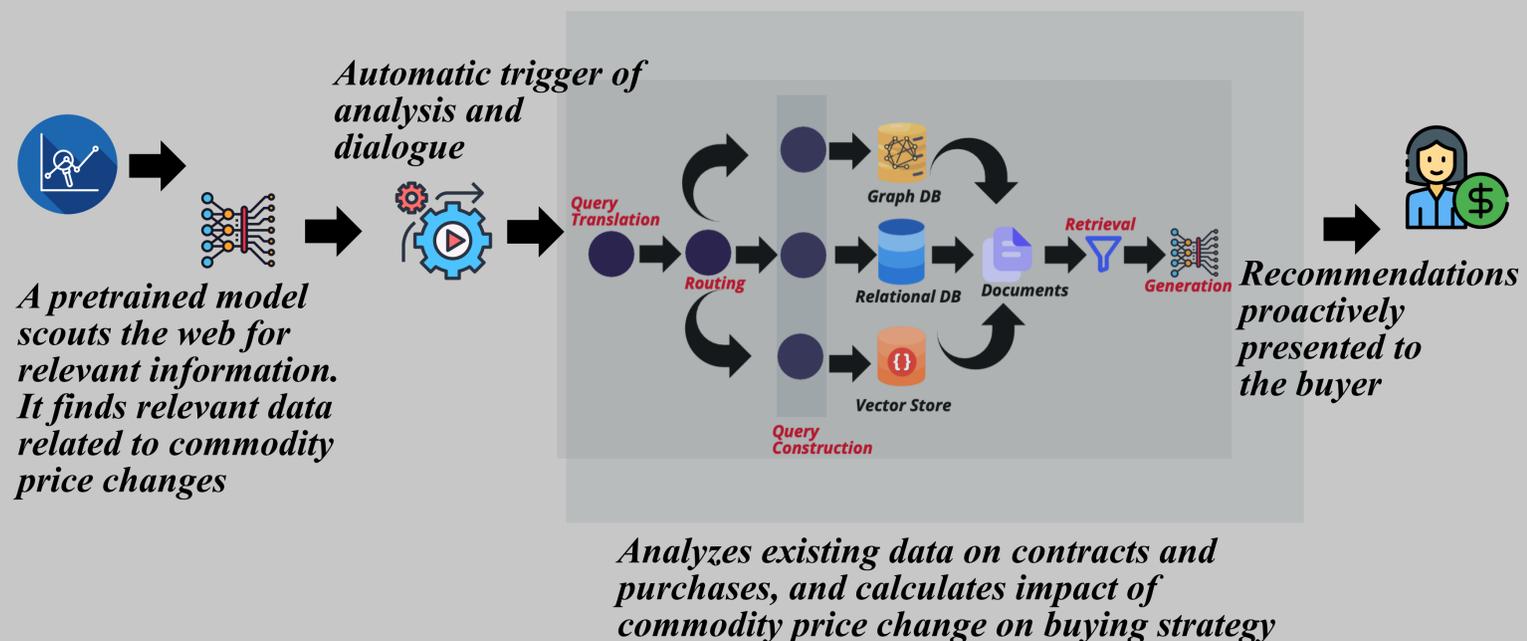The crux of this capability will be **proactive** vs reactive.

All the current possibilities that we are exploring and building are mostly reactive in approach. What this means is that we interact with the models when we need them. As mentioned repeatedly, this in itself is a major productivity enhancer. It allows buyers and sourcing professionals to focus on their core tasks and allow them to think proactively.

But what if we can push those working within the business processes to think and strategize as well? That can be done by taking a proactive approach to Generative AI.

So let us look at this with an example from the procurement area itself. You are a commodities buyer. Numerous AI-enabled tools already in the market leverage ML to easily make sense of commodities across interconnected markets. But the market is ever-evolving. An event happens that can impact your buying strategy. Millions and millions of Dollars may be saved with timely action. A tool that is always live, catches this event, translates that into implications and next steps, and alerts the buyer and their manager. The scenario is illustrated in **Figure 4**.

Figure 4 : Proactive Prescriptive Analytics Leveraging Generative AI

Automatic trigger of analysis and dialogue

A pretrained model scouts the web for relevant information. It finds relevant data related to commodity price changes

Recommendations proactively presented to the buyer

Analyzes existing data on contracts and purchases, and calculates impact of commodity price change on buying strategy
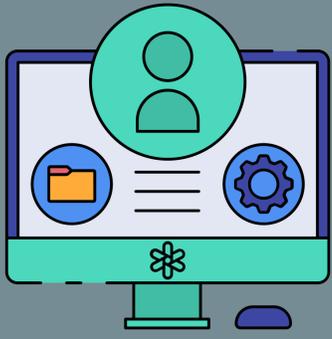
You can pick any sub-function within the realm of supply chain, and you will find that the opportunities expand significantly when you focus on Generative AI's capability to churn valuable insights that are embedded within documents, and when you pair Generative AI with existing analytics approaches. Logistics and transportation can be another example.

We have recently seen many digital transportation startups and even established players struggle. Their struggle is due to their perspective that merely digitizing or automating manual processes adds a significant enough value. While there is no doubt that a digitized and automated process is a significant improvement over manual processes, the differentiating aspect comes from how the data captured through digitization is leveraged. None of these struggling platforms invested enough resources to add a data science layers that could have enabled its customers to extract additional value from the product. This same aspect applies to Generative AI.
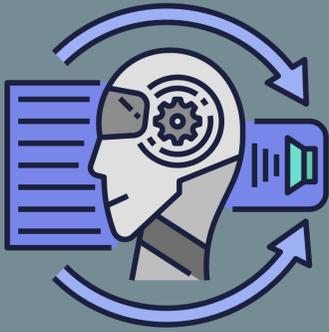
If you look at the possibilities with this lens, the realm expands significantly. This is the approach that will eventually create the differentiating aspect. We will explore some of these possibilities in Chapter 2. But the onus is on you, the executive, to map the realm of possibilities. Within next five years, most organizations will be done with the hyper automation applications of Generative AI. If you decide to draw boundaries at this capability, you will end up becoming one among thousands of companies out there.

However, you have to keep in mind that in order to leverage the insights and analytic capabilities of Generative AI, you need to invest significantly in your ontology, starting now. We know that knowledge bases will be a critical source of truth for Generative AI-powered applications. Ontologies form the structure on which knowledge is contextualized.

This approach allows Generative AI solutions to make inferences based on context. What this means is that you need to start working on codifying, digitizing, and structuring the data that you plan to leverage.
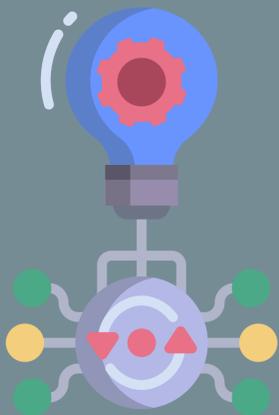
You should be able to identify what needs to be ontologized once you have identified use cases that should be part of your roadmap. Having this capability in place will allow you to propagate knowledge and skills fluidly across your enterprise, leveraging Generative AI.
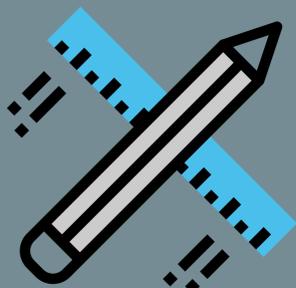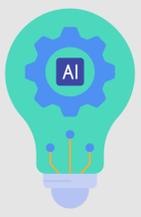
Exploring Opportunities

If we start listing out the potential opportunities of Generative AI in the supply chain, or for that matter, any other function, the list can be long. However, like every digital transformation 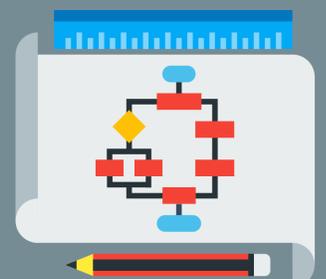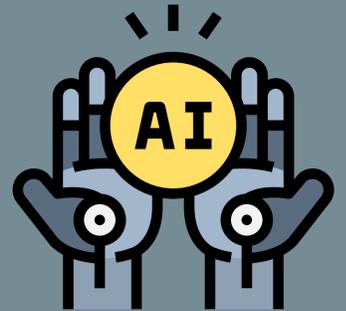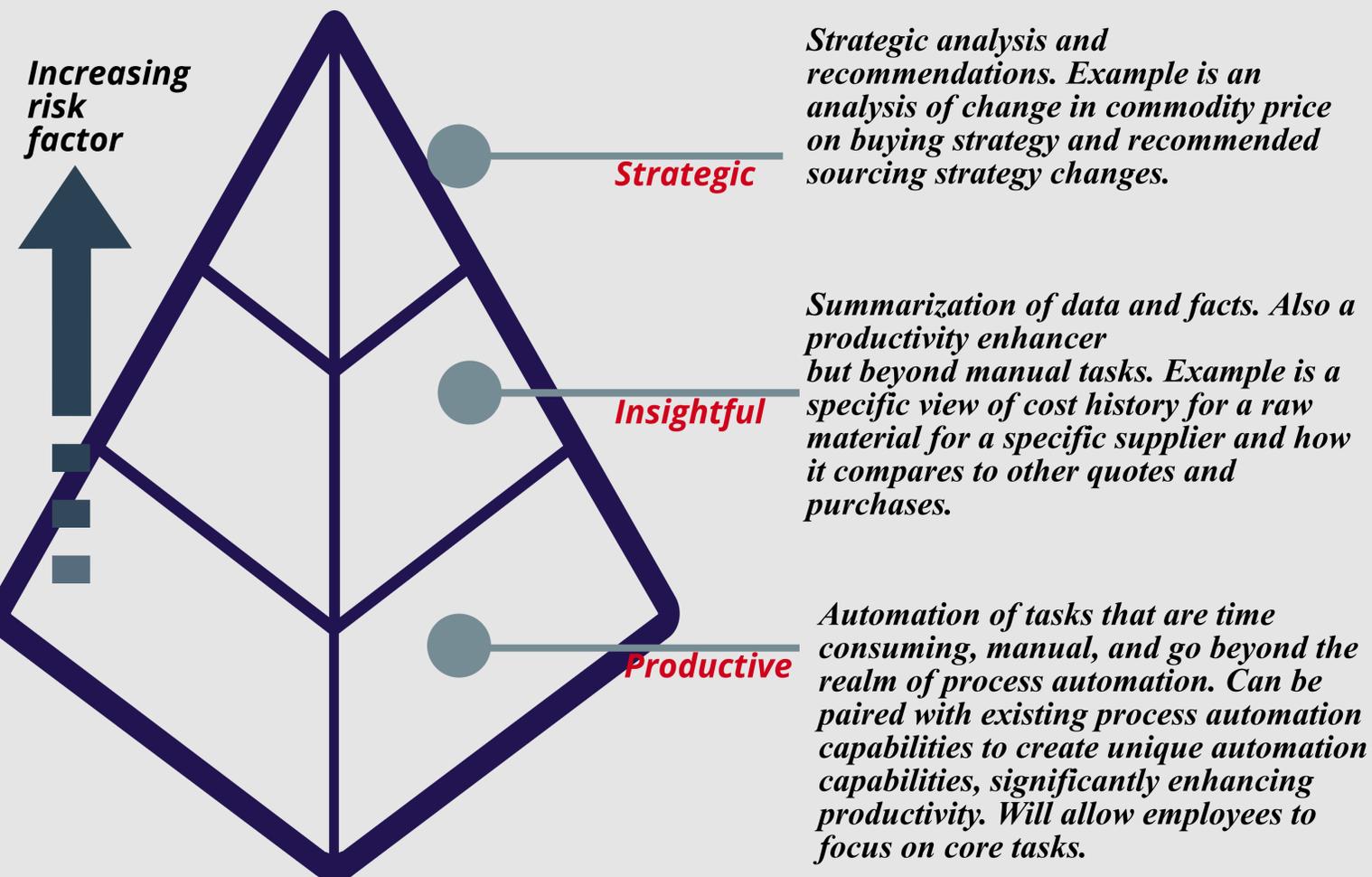opportunity, there is a need to carefully evaluate the impact vs the resources that need to be invested to build specific capabilities.
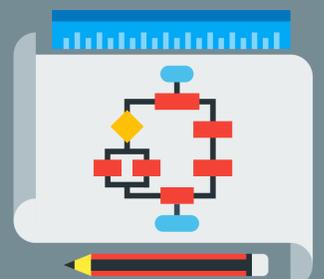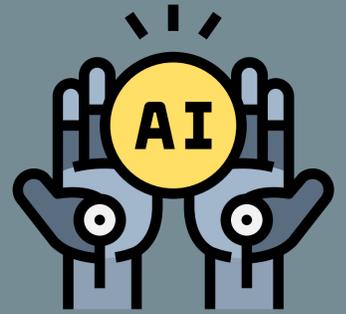
As mentioned before, LLM training is much more extensive than other ML-based approaches that organizations are currently leveraging. What this means is that there may be scenarios where even though the value delivered may be only slightly more as compared to another use case, the training and other requirements to help make the vision a reality will be more or less the same. This means that developing a roadmap based on a practical evaluation of the capabilities you want to develop becomes important.

The first step is understanding that Generative AI capabilities across the supply chain and many other functions can be categorized into three broad categories. These three categories are productive, insightful, and strategic.

The capability pyramid shown in **Figure 5** is not supply chain-specific. You can extrapolate this to any other function. But the key message here is to understand that there are layers of capabilities that you can build by leveraging Generative AI. As you can assume, the majority of companies will start their journey with automation. In tandem with other technologies, Gen AI can help build hyper-automation capabilities. These are generally considered low-hanging opportunities and a good way to start your journey. However, as the focus of this report highlights, the need of the hour is to start working on building that apex-level capabilities.

Figure 5: Hierarchy of Generative AI Applications

Increasing risk factor

Strategic — *Strategic analysis and recommendations. Example is an analysis of change in commodity price on buying strategy and recommended sourcing strategy changes.*

Insightful — *Summarization of data and facts. Also a productivity enhancer but beyond manual tasks. Example is a specific view of cost history for a raw material for a specific supplier and how it compares to other quotes and purchases.*

Productive — *Automation of tasks that are time consuming, manual, and go beyond the realm of process automation. Can be paired with existing process automation capabilities to create unique automation capabilities, significantly enhancing productivity. Will allow employees to focus on core tasks.*
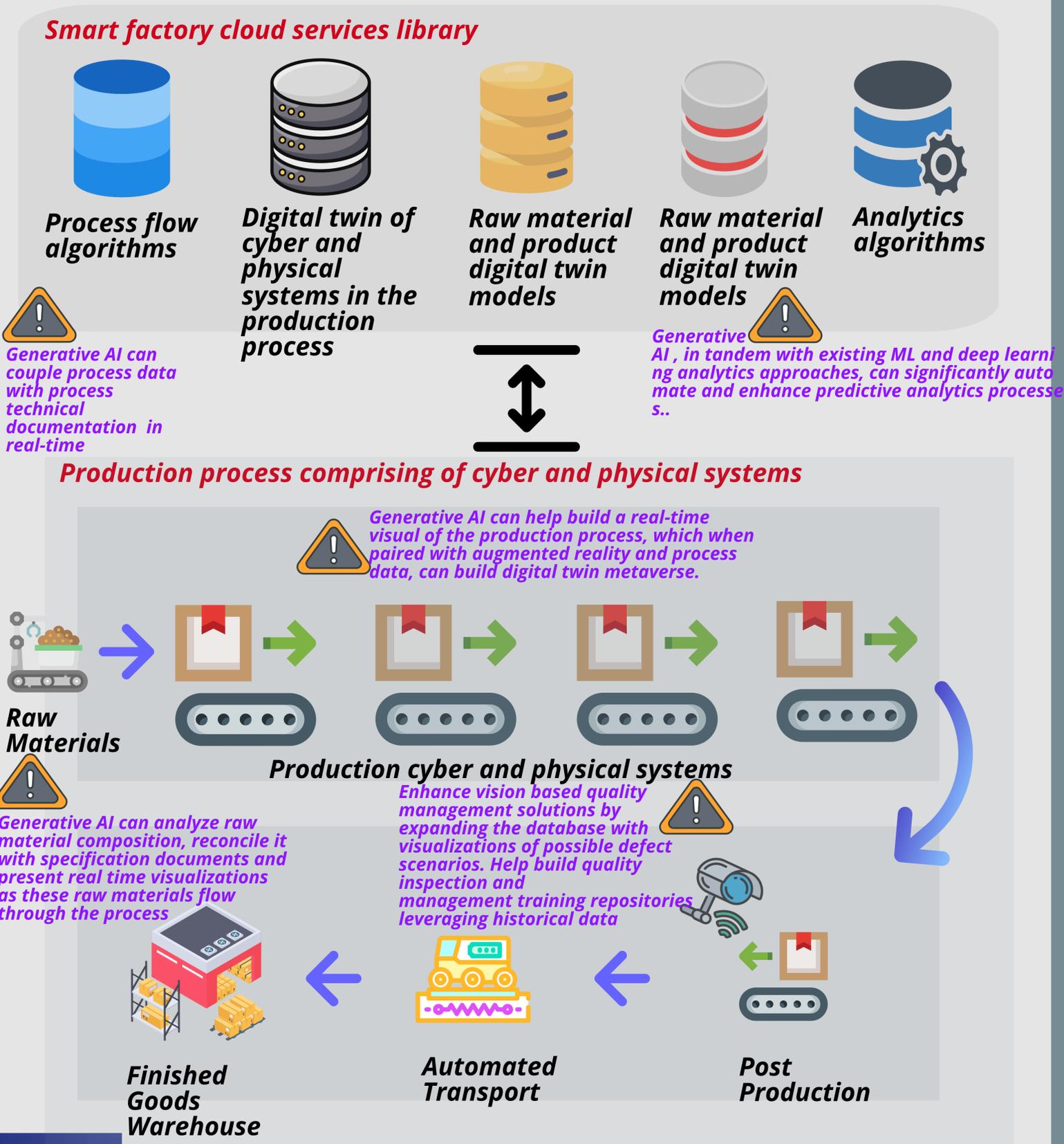
Once you understand that there is a roadmap and the capabilities that you need to build will be built during a journey, it allows you to explore opportunities of leveraging Gen AI at a much granular level. Let us explore this from the perspective of smart manufacturing. **Figure 6** shows an overview of flows and linkages in a smart factory setup.

This is not the most granular level since it is not possible to break every component further down in the same figure. However, the idea is that when you have a representation that allows you to look at both the forest and the trees, it helps you identify opportunities across all the three categories of productive, insightful and strategic.

As you can see, this view, where you deep dive at this level, you can understand both the opportunities as well as the limitations. Rather than thinking constrained within the realms of co-pilots, you can explore specific insights-related areas. To be more specific, proactive applications where instead of you initiating a communication, the model proactively shares insights and relevant data with you. Note that the opportunities identified in the figure are representational, not exhaustive.

Figure 6 : Leveraging Process Level View to Identify Opportunities

Smart factory cloud services library

Process flow algorithms

Digital twin of cyber and physical systems in the production process

Raw material and product digital twin models

Raw material and product digital twin models

Analytics algorithms

Generative AI can couple process data with process technical documentation in real-time

Generative AI , in tandem with existing ML and deep learning analytics approaches, can significantly automate and enhance predictive analytics processes..

Production process comprising of cyber and physical systems

Generative AI can help build a real-time visual of the production process, which when paired with augmented reality and process data, can build digital twin metaverse.

Raw Materials

Production cyber and physical systems

Generative AI can analyze raw material composition, reconcile it with specification documents and present real time visualizations as these raw materials flow through the process

Enhance vision based quality management solutions by expanding the database with visualizations of possible defect scenarios. Help build quality inspection and management training repositories leveraging historical data

Finished Goods Warehouse
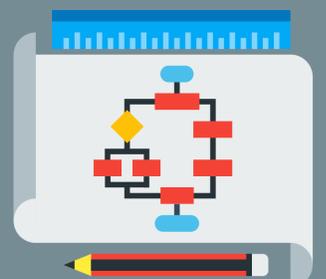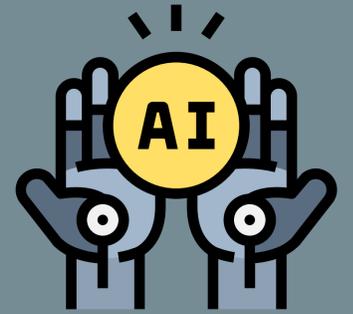
Automated Transport

Post Production

As highlighted early on in the report, the goal of this report is not to focus on listing possible application areas but on thinking about the possibilities of leveraging Generative AI realistically beyond conversational co-pilots. However, we will still list out possible application areas for the top sub-functions within the supply chain in this chapter of the report.

The goal behind doing this is to force you to think about these applications from the lens of the three categories of automation, insights, and strategy that we have highlighted in this report. Evaluating the possibilities with this categorization and then evaluating the possibilities using the risk and rewards matrix will allow you to develop your roadmap more prudently.

Remember that these possible applications are just illustrative, primarily being shown to think about the categorization. You can find lists of application areas, generic in nature like these, among hundreds of white papers across the internet. However, their utility is limited. Like every other technology, your journey or roadmap, discussed previously, is unique. And the only way to develop a unique roadmap is to follow the comprehensive exercise illustrated using the smart manufacturing example.

Every subsequent table in this chapter summarizes examples of possible application opportunities in various sub-functions of the supply chain, categorized by productive, insightful, and strategic.
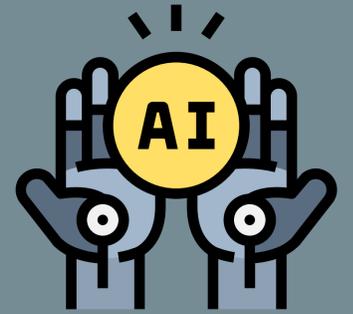
None of these tables are exhaustive lists; not all supply chain sub-functions have been highlighted. The opportunities are rather more representative to highlight how you can think from the perspective of the three buckets. As indicated previously, these lists are available in abundance on the internet, and you can even ask ChatGPT to generate one for you.

Procurement

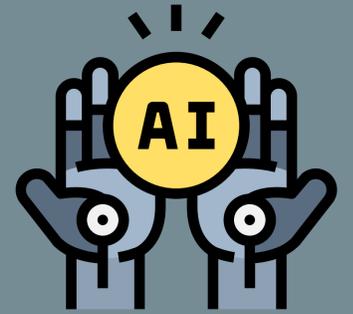*Table 1: Examples of Generative AI applications in procurement*

Strategic	As highlighted previously in an example, Generative AI can help perform real-time, "always-on" market intelligence, and couple the same with internal insights to prescribe and predict internal procurement strategy optimization opportunities. Generative AI can help perform spend analytics beyond the spend cube data. Leveraging spend data and integrating it with contextual data from documents and emails, it can generate insights that procurement managers may not be able to unearth by themselves.
Insightful	Mine descriptive data that can help automate supplier management by automating supplier performance data. Generative AI can help couple quantifiable performance data with contextual data, like resolution related communication history from suppliers. Identify savings opportunities based on contractual data and data embedded beyond relational databases. An example of opportunity could be suggesting that an offer in an email from a supplier can be better terms than those outlined in a RFP response from another supplier.
Productive	Build a comparative summary of contract language for specific clauses across supplier. Help centralize communications pertaining to supplier onboarding and supplier management.

Transportation

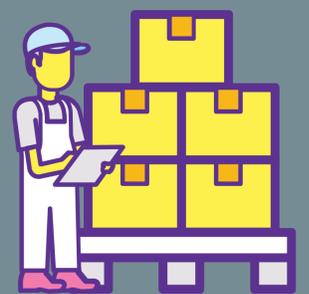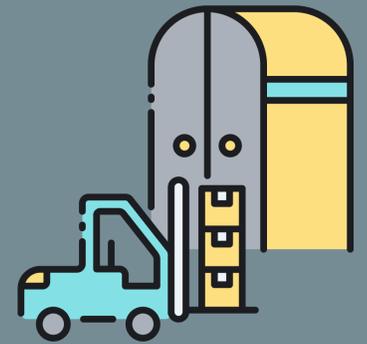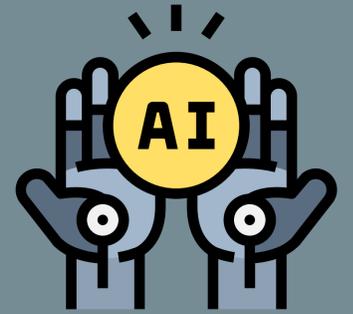*Table 2: Examples of Generative AI applications in transportation*

Strategic	Predicting potential traffic disruptions and suggesting alternative routes, based on real-time weather and traffic data, social media feeds etc. Intelligent freight forwarding, leveraging real-time market data and unstructured insights. Compiles preferred carriers and routes by learning from historical shipments data. Compiles data pertaining to asset performance and driver behavior and prescribes best practices and remedies by analyzing that data.
Insightful	Generative AI powered simulators can help address undesirable driver behavior and can significantly transform commercial driver training approaches. Generative AI can help visualize transportation routes in real-time, with text and graphics, to get better context of real-world routes and eventually plan them better. Anomaly detection capabilities leveraged on data from transportation asset sensors, coupled with visualizations, can help communicate anomalies and their impact more efficiently to maintenance professionals.
Productive	Documents like transportation contracts, Incoterm documents, BOLs can be contextualized leveraging Generative AI.

Warehousing

Table 3: Examples of Generative AI applications in warehousing

|	
Strategic	Generative AI can help minimize inventory loss due to damage in the warehouse by mining contextual data pertaining to damage from documents, associating them with SKUs, and visualizing the current state of placement vs the future best practice placement to avoid damages.
Insightful	Visual and contextual warehouse layout and process simulation will help not only design better warehouses, but will also help optimize process flows in existing warehouses.
	Forklift drivers can be trained more efficiently leveraging simulation tools powered by Generative AI.
	Generative AI can help add more context to pick lists to minimize picking errors and to also efficiently run picking routes in warehouses.
Productive	Combined with other bots on the floor, Generative AI can take cycle counting and other inventory management process automation to a whole new level, reducing the cycle time, efficiency and accuracy.
	Generative AI can help improve data accuracy of inventory data, thereby significantly impacting customer satisfaction as well as reducing inventory management costs.

Manufacturing*

Table 4: Examples of Generative AI applications in manufacturing

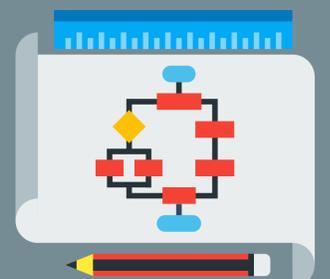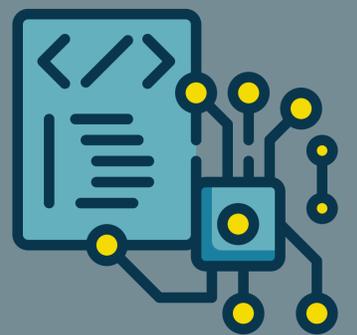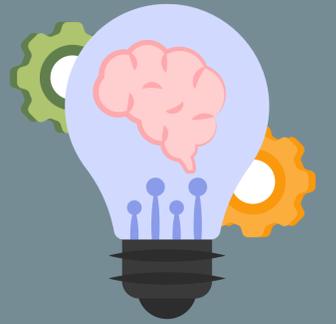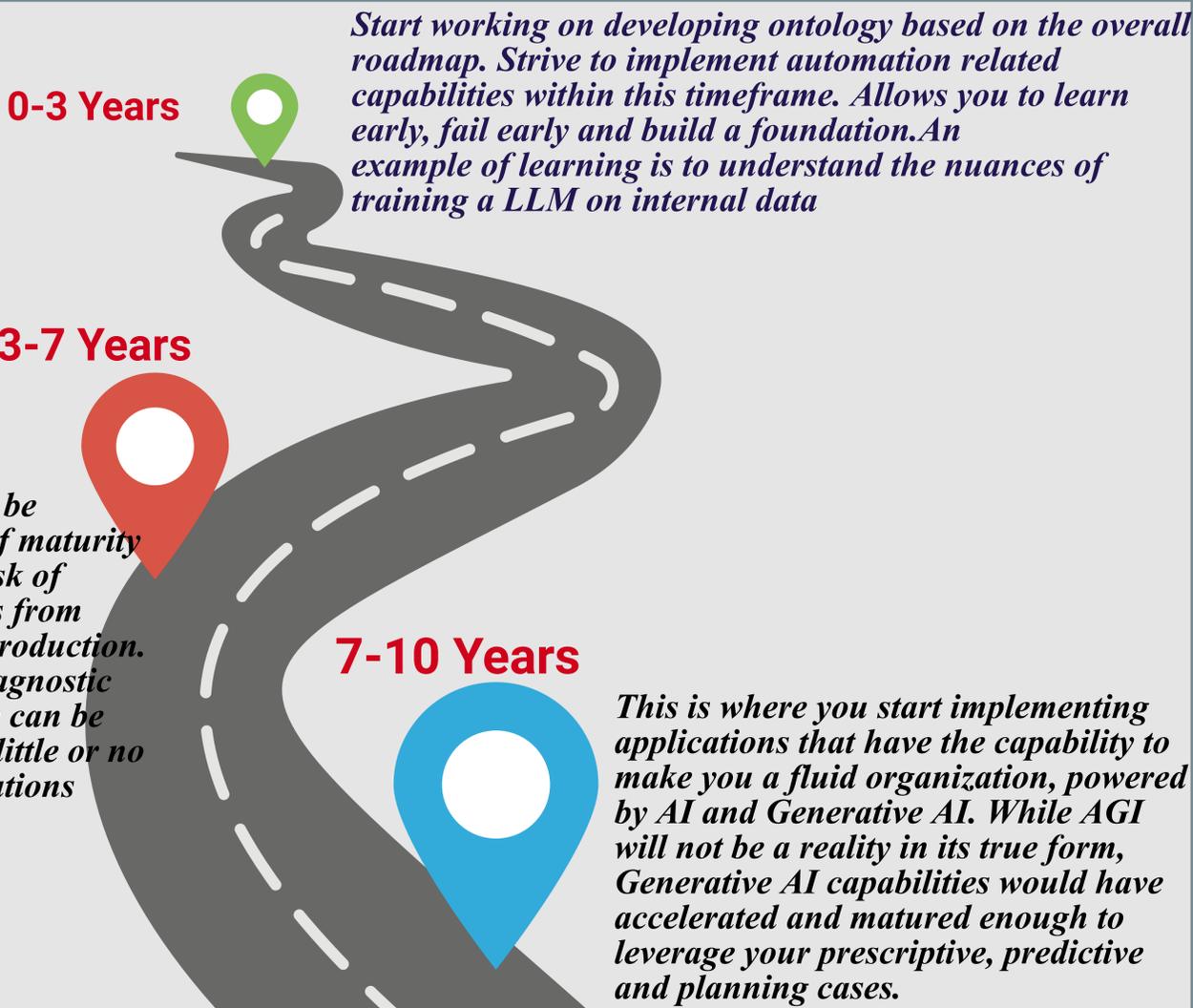| Strategic	Generative AI can help couple asset and process related documentation with data generated and collected on the shop floor, to prescribe optimal work orders and job schedules. When it comes to predictive maintenance,Generative AI can help enhance predictive maintenance by adding visual context to work orders, by leveraging data from other ML and deep learning algorithms.
Insightful	Generative AI can be leveraged on data collected from digital twins, and coupled with other analytics approach to describe and diagnose. It can add context to insights from other ML algorithms by applying additional context to the same. Generative AI can help create documentation pertaining to SOPs in manufacturing processes as well as documents pertaining to quality management.
Productive	Automate creation of standard documents leveraged in manufacturing like work orders.
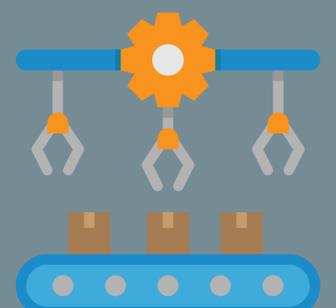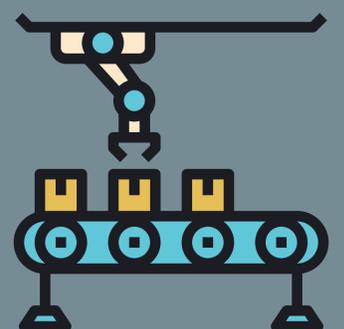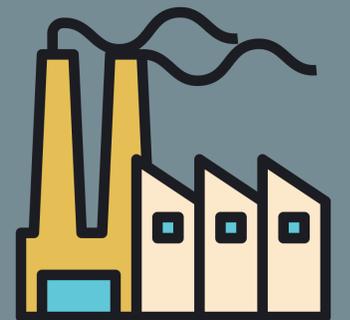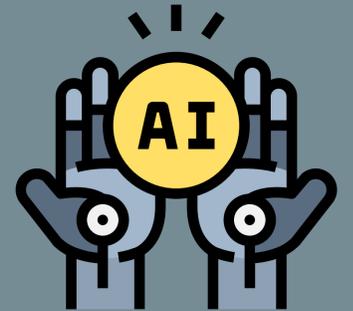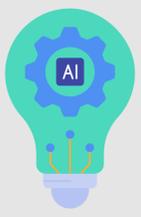
Evaluate Opportunities

This report focuses on the considerations for building higher-level capabilities in the hierarchy. The reason behind that is simple. Within the next three years, most leading companies would have implemented the automation-level capabilities highlighted in the capabilities pyramid. Remember that many of these automation use cases already have some form of automation. The additional capability gets infused by integrating Generative AI in the automation solution. Automation, while a foundational capability that must be built first, is not the differentiating capability.

The differentiating capability comes from the two higher levels of capabilities of insightful and strategic applications. The reason you need to think about this entire pyramid of capabilities holistically right now is that you do not want to start aspects from scratch a few years from now when you start building these higher-level capabilities. In many cases, data sources for automation and insights generation may be identical. In that case, it is critical that you think about your current Generative AI ontology strategy from the perspective of future state capabilities, so that you do not have to invest years of efforts again in the future.

The landscape of Generative AI and AI in general, will evolve rapidly during this decade. However, a good thing about planning your journey strategically is that if you build foundations right and plan your roadmap in a flexible format, rapid or sudden advances will not derail the work you have already invested in your roadmap. To be realistic, there will be some wasted effort, considering the pace of evaluation of technology we are experiencing. But that can not be an excuse for adopting a "wait and watch" strategy. In today's age, that would be suicidal.

Figure 7: An Illustrative High-Level Generative AI Journey Roadmap

0-3 Years

Start working on developing ontology based on the overall roadmap. Strive to implement automation related capabilities within this timeframe. Allows you to learn early, fail early and build a foundation. An example of learning is to understand the nuances of training a LLM on internal data

3-7 Years

Generative AI will be nearing the level of maturity that reduces the risk of leveraging insights from Generative AI in production. Descriptive and diagnostic analytics use cases can be implemented with little or no errors or hallucinations

7-10 Years

This is where you start implementing applications that have the capability to make you a fluid organization, powered by AI and Generative AI. While AGI will not be a reality in its true form, Generative AI capabilities would have accelerated and matured enough to leverage your prescriptive, predictive and planning cases.
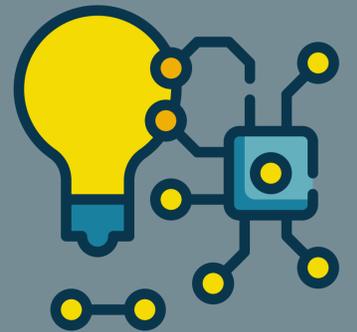
Figure 7 highlights an example of a roadmap you can build. While this focuses on Generative AI, remember that you can or should not build a siloed Generative AI strategy roadmap. This type of roadmap will be a subset of your overall data and analytics roadmap, which spits out an AI roadmap, of which a Generative AI roadmap will be a component.
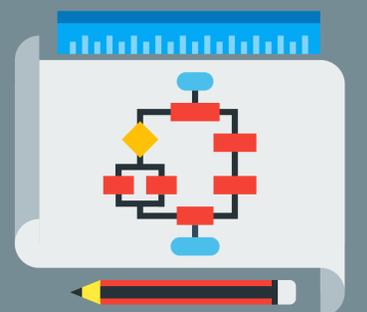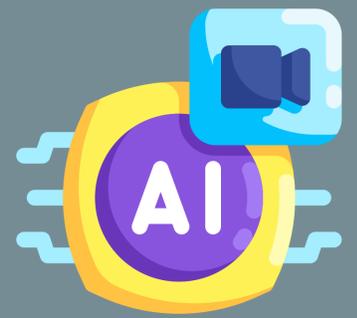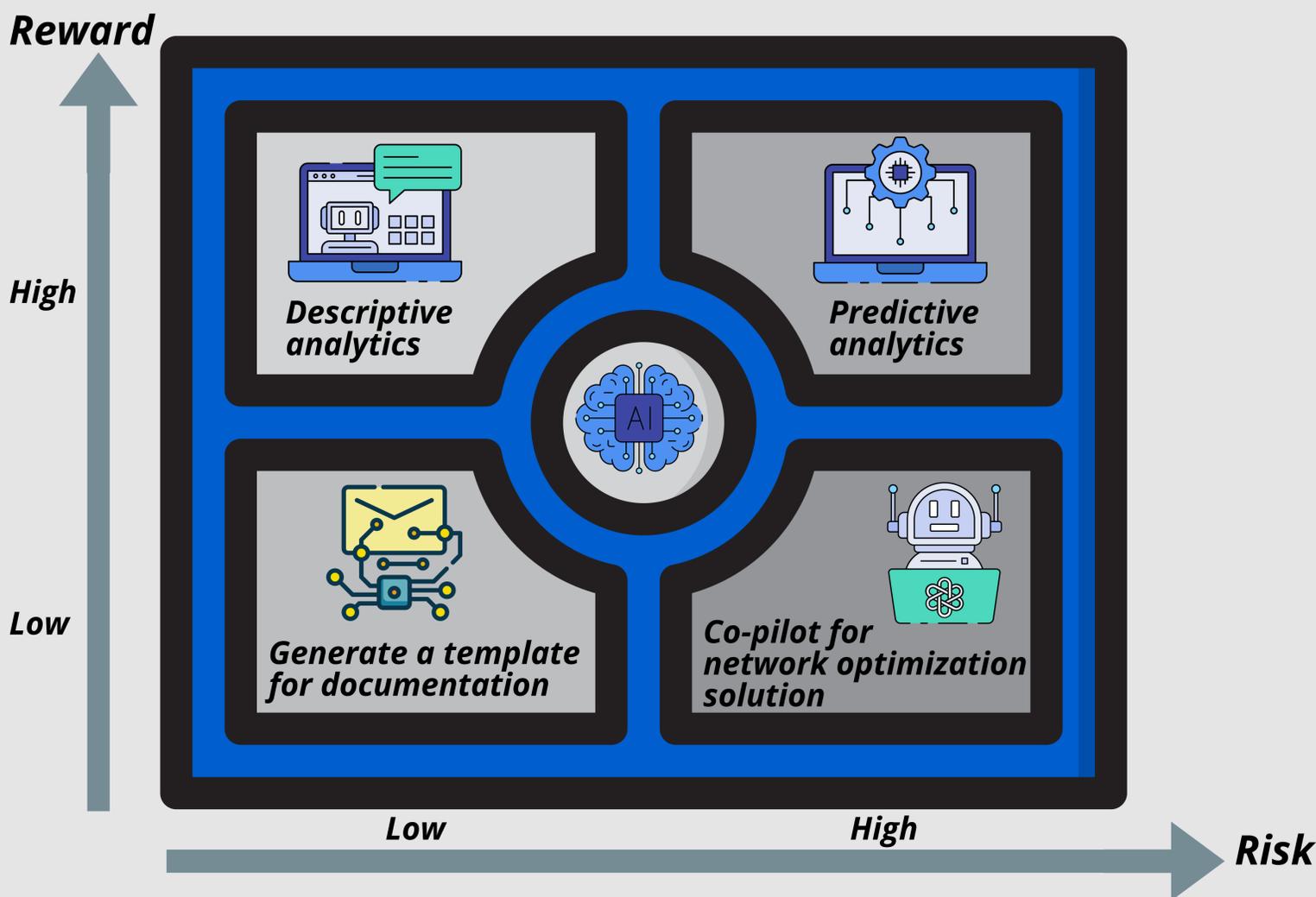
However, before you build that roadmap, you need to understand the risk and reward trade-off for these application opportunities. Despite all the excitement, you have to keep in mind that for some types of applications, the technology may not work perfectly, and hence, implementing it in production may involve some risks.

While investing more resources can certainly eliminate these risks for these advanced applications, there needs to be a careful examination of the value you will derive from investing additional resources. This evaluation will help you determine which opportunities will eventually find a place in your journey roadmap.

As mentioned previously, Generative AI has the potential to significantly transform many aspects of business processes, ranging from automation all the way to strategic insights and model building. The more creative we get with technologies, the more opportunities we will create to leverage these technologies to help transform our businesses. However, combining the hype of these technologies, like generative AI, with the sole objective of showing some form of cosmetic innovation will lead to prioritizing Generative AI into use cases where it does not add as much value as some other use cases.
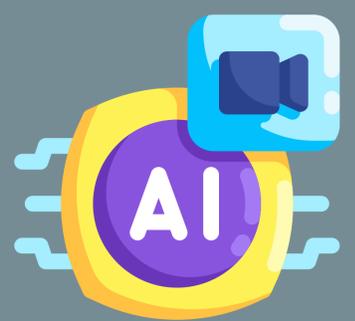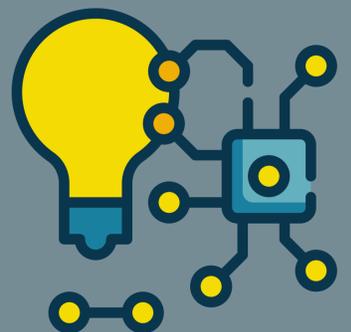
Figure 8: Risk Reward Matrix for Evaluating Generative AI Applications

Reward

High

Low

Descriptive analytics

Predictive analytics

Generate a template for documentation

Co-pilot for network optimization solution

Low   High   *Risk*

The risk-reward matrix illustrated in **Figure 8** is a simple yet effective way to think about the realm of possibilities. Each possible opportunity has its own rewards and risks. Remember that risk in this case is not just the risk of failure in terms of an effective final deliverable. It is also about the resources that you invest. For example, developing a co-pilot for a strategic analytics tool that gets leveraged once a year will need almost similar development resources but with little value. Risk also pertains to the accuracy of results. Implications of inaccurate results are more prevalent in predictive and prescriptive analytics-based capabilities than in template generation.

However, since you will probably build or at least train your own LLM model for these applications, ensuring a significantly high level of reliability for analytics use cases should not be challenging. Hence, you do not need to get thrown off when you read about massive hallucination stories about ChatGPTs or BARDs of the world. You can avoid that when you train your own LLMs in the context of your specific use cases.

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