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Collaborative Intelligence

**AN AI-POWERED SYSTEM
THAT PUTS HUMANS IN CONTROL**



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Executive Summary

When introducing AI into a process, organizations can achieve breakthroughs and cost savings – but AI can also be very unpredictable and cause harm if not steered and controlled. It requires a methodology to manage change. And most importantly, humans must be a part of the process to ensure the AI doesn't wreak havoc but instead aligns with the values of the organization. Real-time collaboration between humans and AI is essential.

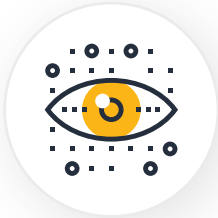
Organizations need a system designed to facilitate this real-time collaboration so humans can provide feedback and make decisions to steer the AI. But organizations shouldn't limit this system to just conversational AI for chat. They should allow humans and AI, together, to orchestrate events that automate business processes.

Event orchestration leads to real-time decision making and integration with various business systems, apps, devices and machine learning models. I call this system ***Collaborative Intelligence***.

An example of “collaborative event orchestration” might be that during a conversation with ChatGPT, the AI recommends a choice of optional actions in response to an event. When the human chooses an option, that choice triggers an event to make a purchase. Another example might be to send a command to a robot to do something automated. In fact, ChatGPT has plugin options that can integrate with many types of systems in this way. This kind of collaboration with AI can be built into business processes.

Organizations need to build ***Collaborative Intelligence*** into every business process. Or rather, it is very clear that AI will be involved given the very rapid pace it is being incorporated into thousands of products and services. The question is, are you prepared for it, and how will you manage the transformation to ensure humans stay in control? My recommendation is that you carefully manage how you introduce the change. It must be incremental. And it must be wise.

To begin the intelligent transformation of your business, I propose the adoption of my **4-Point Plan**:



A **vision** for collaboration with AI



A **strategy** for incrementally maturing the intelligence of the AI over time



A **methodology** that trades control appropriately between AI and humans



A **platform** that's flexible and provides the required modern technology stack to leverage AI in real time

The **4-Point Plan** is designed to take you on a journey from a less technical, higher-level vision in Point 1 to a highly technical Point 4. Each point builds upon the previous point. For example, in Point 4, you will see that the technical platform architecture emerges directly out of the methodology of Point 3. Think of it as progressive “nerdy-ness.”

But before we go further into my **4-Point Plan** to achieve Collaborative Intelligence, let me give you some basic context on the current state of the tech industry as it relates to this topic.

A man with a beard and a woman with curly hair are sitting at a desk in a modern office. The man is pointing at a computer monitor while the woman looks on. They appear to be in a collaborative discussion. The office has large windows and a desk lamp is visible.

Why Your Organization Needs Collaborative Intelligence

The rapid pace of technological innovation and the increasing demand for artificial intelligence are disrupting traditional business models and creating new opportunities for growth.

Organizations are struggling to keep up and face significant challenges in adopting and integrating digital technologies into their operations. As such, there is a growing gap between digitally mature organizations and those that are lagging, putting the latter at a competitive disadvantage.

However, rushing to adopt AI just to keep up can be a costly mistake. It's also a mistake to ban its use because you're not ready to move forward with change or are unsure of the risks involved. There is a way to embrace AI and use it effectively and with control.

What your business needs is a system designed to facilitate intelligent collaboration between humans and AI, where the AI and humans trade control at various points of a process. The Collaborative Intelligence (CI) system draws upon many emerging technologies and trends to make real-time collaboration and control of AI possible...

1 AI Assistants with Generative AI

Artificial intelligence is exploding at lightning speed. Breakthroughs in AI, like ChatGPT, are game changers. AI is now beginning to be seen as something that will be part of everyday business processes. Many products and services have already incorporated AI.

CI applies AI to specific tasks or intents to enable controlled use of generative AI agents.

2 AI Alignment and Human Feedback

Businesses need to keep humans in charge of AI to ensure it aligns with the values and ethics of the business and society.

CI enables humans to steer the AI in the right direction.

In a human-in-the-loop automation system, a task or process is partially or fully automated but still requires human oversight, intervention or decision making at certain points. This helps ensure AI alignment with human feedback on ethical and values-based judgement calls.

CI features a 5-step methodology, which we'll define later, that ensures the human is in the loop, always.

3 Ambient Intelligence

Amazon is the leader in ambient intelligence with Alexa. Ambient intelligence is an environment where each of your devices and services interconnect through artificial intelligence. In this paradigm, AI understands the state of your environment and body, helps you when you need it and recedes into the background when you don't.

CI makes it easy for humans to engage in conversation with the AI.

4 Internet of Things

The Internet of Things (IoT) refers to a network of interconnected physical devices, vehicles, appliances and other objects embedded with sensors, software and connectivity capabilities that enable them to collect and exchange data over the internet. In simpler terms, IoT is the concept of connecting everyday objects to the internet and enabling them to communicate with each other and users. There are billions of IoT devices in the physical world today. This trend is rapidly growing as the world becomes increasingly connected. AI is often used in conjunction with IoT to perform automated tasks, like turning the lights on in your home.

CI supports real-time collaboration between humans, AI agents and devices.

5 Business-As-Software

Large portions of a business are now defined in software, and not only the front end of the customer experience. Software is increasingly managing back ends, changing what used to be a set of disconnected apps into a unified system.

CI leverages an event streaming platform to connect all your business software to AI.

6 Data-In-Motion and Event Streaming Platforms

Event streaming platforms are an emerging category of data infrastructure. In [this video](#), Jay Krepes, CEO of Confluent, says:

"Data-in-motion is an emerging category of data infrastructure. It is an end-to-end reimagining of how a business operates. Traditional infrastructure isn't built to support these requirements. To reimagine their business as software, companies need a new type of infrastructure..."

6

... They need to seamlessly harness the flow of data across all the parts of their organization. They need to be able to react to this data continuously to be able to adapt and respond to events as they unfold in real time. They need infrastructure for data-in-motion. Data-in-motion allows for ubiquitous access to data in any system as it is generated. And it provides the real-time, continuous processing needed to react and respond in the moment. This acts in a similar manner to the nervous system in biology, which ties together all the independent parts of the body into a coherent whole that can react and respond intelligently in real time."

CI uses Confluent to power its intelligent real-time operational system and to connect and integrate AI into business systems and processes.

7

Streaming Artificial Intelligence

Businesses need AI and machine learning (ML) systems fed by continuous streams of data in motion.

CI uses ML models in real time to make recommendations to humans.

8

Real-Time Intelligent Operations

The modern company requires access to real-time data across every part of the business allowing it to react to everything at the moment or 24/7. Modern companies can't wait around for daily batch cycles to analyze and react to data coming from siloed applications and databases. These intelligent, real-time operational systems are increasingly required to compete and win in the world today.

With all these recent advances and rapid breakthroughs, you need a new way of thinking. Your organization needs to transition to an intelligence-first paradigm – and that requires a methodology that integrates AI into every part of business operations while keeping humans at the forefront.

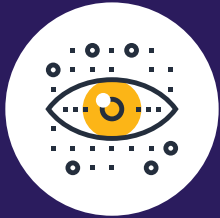


A 4-Point Plan to Achieve Collaborative Intelligence

At NASA, when the crew's life depends on it, trading control between the AI and humans is critical. AI should recommend, and humans should decide. Period.

My twin brother, Ron Kerr, who worked in Intelligent Automation at NASA, says it should be "READY, ARM, FIRE." In other words, when ready, the AI should "arm" but not fire. This keeps the crew in control of when they choose to fire rather than letting the AI take aim and fire. However, humans can also decide to fully delegate to the AI if they choose to allow it to fire immediately. The choice varies depending on the criticality of the procedure.

Likewise, your organization needs a methodology and an infrastructure that ensures you can respond to change quickly and remain on the cutting edge of technology – while remaining in charge. To begin transforming your business, I propose adopting my 4-Point Plan.



Point 1: The Vision

As business leaders, you must adopt a vision that embraces AI, not fears it. You must envision a system designed to facilitate intelligent collaboration between humans and AI, with humans providing feedback and making decisions to guide the AI. Humans steering the AI is a critical part of this vision to align the AI to your organization's values.

The vision is not simply about research. It is about practically applying AI and building it into all your business processes. It requires a strategy of continuous improvement to mature the AI's intelligence over time so that you can achieve rapid success, sustain it and react to changes in AI technology. To implement this strategy, you need a methodology – and a modern platform.



Point 2: The Strategy

Collaborative Intelligence leverages AI to mature a business process from little-to-no automation up to fully autonomous or somewhere in between. The end state of each process will vary depending on the goal. In some cases, a process can become fully autonomous, not requiring any human intervention. In other cases, a process may be very manual at first.

The goals are to incrementally mature the intelligence of the automation, continually improve each business process over time, and continually retrain and refine your AI with experience and human feedback.

This strategy is a timeless one. It is based on [the teachings of W. Edwards Deming](#), the father of continuous improvement, who led the transformation of Japan in the 1950s. It simply applies the scientific method to business processes. Deming called this method the P-D-C-A Cycle:

Plan, Do, Check, Act

- **Plan** your next cycle of improvement. Which process? What is your hypothesis on how you might improve it with AI? Do you need a new AI model? Do you need to retrain a model? Do you need to refine the intelligent assistant's neural network?
- **Do it.** Test your hypothesis on a small scale with the revised models.
- **Check** if the model responded as you expected in your theory.
- **Act** by either adopting the change, revising your theory or abandoning it. Incorporate human feedback into your models and plan your next cycle.

You repeat this cycle many times for each business process to continually mature the intelligence and level of automation over time, as shown below.

The PDCA Cycle

By W. Edward Deming

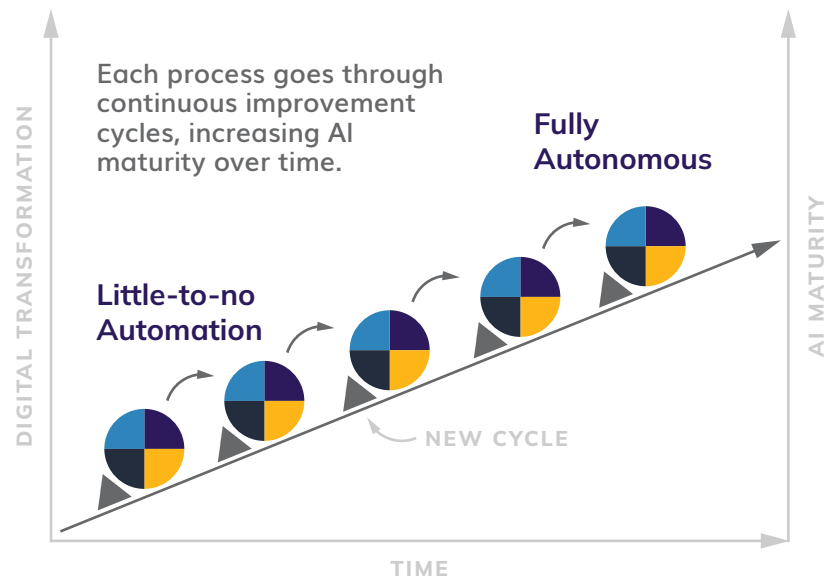


Figure 1: The Strategy of Continuous Improvement



Point 3: The Methodology

Walker Reynolds, a well-known Industry 4.0 influencer, has said,

"What is the holy grail? The holy grail is that our business processes are closed loop ... that is, we collect information about the state of our business in real time, put in one location, plug it into the cloud ... our machine learning algorithms are going to learn about our business in real time, make predictions or recommendations on how to improve the process in real time and push back those recommendations."

If I were to put this continuous process, or holy grail, into a flow chart, it would look something like this:

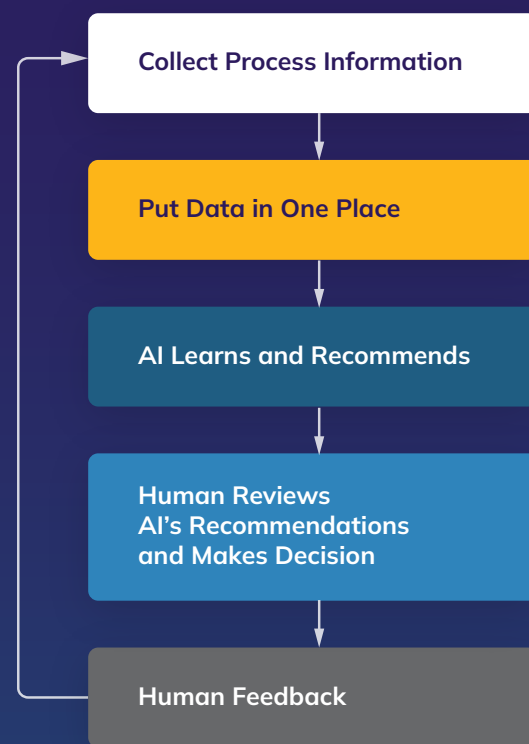
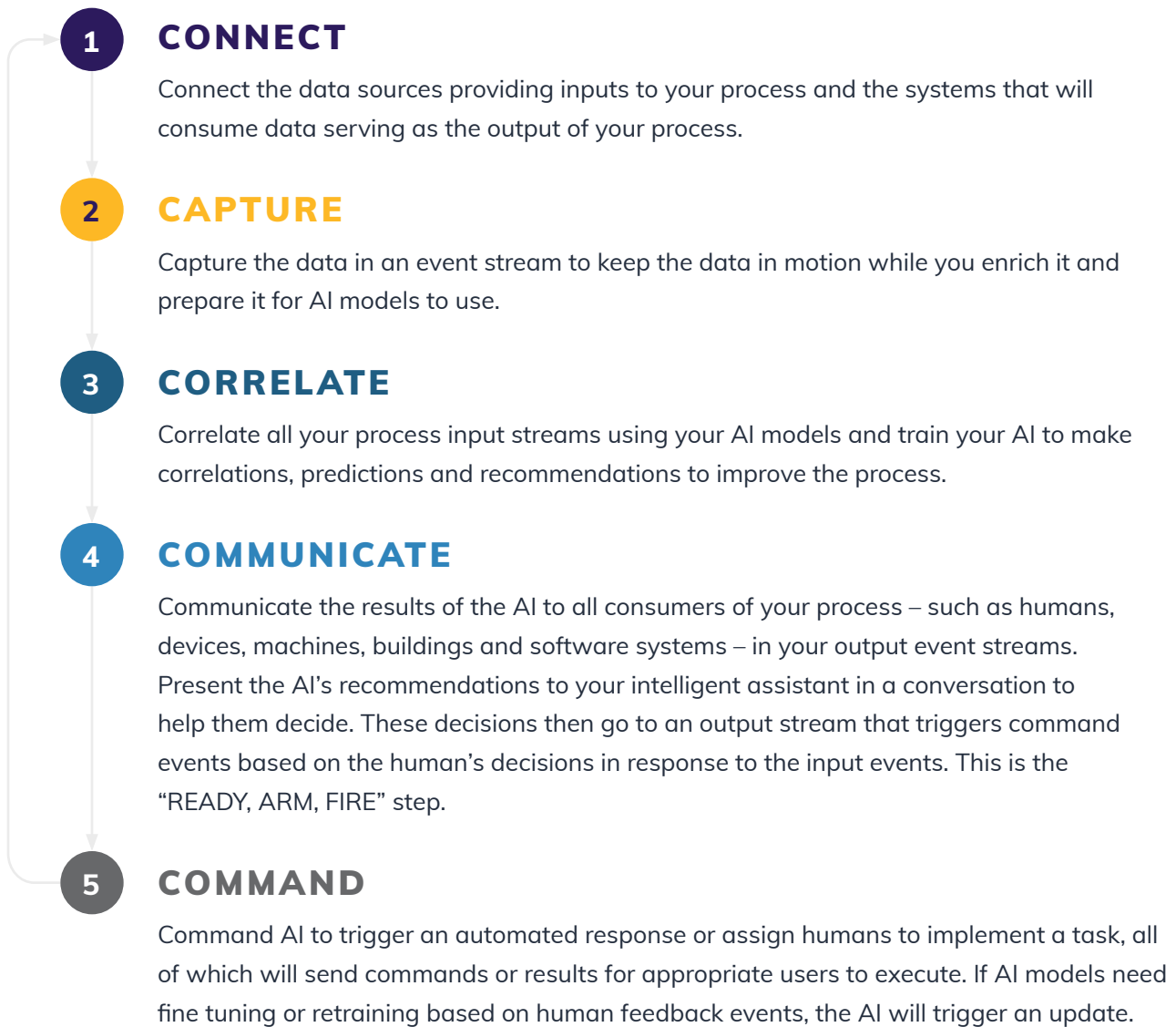


Figure 2: The Holy Grail Closed-Loop Process

The holy grail harkens back to Deming’s continuous improvement idea of a closed-loop process or ongoing cycles of improvement. I have combined these ideas into a methodology I call *The 5Cs Methodology* of Collaborative Intelligence.

The 5Cs Methodology

There are five steps to building AI into your business processes and maturing it over time.



Below is a flow chart that shows how this closed-loop methodology works.

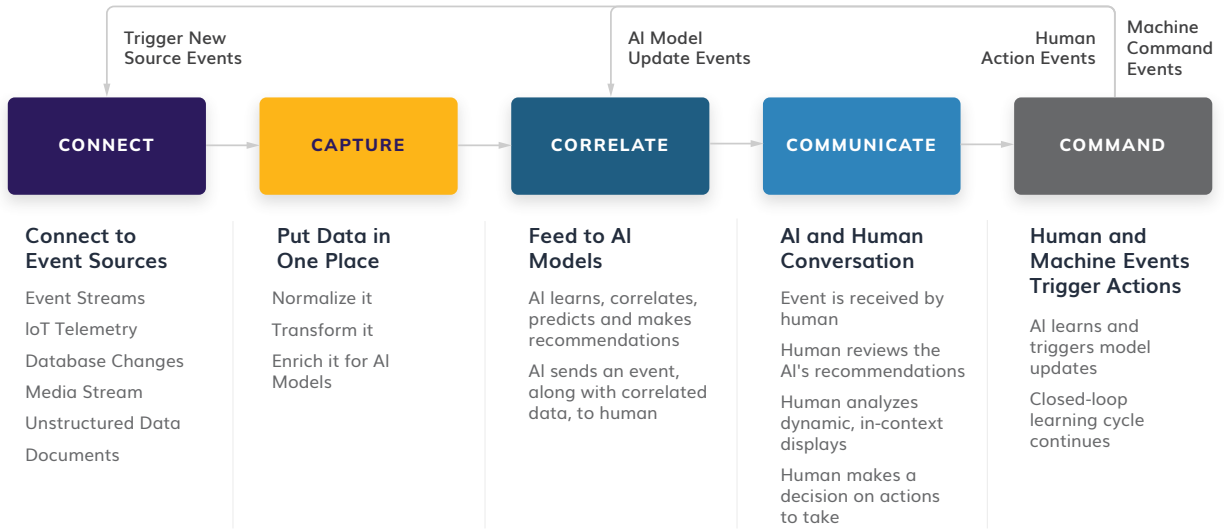


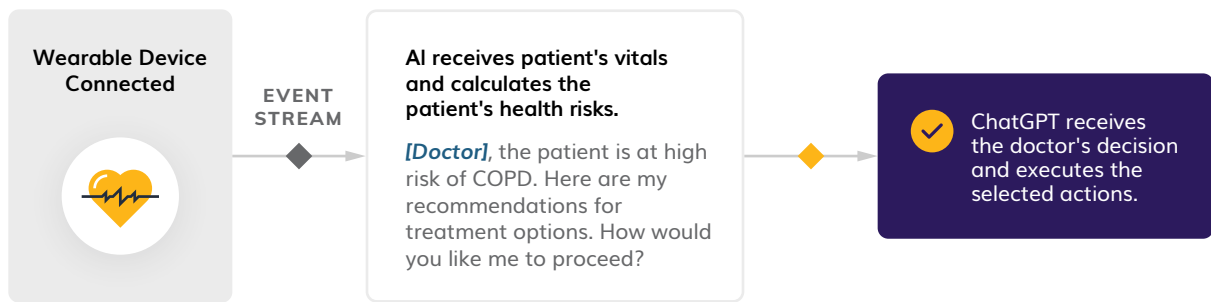
Figure 3: The 5Cs Methodology of Collaborative Intelligence

Now, let's show you what this looks like using real-world scenarios across industries and sectors.

Use Cases for The 5Cs

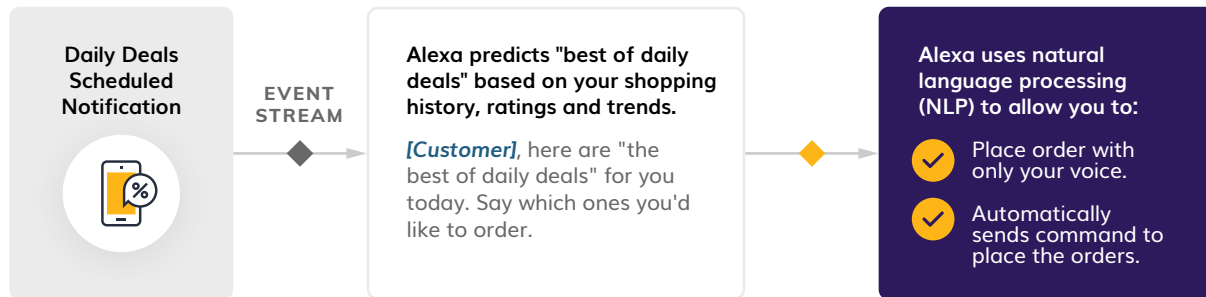
The 5Cs Applied in Remote Patient Monitoring

Healthcare



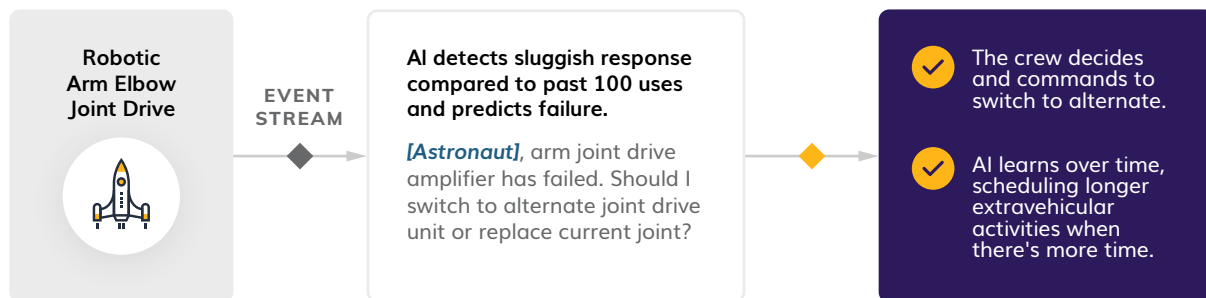
The 5Cs Applied in Shopping Using Alexa as AI Assistant

E-commerce



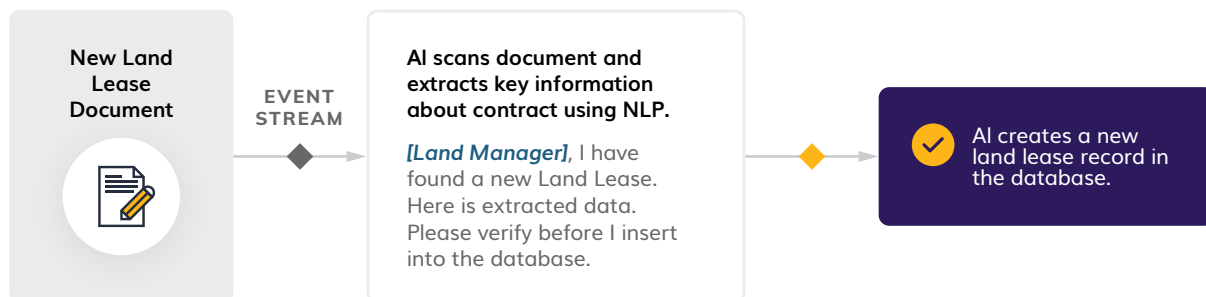
The 5Cs Applied in NASA Robotics

Space



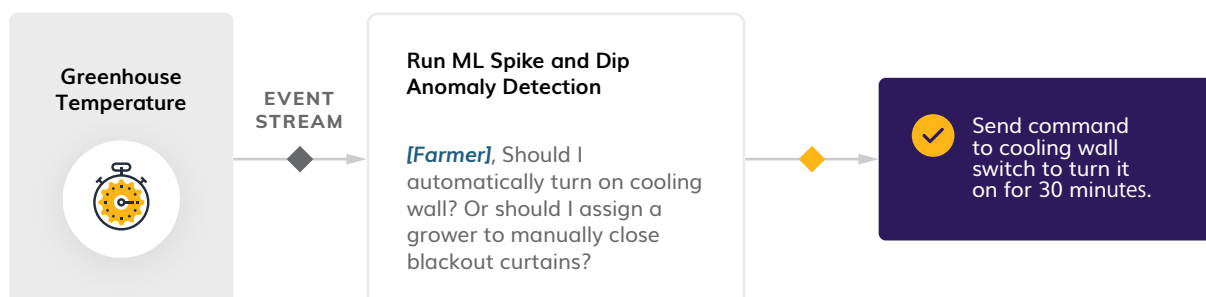
The 5Cs Applied to Land Lease Management

Oil & Gas



The 5Cs Applied to a Hemp Farm Greenhouse

Agriculture



The 5Cs Applied to a Production Line

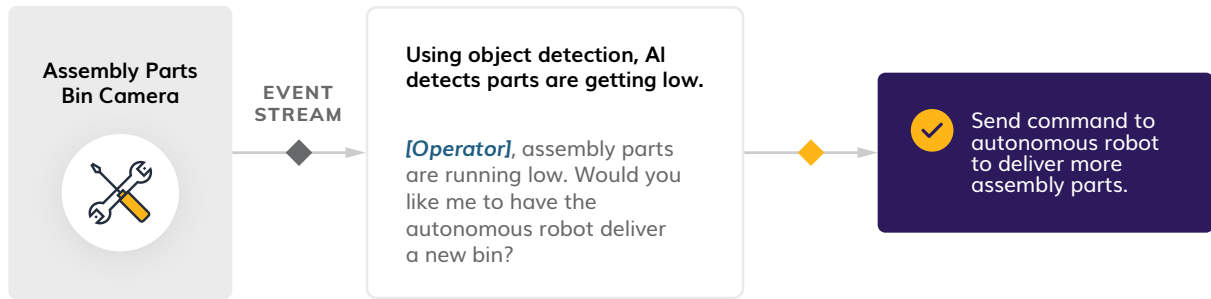


Figure 4: Use Cases of 5Cs Methodology

Note that these examples align the AI to specific processes. There are thousands of other examples like these in any organization.

Once you understand how the methodology works, you can begin to build a roadmap for how to apply the 5Cs to your business processes. I suggest starting small by making a list of the business processes you'd like to begin with, jotting down your ideas for improving each process, and defining a plan of action. The first cycle may not involve AI yet, but you can integrate it into future cycles.

Use the roadmap below to list your processes and the cycles you expect to complete in the short term.

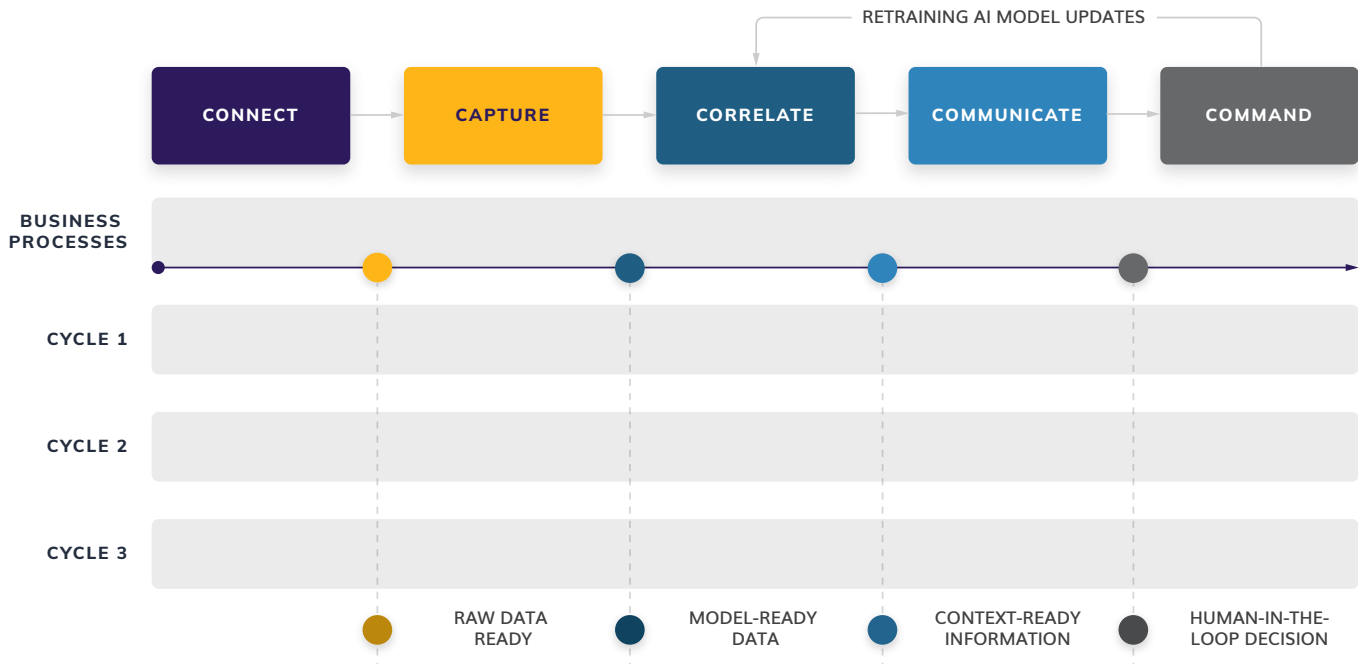


Figure 5: Roadmap for Collaborative Intelligence of Each Business Process

The Reference Architecture

The 5Cs Methodology informs the requirements for a technology architecture and reference technology stack, enabling the transformation to an intelligent digital-first paradigm.

On the next page, I've included a chart that provides detail on the reference architecture and technology stack. You'll notice the general flow is to move data and information near the physical world at the top, turn it into a digital version, make it intelligent and bring humans into the loop at the bottom.

The reference tech stack is technology agnostic, meaning you can choose from many products to achieve each of the layers. In Point 4 of my 4-Point Plan, I share my recommendations on the best technologies to use, keeping in mind that technologies change very quickly, so this recommended platform may change.





Figure 6: Reference Architecture and Reference Technology Stack



Point 4: The Platform

The Collaborative Intelligence Platform (CIP) implements the top modern technologies required to execute the CI methodology end-to-end. The platform architecture consists of the integration of four leading cloud-native technologies. The four technologies are shown below.



Figure 7: Collaborative Intelligence Platform

Next, I will explain the role each one of these technologies plays in the platform. This is where it gets much more technical. So, to make it a little easier, I will use a human nervous system analogy to explain the role of each layer in the platform.

Collaboration Platform

The sensory nervous system (SNS) is a part of the nervous system responsible for processing sensory information coming from the physical, ambient world around you and your interaction with it.

The Collaboration Platform acts like an SNS in that it seeks to understand the state of your body and its environment, helping when you need it and receding into the background when you don't. It's powered by ambient intelligence, an environment where devices and services interconnect using artificial intelligence.

It has four primary functions:

- **Sense** what is happening in the body in the interaction between humans and AI.
- **Capture** human knowledge and feedback using various forms of knowledge capture tools, such as in-app forms, surveys, click events, hand gestures or answers to the AI's questions.
- **Orchestrate** actions that result from the conversations and send messages to the event streaming platform for execution.
- **Engage** users in a conversation with the AI using ChatGPT, Alexa, AR headsets, phones or other conversational devices.

The Collaboration Platform is powered by OpenAI, ChatGPT, Alexa and other conversational devices.

ChatGPT AI Assistant

ChatGPT is responsible for engaging humans in conversation to continually learn from human feedback and refine AI models. It orchestrates events during the conversation and integrates with Alexa/Lex to implement predefined dialog flows as needed. ChatGPT can be "given a voice" using various voice user interface tools such as OpenAI's Whisper API, Microsoft Cognitive Speech Services or Amazon Alexa's Polly and Translate.

Amazon Alexa and Lex

In [the ambient-intelligence vision](#), an AI service such as Alexa and Lex make sense of the state of your environment, including devices, sensors, objects, people and activity around you to help when you need assistance, whether it's reactive (customer-initiated) or proactive (AI-initiated). Lex enables the platform to build text or voice chat experiences for web and mobile apps.

Web and Mobile Apps

Hybrid apps that run on the web and natively on mobile devices enable the Collaboration Platform to capture human inputs and present the state of the body and its environment in real time. These apps are critical to enabling real-time, human-in-the-loop decision making and automation. User interactions and human decisions drive actions upstream. This human feedback is also a series of events sent from front-end applications back to the Event Streaming Platform.

Artificial Intelligence Platform

The brain controls most of the activities of the body – processing, integrating and coordinating the information it receives from the senses and making decisions about instructions sent to the rest of the body.

Like the brain, the AI Platform correlates information and coordinates a collective response to events. It leverages the Collaboration Platform to engage humans and keep them in the loop. When humans are kept in the loop, their decisions and feedback drive updates to AI Models.

“We need an approach where people guide AI systems to learn the things that we already know,” [said Gurdeep Pall, Microsoft Corporate Vice President for Business AI](#).

The AI Platform is responsible for pre-training and refining AI models based on human feedback. It provides the ML operations platform to train and deploy AI models.

OpenAI's ChatGPT API can integrate data from many sources and correlate it to produce a response. Examples include streaming patient data from wearable devices, medical records and self-assessment surveys into a digital triage diagnosis. It can also take its results from an AI model to make predictions and recommendations. The AI Platform outputs the collective response as an event to the Event Streaming Platform, which gets consumed by ChatGPT's conversational user interface.

The AI Platform is powered by Microsoft's AI Platform, Cognitive Services and OpenAI's application programming interfaces. Microsoft AI and ML models are integrated with event streams to perform real-time streaming ML.

Event Streaming Platform

The central nervous system (CNS) integrates received information, coordinating and influencing the activity of all parts of the body.

Like the CNS, the Event Streaming Platform receives information from SNS and PNS, then carries out commands. It also correlates and coordinates data from many sources.

The Event Streaming Platform keeps data in motion and allows for ubiquitous access to data in any system as it is generated. It also provides the real-time, continuous processing needed to react and respond in the moment. This acts like biology's nervous system, which ties together all independent parts of the body into a coherent whole that can react and respond intelligently in real time.

This platform is powered by Confluent Cloud, a fully managed Apache Kafka platform-as-a-service provider.

Connectivity Platform

The peripheral nervous system (PNS) lies outside your brain and spinal cord. It plays a key role in sending information from different areas of your body back to your brain as well as carrying out commands from your brain to various parts of your body.

Like the PNS, the Connectivity Platform connects the things around you to the platform. It transmits telemetry from the physical world to the cloud and from the Collaboration Platform applications back to the physical world. The Connectivity Platform is powered by four technologies: Confluent Connectors, MQTT, Waterstream.io and Litmus Edge (for industrial equipment):

Confluent Connectors

Confluent Cloud offers hundreds of connectors to enterprise systems, applications and databases. Some produce data and others consume it. Connectors enable ChatGPT to send and receive data from systems to orchestrate workflow and automate processes.

MQTT

MQTT is the industry standard protocol for IoT device communication. It is designed as an extremely lightweight publish-and-subscribe messaging transport that is ideal for connecting remote devices with a small code footprint and minimal network bandwidth. It allows for messaging between device-to-cloud and cloud-to-device. It can travel over WebSocket connections, making it ideal for transmitting events from applications and chatbots to the Event Streaming Platform. MQTT protocol is not only ideal for messaging transport from machines and devices but also for messaging transport from the Collaboration Platform user interface applications back to the devices and other systems that need to subscribe to the various MQTT topics.

Waterstream.io MQTT Broker

Waterstream turns the Kafka-compatible, Confluent.io platform into a full-fledged MQTT broker. It enables the connection of millions of devices to the Event Streaming Platform with no code. It also connects web and mobile apps to the platform using MQTT-over-WebSockets, an important enabler for real-time front-end applications and dashboards. It also sends ChatGPT messages to the Event Streaming Platform to process actions and automation commands.

Litmus Edge

Litmus Edge comes into play when the system needs to connect to industrial equipment, programmable logic controllers and robotics. It can perform event stream analytics at the edge when not connected to the cloud.

CONCLUSION

To get started on the journey to Collaborative Intelligence, start small.

And don't forget to celebrate incremental wins along the road. It won't happen overnight, but as long as you keep repeating the process, you will achieve remarkable results.

Dr. Jordan B. Peterson, a world-renowned thought leader, says:
"Consistent, small achievements add up incrementally across time into remarkable progress. You have to be willing to give yourself credit for small achievements."



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ABOUT THE AUTHOR

Donnie Kerr, a Principal Architect for [Centric Consulting's National Technology Services](#), has over 30 years of systems engineering experience. He's worked across industries for companies such as NASA, Nike, CBS, Discover Financial, Fidelity, SAP, Fujitsu, BP, Linn Energy, and several innovative tech startups.

He brings expertise in a broad range of areas and technologies, including AI and Collaborative Intelligence, digital transformation, interactive and conversational experiences, event streaming and intelligent automation, Internet of Things (IoT), wearables, mixed reality and more.



Fun fact: Donnie is a former NASA "rocket scientist" who worked in mission control.

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Are you interested in getting started with AI?

We can work with you to build a Collaborative Intelligence Platform in your own AI Innovation Lab, which can serve as an extension of your business for prototyping emerging technologies.

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ABOUT US

Centric Consulting is an international management consulting firm with unmatched expertise in business and digital transformation, **AI strategy**, technology implementation and adoption. The firm has established a reputation for combining the benefits of experience, flexibility and cost efficiency with the goal of creating tailored solutions centered on what's best for your business. Founded in 1999 with a remote workforce, Centric has grown to 1,500 employees and 14 locations across the country and India.

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