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Give Your Business Its Own AI Captain

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Introduction

The Mayflower Autonomous Ship is a pioneering and truly independent seafaring vessel. Developed by Promare in partnership with IBM and other organizations, it utilizes a combination of technologies to sense other vessels and ocean conditions in a similar way that data allows you to sense and gain insights on transactions and business conditions. But, where you may have people making decisions, the autonomous ship relies on an AI Captain to find the optimal path.

In this white paper, we'll explore how you can leverage IBM Cloud Pak for Business Automation and other IBM solutions to automate the critical decisions that drive your "ship" and give your business its own AI Captain. Just as IBM has been instrumental in the development of the Mayflower's AI Captain, it has also helped global enterprises solve many critical operational challenges. When used in conjunction with our DecisionsFirst™ approach, IBM solutions can help your organization achieve positive business outcomes by streamlining business processes, minimizing manual effort, integrating AI-based insights for better decision-making, and solving inefficiencies—especially for customers.

Let's dive into the evolution of the Mayflower, so you can see the parallels in your business.

The Mayflower Story

Promare is currently in the process of conducting performance tests on the world's first autonomous ship, which is due to set sail for its first transatlantic voyage bound for Plymouth, Massachusetts. Early on, the project started as a grassroots effort by Marine AI, with the collaboration of smaller ocean industry companies. But, as the project progressed and IBM AI, cloud, and edge technologies were being integrated into the system, IBM got more deeply involved.

The goal is to establish the Mayflower as an open platform for marine research that would reduce costs and ease the burden on scientists and sailors, who brave a dangerous and unpredictable environment in the course of their data-collecting missions. Some of the oceanographic scientific experiments that will be conducted by Mayflower in the foreseeable future include measuring temperatures, taking water samples to test for microplastics and—perhaps most intriguing of all—identifying whale acoustics to track and study these immense ocean-dwelling mammals.

The futuristic Mayflower is completely uncrewed and travels at 8 knots (~9 miles per hour), with a burst speed of up to 16 knots (~18 miles per hour). As a completely autonomous entity, all the ship's decision-making ability is resident on the vehicle itself. To achieve this required a confluence of many technologies and capabilities.

AI/ML and Decision-Making in Practice

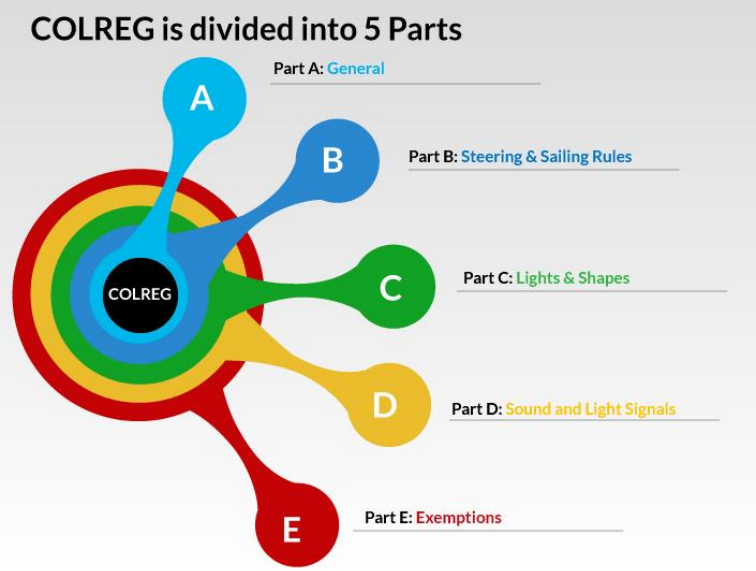
At the helm of the Mayflower is the "AI Captain," a virtual decision-maker onboard the ship that ensures the safe passage of the vessel in a highly changeable environment fraught with danger. It's up to the AI Captain to make decisions, turning on the right functionality at the right time and under the right circumstances. The highly robust AI Captain was developed by software engineers from Europe and North America.

Here's how Rob High, VP and CTO for edge computing at IBM, describes the project.

> "This is a test bed for integration of AI/ML and deterministic rule-based decision-making. The Mayflower is an edge device, with a computer on board and a low-bandwidth connection to shore, so all decisions are made onboard. There are symbiotic relationships that enable the ship to operate independently at sea: training the AI model, systems integration, and operational COLREGs."
>
> *Rob High, VP and CTO for edge computing, IBM*

COLREGs, or the International Regulations for Preventing Collisions at Sea, were formulated by the International Maritime Organization to prevent seagoing vessels from colliding. These are the "rules of the road" at sea. For the Mayflower, a critical part of understanding its environment is knowing how other ships behave and how they comply with COLREGs rules. This is a key element in the safe operation of the vessel itself.

Figure 1: The Elements of COLREG



Source: International Maritime Organization

To ensure the vessel is following COLREGs, as well as recommendations from the International Convention for the Safety of Life at Sea (SOLAS), the "AI Captain" onboard the Mayflower draws on IBM's business rules management system (BRMS), Operational Decision Manager (ODM, part of IBM Cloud Pak for Business Automation). Leveraging ODM in this context means that domain experts (sailors, in this case)—and not programmers—can manage the rules that guide the AI captain. ODM also provides a completely transparent record of its decision-making process, building trust with other ocean users and allowing for continuous improvement.

Let's turn to the AI technology part. As mentioned earlier, an essential capability of the Mayflower is understanding what's going on around it. One of the Mayflower team's first undertakings was to develop computer vision models based on different types of artificial intelligence—namely machine learning and deep learning. The engineering team fused data from multiple sensors, along with information from weather surveillance radar, to develop a hazard chart. Relying on a large set of complex algorithms, the AI Captain on the ship learns how to determine an optimal and safe path in a complex environment. It is able to make the right navigation decisions, weighing an AI-based assessment of weather and ocean conditions, operating status, and hazards with deterministic rules covering naval regulations and protocols.

Since the ocean is a dynamic and sometimes hostile environment, communication with a shore-side system is not always possible. Ultimately, the ship needs to be able to make smart decisions all on its own, so the intelligence is resident onboard.

Now that you understand how the AI Captain on the Mayflower works, let's look at how this approach crosses over into business. Figure 2 shows the elements of a Business AI Captain.

Just as the Mayflower Autonomous Ship has to make decisions as it sails the oceans, so your business needs to make decisions as it executes its business processes and responds to business events. Each of these decisions is handled by your Business AI Captain through a decision service.

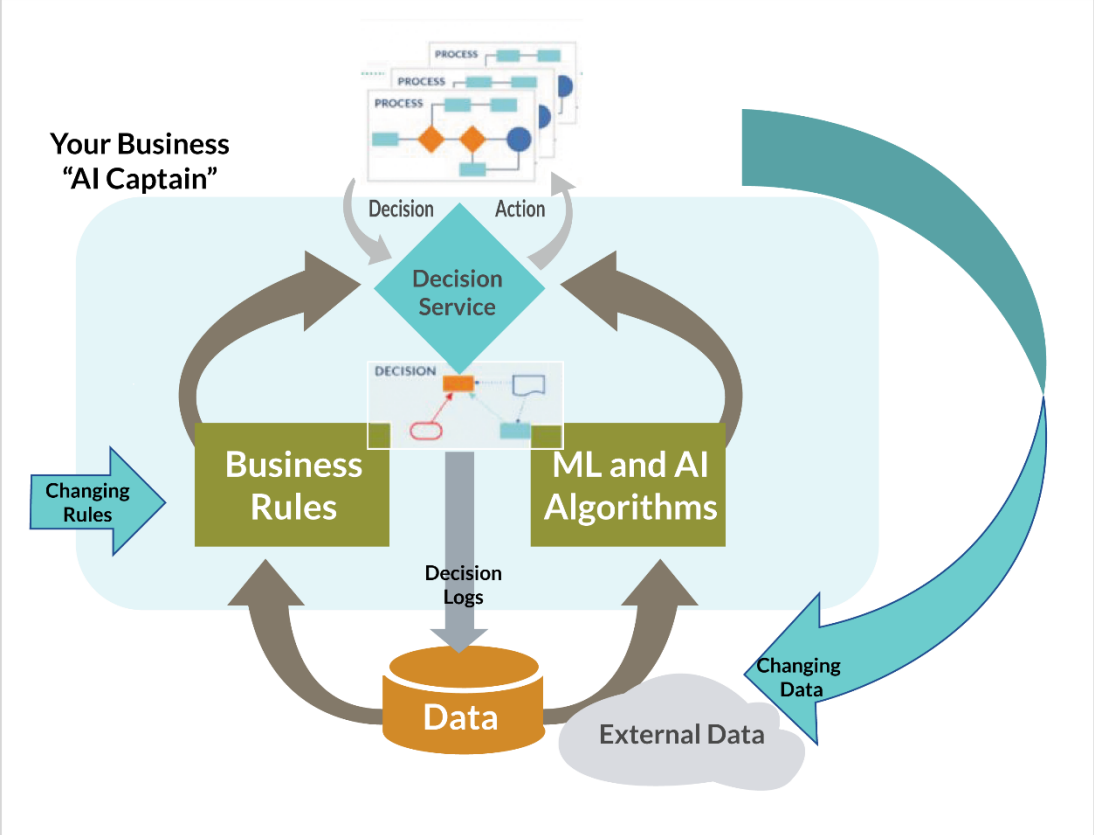
You can think of COLREGs as the specific and relevant industry regulations with which you need to be in compliance. SOLAS is akin to the policies and procedures that guide and support business decisions at your organization. Just as it's critical for the Mayflower's AI Captain to accurately implement regulations and best practices (as well as create a

transparent record of how decisions are made), maintaining compliance and upholding internal policies are similarly critical in business. The AI Captain implements these regulations and policies as business rules in a business rules management system and so should you.

AI insights about surrounding vessels, shorelines, weather and ocean conditions are analogous to the predictions that you want to be able to make about your business environment. Instead of the ocean current, you need to understand risk, customer behavior, fraud, customer demand, and reliability. Just as the Mayflower needs predictions to operate safely and make good decisions, so do you.

Plugged into your IT infrastructure, data from multiple sources informs both your business rules systems and machine learning models. These models and business rules are the underpinnings of the decision services that let your Business AI Captain drive meaningful decisions and recommended actions across your business.

Figure 2: Key Elements of a Business AI Captain



So how do you build a Business AI Captain?

Put Decisions First

Technologies and solutions of various types, including AI, are used by the Mayflower AI for decision-making. Before these technologies could be deployed on the open seas, the design team of Mayflower's AI Captain needed to have a detailed understanding of the numerous decisions the vessel would have to make.

Building an AI Captain for your business works much the same way. The best way to approach this task is to model the decision-making in a visual way by using a notation like the industry standard Decision Model and Notation (DMN), which breaks down complex decisions into their component pieces. Building a model of the decision-making helps you clearly articulate the approach you want to take and ensures that the AI team knows what this is. Decision models also provide a way to show how regulations, best practices, and constraints have an impact on decision-making.

- **Step 1**: Identify the business decisions that matter to the business. Learn how to measure improvement in these decisions, identifying the metrics and key performance indicators (KPIs). Model the decisions, breaking them down into their component pieces, so you understand how they work.
- **Step 2**: Use ODM, a key element of IBM Cloud Pak for Business Automation, to automate decisions that are guided by policies, regulations, or best practices. Capture the business rules behind each piece of the decision making, using the decision model to ensure that each piece is easy to understand and manage.
- **Step 3**: See how AI will help this decision-making. Find pieces of decision-making where judgment could be replaced or enhanced with ML or AI algorithms. See if the data you have or data you can get will support developing these algorithms.
- **Step 4**: Once you start executing these rules and algorithms, record how you made each decision. Look at the data you generate to see what you can learn from it and what patterns surface. Apply what you learn to continuously improve the business value of your decision-making approach.

The most effective way to define the decisions is to use decision modeling and the Decision Model and Notation standard. Building a DMN decision model in a tool like DecisionsFirst Modeler acts as a powerful visual blueprint for your AI captain. This blueprint can then be integrated with both IBM ODM and Watson ML.

Many of the decisions best suited to AI improvement are operational decisions: high-volume, transactional decisions. These are increasingly automated and embedded in the enterprise's IT infrastructure. The AI algorithms developed to improve these decisions need to be embedded in these automated decisions. AI algorithms and techniques add value in

part because they reduce the time to develop insight from large volumes of data. Automating the decisions that use AI algorithms ensures the time saved is used effectively. In addition, many of the decisions that offer the most value from analytics are high-volume, quick-response decisions, so automation is key, both in business transactions and when traversing the ocean.

Automation

A DecisionsFirst approach works best when an enterprise has a flexible AI-driven platform. The IBM Cloud Pak for Business Automation solution helps automate the critical decisions that drive your ship and help your business build its own AI Captain. Modular and easy to integrate, this solution is critical to business automation, as it can help make operations more agile. It also enables continuous improvement—one of the fundamental mantras of Decision Management—with built-in analytics that track business performance.

IBM Cloud Pak for Business Automation allows teams to focus on the business value—an improved business decision—and then select the right tool—the best algorithm or technique and the most effective AI engine. This combination of algorithms is often called "prescriptive analytics" or "prescriptive AI," which Forrester formally defines as:

> "Any combination of math, experiments, simulation, and/or artificial intelligence used to improve the effectiveness of decisions made by humans or by decision logic embedded in applications."
>
> *Forrester Research*

Applying AI to Decision-Making

AI algorithms can help determine what's likely to happen in the future. This gives you a view ahead, so you can decide in a way that takes advantage of a fleeting opportunity or mitigates a potential risk. You can readily see how the use of predictive algorithms would be absolutely essential to the operation of the Mayflower. Think of it as a tool to heighten the onboard AI Captain's "foresight" during navigation, allowing the onboard AI Captain to determine the potential of risk and then make the best possible, lowest-risk decision within the context of where it is and where it is headed at any given time. It is through predictive AI that the Mayflower's AI Captain knows to change course in the midst of an approaching storm. The AI Captain takes in insights derived from computer vision input and data collected by multiple sensors: radar, onboard cameras, GPS, attitude sensors (that measure the pitch and role of waves), geospatial, and water depth measurements. It then leverages the rules—COLREGS and SOLAS—to apply these insights and take the best possible action.

In business, an AI algorithm might predict how likely it is that a particular piece of equipment will fail in the next 30 days, how likely a transaction is to be fraudulent, the risk that a customer will miss a payment, or how likely a customer is to accept an offer. Multiple AI algorithms can be used to guide, predict, and prescribe the decision-making approach likely to have the most value.

A clear understanding of all the various pieces of the decision-making and a decision model show which predictions or algorithms fit where. They clarify how accurate and timely the algorithms need to be in order to be useful. And they show what rules have to be applied either as guide rails to keep the algorithm legal and appropriate or to leverage the algorithm into a better business decision. If the rules behind the decision have been implemented in ODM, then they can call out to the deployed algorithms to get the predictions and scores when they need them.

The IBM Watson Machine Learning service is a great way to develop the algorithms you need for your decisions. Watson Studio enables you to bring a wide range of algorithms to bear, and Data Refinery allows you to transform large amounts of raw data into the quality information your algorithms will need. Once you've built your models, the service enables you to deploy them quickly, retrain them as new data is ingested and assimilated, and then integrate the models into your applications. (See Appendix for more details.)

Continuous Improvement

When businesses first adopt AI, they often focus on trying to find big wins—one-time improvements that will make a significant difference. Initially, AI is often regarded as a way to change direction, altering the fundamental assumptions of the business, but, in a well-run business, such opportunities are usually rare. While AI may reveal that some underlying business assumptions are wrong or could be profitably changed, such changes are often relatively minor. As businesses become more familiar with the power of AI, they realize that its value lies not in these one-time improvements but in *continuous* improvement. They use AI and data to learn what works, adapt decision-making, and continuously improve results.

To realize improvements in the effectiveness of your AI Captain's decision-making capabilities, you need to collect data about outcomes and how decisions are made. Most organizations already collect some data about outcomes: what the customer did in response to an offer or about how expensive a repair was, for instance. But business outcomes are not always easy to track. Some outcomes, such as new orders, are recorded in structured data. Others, such as positive recommendations or complaints, are visible only in social media posts or the unstructured text of emails.

As data-driven, AI-based decision-making becomes the norm, organizations need to collect information about how each decision was made. Why was this the offer that was made? How did we classify the customer and their interests? It also needs to collect information

about the premises for the AI algorithms that were used: what was the predicted urgency of the repair, and how likely was it considered to be that this customer would accept this offer? This data about the internals of the decision needs to be matched to the business outcome that resulted. These three elements—the AI algorithms used, the decisions made, and the results achieved—are the three legs of continuous analytic improvement.

This continuous monitoring identifies new opportunities for AI algorithms, showing where decision-making is not improving. Where AI is being used, it shows which AI algorithms need a refresh. Analyzing this data helps your AI teams compare the ROI of a new AI algorithm with that of improving an existing one. And areas where AI algorithms degrade quickly are great opportunities for your AI teams to deploy more advanced algorithms.

As your team's understanding of the decision improves and as it refines its AI-based insights, new data will inevitably emerge. Ready access to a wide range of data types, formats, and sources will help keep projects on track. A focus on business value requires technical flexibility.

In the process of testing, building, and refining the Mayflower, engineers and scientists were prepared to receive constant influx of new data from multiple sources and sensors and had to constantly adjust and adapt the AI Captain so that it could learn to respond in the most optimal way under changing circumstances. The Mayflower underscores the importance of training and retraining models as fresh data is assimilated. As the AI Captain maneuvered the ship around busy Plymouth Bay in the U.K., it collected new data points that were then incorporated into the model in order to fine-tune models and improve decision-making.[1]

Finding out that an AI algorithm is less predictive of a positive outcome than it used to be, or that a decision-making approach is no longer working, is one step. Updating the AI algorithm promptly with a more predictive one or adding new AI algorithms to improve the decision-making approach is equally important. An AI enterprise not only detects that it needs to improve its decision-making, it actually improves that decision-making quickly and effectively. To achieve this, you can rely on a secure, reliable, and scalable platform like IBM Cloud Pak for Business Automation that allows for easy update and re-deployment of its AI algorithms. AI algorithms are treated as a portfolio to be monitored and managed, and an ongoing task is to minimize the cycle time for improvement.

This is where experimentation comes in.[2] If you're not 100% certain about which approach to decision-making works best, running experiments can help you determine the best method. Always make sure there is a clear, shared understanding of the purpose and scope of the experiment. Graphical representations of the experiment enable compliance and transparency, so they can be seen and discussed by others. A robust design ensures the experiment is also run the same way, ensuring replicability and reliability.

Conclusion

Businesses can learn a lot from the Mayflower. If you set your sights high and want to drive great business outcomes in a dynamic environment, the development and implementation of the autonomous vessel's AI Captain provides a valuable roadmap for successful digital decisioning.

Andy Stanford-Clark, Chief Technology Officer, IBM UK and Ireland, describes this succinctly and offers up the Mayflower as an inspiration for businesses:

> "Able to scan the horizon for possible hazards, make informed decisions and change its course based on a fusion of live data, the Mayflower Autonomous Ship has more in common with a modern bank than its seventeenth-century namesake. With its ability to keep running in the face of the most challenging conditions, this small ship is a microcosm for every aspiring twenty-first-century business."[3]
>
> *Andy Stanford-Clark, Chief Technology Officer, IBM UK and Ireland*

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[1] https://newsroom.ibm.com/2020-03-05-Sea-Trials-Begin-for-Mayflower-Autonomous-Ships-AI-Captain

[2] Decision Management Solutions, "Business Decision Experimentation"

[3] https://newsroom.ibm.com/2020-03-05-Sea-Trials-Begin-for-Mayflower-Autonomous-Ships-AI-Captain

CONTACT

We've helped many organizations develop their own AI Captains. If you're ready to discover the value in this approach, and utilize data from multiple sources to inform both your business rules systems and machine learning models, we can help. By adopting ODM and machine learning, your business will improve the accuracy of decision-making and drive meaningful and impactful actions across your business.

To schedule your own free AI Captain Discovery Workshop contact us at our website. We'll help you identify the highest value use cases for an AI Captain, show you how to get started and give you concrete advice about how to integrate an AI Captain into your existing systems. **Contact us today.**

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Appendix

IBM Cloud Pak for Business Automation

IBM Cloud Pak for Business Automation is a hybrid (cloud, on premises, or IBM-hosted managed service) solution that applies intelligent, AI-powered automation to the transformation of core business operations. In the realm of digital decision-making, it generates recommendations and outcomes for rule-based decision automation by applying machine learning to collected data. It also helps you prioritize key tasks to help make your workflows more efficient.

Building an AI Captain with IBM Cloud Pack for Business Automation revolves around the use of IBM Operational Decision Manager (ODM) to manage business rules and decisions. ODM is a comprehensive decision management solution to automate and govern rules-based decisions on premise or on the cloud. ODM makes it easy to integrate ML and AI algorithms into these decisions and supports a modern, hybrid, micro-services architecture. The workflow orchestration in IBM Cloud Pack for Business Automation integrates automated decisions into business processes and case management flows, taking advantage of content services and document processing to bring unstructured data into the same environment.

IBM Cloud Pak for Business Automation is built on Open Shift to ensure that it runs anywhere you need it to. It uses Business Automation Insights to track events and data throughout your system to ensure you can monitor your decisions and their outcomes in order to deliver continuous improvement.

IBM Cloud Pak for Business Automation also includes process analysis tools that use existing data to identify where automation will have the greatest impact and Robotic Process Automation (RPA) to augment the work done by your workforce.

IBM Watson

IBM Watson Studio is an AI modeling platform that can be used on any hybrid infrastructure. You can build, train, and run models with AutoAI models, SPSS Modeler, or notebooks automatically, visually, or with Open Source. You can leverage virtually any category of data: images, geospatial, text, and device.

The IBM Watson Machine Learning service enables you to rapidly deploy the models you've created, retrain them through continuous learning using your data, and integrate the models into IBM ODM. You can monitor the models to make sure they don't drift too far afield from the original direction and to check for bias and potential risk.

Another key component is IBM Watson OpenScale, which provides complete transparency in the development of AI models—across the entire lifecycle. It demystifies AI and eliminates "black box" scenarios.

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