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Chapter 10: Automating decision-making and operational workflows with artificial intelligence-powered cloud services

10.1. Introduction

Automating workflows to better support business operations and employees has grown in popularity recently. The goal is to allocate mundane and repetitive tasks to software, freeing up human employees for more demanding and productive roles. This trend has been accelerated by the recent explosion of cloud services infused with advanced artificial intelligence capabilities. Major cloud service providers have not only expanded the breadth of their product offerings – such as intelligent document processing, intelligent search, and voice capabilities – but also are building increasingly sophisticated AI capabilities into individual services, such as document and image processing, information retrieval, and personalization and recommendations. Moreover, these capabilities have been made available in ways that simplify their integration into existing as well as new enterprise applications, enabling organizations to quickly automate operational workflows in ways that can improve overall employee productivity (Breivold & Crnkovic, 2011; Dastjerdi et al., 2015; Ghosh & Mallick, 2022).

As a result, organizations can now automate time-consuming, repetitive manual tasks that contribute little to business objectives and may be viewed as uninteresting by employees. Empowering employees to devote more time and energy to high-value business tasks creates job enrichment that can lead to significant increases in job satisfaction and engagement. Decreasing the burden of mundane task performance on front-line employees can help mitigate fatigue that can lead to errors and neglect that in turn can adversely affect customers. Such de-risking of workflow tasks is particularly valuable in service industries that are experiencing increasingly high employee turnover rates. Automating such tasks also creates the potential for cost savings, which can be

significant if technology service levels rise and wages continue to increase. Indeed, if these rises continue, the business case for implementing automation technology will become even stronger.

With its continuing emphasis on Policy as a Service, and on decision-defining templates, the AI-enabled cloud now provides a layered architecture for automating enterprise decision-making, process automation and monitoring for high-volume low-complexity tasks. Automation of decision-making and operational processes lowers the overhead of back office functions and enables organizations to focus their resources on creating value (Sculley et al., 2015; Villamizar et al., 2016).

Fig 10.1: AI Workflow Automation

10.1.1. Background and Significance

One of the most substantial opportunities offered by technology is to streamline the modern-day enterprise to enable it to focus on creation of value. Users and stakeholders prefer service delivery models that go beyond 'plug and play' experiences; they want automation that provides least effort and minimal friction. In the enterprise context, there is massive paperwork that is involved in moving decisions along different approval layers, moving data between different systems, consolidating information on different systems for reporting purposes, and establishing a digital paper trail of an organization's high-volume low-complexity activities. While many organizations still rely on enterprise mobility application strategies to transform the user experience, backend automation of enterprise processes is imperative to maximizing return on enterprise mobility projects.

Automation, using business rules and market based operations research shapes, can simplify back-office work for the enterprise so that its front-office operates at maximum efficiency. Combine that with automation of decision-making and you have suddenly transformed the enterprise into an automated value-creation machine that can work in lockstep, not only with changing enterprise demands from customers and stakeholders, but also with changes occurring in its current or future operating environment.

The recent developments in artificial intelligence research, and in particular, AI-enabled services on the cloud, make this transformation possible – for the first time, organizations can now easily automate decision-making and backend operational processes to alleviate the burden on their resources, productivity, and reduce the size and complexity of their enterprise ecosystem.

10.2. Understanding AI in Cloud Services

Although most people are already familiar with the meanings of the terms AI and cloud computing, this section will clarify the definitional scope, key characteristics, and fundamental distinctions of the two domains. These prescriptive definitions will point to the necessary and sufficient technologies and features that must exist for AI to be incorporated in cloud services.

AI, defined broadly, is a set of software and algorithms emulating natural human intelligence and decision-making. More specifically, AI is a branch of computer science devoted to solving problems that, until recently, required human mental faculties, such as decision-making, planning, learning, and understanding natural human languages. AI attempts to solve these problems by employing similar decision-making methods that humans would use, such as cognitive simulation and inductive reasoning, or other software and algorithms, such as expert systems, Bayesian networks, neural networks, online analytical processing, and machine vision.

These emulating software and technologies must include the following four core functionalities in order for the cloud service to be considered AI: perception, cognition, action, and learning. Perception refers to receiving information input from the real-world environment surrounding the AI system. Cognition refers to analyzing the input environmental data and connecting it to prior knowledge stored in the AI system based on a cognitive model of the real-world environment. The next core functionality, action, refers to the AI-enacted responses back to the environment, usually influenced by the analysis-result data coming from the cognition step. The last capability of AI must allow it to learn new knowledge and automatically update its existing cognitive model when it encounters and interacts with changes occurring in the real-world environment surrounding the AI system.

10.2.1. Definition of AI and Cloud Computing

In the last decade, cloud computing has fundamentally transformed the ways organizations manage immense amounts of information. It is now possible to store and retrieve data on-demand and process that data much faster than ever before with incredible cost effectiveness. Cloud computing allows numerous global companies to share system resources and data on dedicated servers, while at the same time reducing costs associated with on-premises hardware and software.

Artificial intelligence (AI) is one of the most exciting application domains benefitting from the advances brought by cloud computing. AI comprises an array of technologies that allow machines to sense, comprehend, act, and learn in order to perform a wide variety of complex tasks. These capabilities have long been the province of intelligent agents and expert systems but have become practical in an increasing number of situations due to the explosive accumulation of vast amounts of data, the ability to learn mappings from inputs to outputs within these data sets using machine learning and deep learning approaches, and the continued march of Moore's law, which has caused hardware for running inference from machine learned models to become extremely low-cost and pervasive. AI-capable solutions or services include a range of activities, from designing intelligent bots that simulate human experts on a specialty to creating data-driven decisions that guide electric grids and financial markets around the world.

10.2.2. Key Technologies Enabling AI in the Cloud

The prevailing thesis of this essay is that we are on the verge of a transformation in the use and utility of AI, brought about by major advancements in the use of AI techniques and increased access to more varied and larger data sets of the sort that helps train machines to think, act, and respond cognitively; and the development of infrastructure that lowers the hurdle for companies and individuals to access sophisticated AI tools and services, and for the developers of new AI models to expose their capabilities for use by others. AI draws on advancements in four sets of technologies that allow better performance in complex, cognition-like tasks: algorithms, training datasets, training systems, and model availability and deployability. The Cloud is being used to advance AI in three major areas: to exploit public Cloud infrastructure for AI training at scale from any locale, to deploy already-trained AI models as services that could be easily used by companies and individuals, and to develop, tune, and adapt AI models via tools that expand the number of people capable of applying these technologies.

Deep learning algorithms are a significant part of the current AI “golden age”. These technologies accomplish superior performance in a variety of sets of cognition-like tasks, such as visual perception. Machine translation—they began as better algorithms for

converting one human language to other human languages—could not have happened without the insight that one could train a neural network to learn language mappings by ramping up a very large training set of pairs of sentences that say the same thing in different languages.

10.3. The Role of Automation in Decision-Making

Decision-making is a prerequisite for the execution of any work task. Many routines require a simple and repetitive decision-making process. An experienced worker can make these decisions quickly, but they often take a long time and may still not be accurate. Other routines are much more complex. They require a detailed analysis of large and complex data. Sometimes, pulling together all the needed insights takes a long time, and the decision is still not accurate, or the execution time is longer than deemed acceptable, while the costs of wrong decisions are extremely high. In such cases, efficiency and accuracy are both critical. Although AI-driven cloud services cannot yet fully automate the decision-making process, many steps of the process can and should be automated with the help of artificial intelligence services.

Fig 10.2: Automation in Decision-Making

Automation plays an important role in decision-making by directly automating manual tasks that were previously performed by skilled workers. It also allows for highly accurate and precise recommendations, which, because they automatically follow a proposed path, also outsource a lot of responsibility, even potential consequences of the wrong decision, to the automation solution. In addition, automated decision recommendation systems can significantly enhance or speed up human decision-making.

Such advisory solutions can digest and analyze huge data volumes and then provide insights in seconds or minutes, while finding all the known and unknown correlations. Other results, not directly related to a decision but still important for making a decision, can be insights into the confidence of the detection, knowledge of patterns, or what-if simulation capabilities.

10.3.1. Importance of Automation

Finding the right solution is often tedious. AI can automatically find acceptable decisions but with limited reasoning ability that are still hard to model with classical AI techniques. Thus deployment of most successful philosophical methods to completely automate the reasoning and your decisions can make only Virtual Personal Assistants based on automatically created multimodal AI Workflow or Hybrid Reasoning Workflow architectures. They allow automation of most operations performed by PAs based on making PAs Intelligent and support personalized augmented actions generating processes, which are by definition tertiary actions. Using the same methods, you can build Cloud Services that allow automation of most operations performed by human employees in any type of organization.

Education, long considered to be an operation so complex and subtle that it could not possibly be automated, is rapidly becoming an exception. The Automating Learning Tool Technologies are capable of automating much of the work of teachers, and this infrastructure technology will soon be coupled with general purpose intelligent assistants that help students learn, assist teachers in the instructional process, and serve management and administrative roles in education. Some types of work are sufficiently repetitive or poorly specified that human beings should not perform them. The current boom in educational technology could be exploited to automate the work of some K-12 teachers. Such automation will free teachers to do what only human beings can do: Design instruction at the conceptual, cognitive, and emotional levels; share their enthusiasm for discovery and inspire students to pursue their own investigations. It is Time to Put the Computer to Work.

10.3.2. Benefits of Automated Decision-Making

Limited human capacity for decision making leads to delays in operations and drives up operating costs. In many scenarios, especially in repetitive tasks, human specific calculations take much longer than electronic specific calculations. AI technology addresses the problems of decision oversights and operational delays by relying on advanced data processing and analysis, which enables intelligent systems to make the best data-based decisions at the right time and automate operations. The decisions made

by intelligent systems can be entirely independent or gradually increase in degree of influence from automation to complete automation depending on human control or lack thereof over decisions. Automated decisions made by intelligent systems increase operational efficiency, effectiveness and consistency. They exhibit strength in the face of high velocity, high volume and high dimensionality of data. For high law-abiding frequency of decisions that require processing by a subject matter expert lends itself to inevitable delays and operating inefficiencies, achievement of the scale of operations made possible by intelligent agents making automated decisions can hardly be reconciled with high quality standards. For low law-abiding frequency of decisions that require consultation or approval from a subject matter expert, the involvement of that subject matter expert is not consequential from a time value perspective, the decisions are stuck in limbo as the operational process flow passes through gateways for obtaining such consultation or approval.

10.4. Operational Workflows and AI Integration

People are quite used to automating their decision making using various digital tools. Even before AI-based services, many news and e-commerce sites were enabling decision making around what we should read and buy. These services were mostly person-based, bias-prone and often imperfect. With generative AI capabilities, users can now expand their decision making with new capabilities that are faster, less biased, and perfectible.

Most work today is done through operational workflows, either put together with multiple enterprise apps or powered directly by some custom business apps relevant to the work being done. Common workflows we encounter include hiring employees, onboarding new customers, sending and receiving invoices, assessing and handling customer requests, predicting and handling sales issues or forecasting and responding to supply issues, among others. All of these workflows involve structured and unstructured data coming from multiple internal and external sources. These data points provide the basis for a series of decisions made at various points in the workflow. These decisions are made by a combination of humans and software bots. However, the bots are now quite limited especially in handling unstructured data and supporting the humans who have to intervene at key points in the workflow.

The latest advances in generative AI along with the generative techniques used can address most of the limitations of workflow systems today. Generative AI can handle unstructured data much better than the bots used today and augment the humans making decisions at usually error-prone points in the workflows. Additionally, using these AI tools, workflows can be defined for the many processes not automated today through software bots. Finally, these AI tools can be used to develop generative capabilities in traditional enterprise software for automating tasks in the workflow.

10.4.1. Mapping Operational Workflows

In the context of organizational AI integration, operational workflows can be defined as strings of interrelated tasks and activities with assigned agents that realize specific organizational objectives. These workflows can cross organizational silos, spanning areas such as product development, manufacturing operations, marketing and sales, delivery, customer support, and organizational performance management. The need to understand operational workflows comes from the need to identify management-focused for efficiency, effectiveness, and economy throughput and in turn identify those workflows to which AI capabilities might be applied to increase effectiveness and/or economy. Mapping organizational workflows usually starts by collecting and interrogating workflow-related information that is then modeled to visually describe the representations and relationships between the work elements that constitute the workflows. Workflow mapping provides a blueprint that breaks down a specific piece of work into smaller steps to help streamline and standardize processes that you can easily share with your whole team.

A detailed workflow diagram gives you a clear overview of every single part of your process, allowing your team to identify any bottlenecks or redundancies that cause delays or inconveniences. To find ways to make your internal processes run more smoothly, you first need to map them out and find a process you would like to improve. In the early stages of discovery, a high-level swimlane diagram is often created to document who does what as people work through a process from start to finish. It also briefly describes what they do and when each task starts and finishes. Swimlane diagrams are useful because they help simplify the understanding of complex workflows with many actors and better depict the interaction between lanes. If this simple process design is the deliverable, we can call this process a high-level design.

10.4.2. AI Tools for Workflow Automation

Workflows build pipelines of interoperable capabilities that bring step-by-step automation for users through sequential opportunities. Simple, repetitive tasks, such as reshaping a spreadsheet, resizing images, etc., have been the focus of workflow automation tools for some time. In contrast, more complex workflows, that require human interpretation of the single steps, inter-related validation across steps, cognitive and emotional aspects, and communication between internal teams and external customers, are usually driven by people with tools that have been designed to support operations. For instance, coordination of actions related to customer requests in an eCommerce, client onboarding in a bank, inter-department clearance for a building permit or emergency medical assistance unit dispatching for a city that runs 24/7, all of these have daily activities in which decisions are made and actions are taken

collaboratively at every step and at every hour of the operational day. Workflow automation tools for these kinds of operations have been used in recent years, such as BPM and RPA.

AI tools are now being integrated within existing workflow automation capabilities, broadening their scope and enhancing their functionalities. They are basing this augmentation on the ability of AI tools to provide CPA functionalities capable of interceding in various operational processes where human agents are not enough, or have prohibitive costs at the required scale due to the increasing ability of AI to overcome the difficulties stated above. A specific recognition of intent and action capability that some newly developed generative AI tools bring to the portfolio of automation alternatives makes many more processes suitable, expanding the business cases for considerable ROI behind the internal IT and organizational efforts. Conversational AI augmentations are allowing for expansive visions of intelligent process automation toolkits.

10.5. Case Studies of AI-Powered Automation

Despite some justified resistance against the inevitable technological changes to the disruptively changing work environment, it is without a doubt that the application of Artificial Intelligence (AI) technologies to automate both administrative decision-making and operational processes is producing immeasurable societal benefits. In this chapter, we review a variety of different concrete examples of AI-powered automation to illustrate how the technological changes brought about by Artificial Intelligence (AI) can help improve various work functions across different industry sectors.

The healthcare sector has long been constrained by shortages of healthcare professionals who can administer appropriate services to its patients. Such shortages have often led to prohibitively long waiting times for patients attempting to receive advice and assistance on simple healthcare services, such as scheduling appointments for non-emergency evaluation by medical experts, acting on administrative procedures requiring paperwork proofs, and clearing doubts about minor health issues with medical professionals. The global demand for healthcare assistance, from primary care to mental health services, has increased, but forced medical professionals to scale down daily evaluations of patients in need. As a result, people have turned to alternative healthcare solutions, such as virtual care services.

AI-powered virtual care services deploy Virtual Health Assistants along with their supportive algorithms to manage the administration of primary care services, to carry on general medical assessments, and to provide answers to patients for their common healthcare requests using FAQ-like origination tools that can minimally understand basic medical domain concepts. Once these intelligent virtual assistants expose potential

health issues that require further evaluation, they can then help schedule visits or connect patients with appropriate medical professionals or intermediaries. In this way, Artificial Intelligence (AI) technologies can help the healthcare sector address its service shortages both more effectively and efficiently with resulting positive economic impacts.

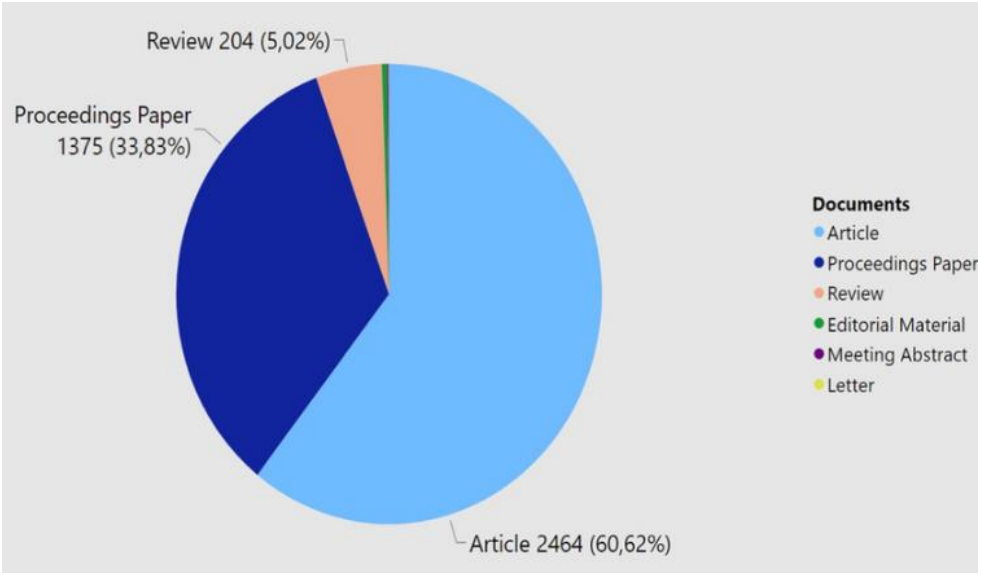

Fig : Automating Decision-Making and Operational Workflows

10.5.1. Healthcare Sector Examples

Balancing the rapid advances in AI for decision support in healthcare with development and diffusion of evidence-based policies, risk management and governance associated with increasingly autonomous complex integrated systems is a major challenge for addressing the inequality and inefficiency associated with the current fragmented system. Three trends are likely to dominate the diagnosis and therapy for improved mid-to-late life health. Systems medicine may be applied for predicting and preventing disease from the study of "normal" multi-omic variation with environmental risk factors. Digital twins may be used for optimizing the timing and choice of therapy for precision approaches. Integrated remote analytics via chatbots, wearables and home diagnostics will also enable real-time management of chronic disease, coordinated by smart automation tools embedded in health care systems.

Healthcare is one of the world's largest industries, costing trillions of dollars a year. Automating rank-and-file jobs is helping to reduce these costs. The resulting lower prices help make healthcare affordable for millions more people. PAs and NPs first expanded into primary care in the 1970s, carrying out a variety of diagnosis, evaluation,

and treatment services, including counseling on health habits, conduct or interpretation of diagnostic tests, and information and education on the effective use of medications. About half of practice was in family medicine, about a quarter in internal medicine, about a fifth in pediatrics, most of the rest in urgent care.

10.5.2. Finance Sector Applications

The traditional finance sector is another mature area that provides many cloud-based AI automation services. The extensive use of accumulated historical data can support predictive or prescriptive AI capabilities in a wide range of areas, such as transaction monitoring, fraud detection, chatbots and virtual assistants, document review and compliance, credit risk assessment, forecasting, constituency and sentiment analysis, and margin call monitoring. Most of the examples were derived from well-known banks or consulting companies, or provided by AI service suppliers. The potential limitations also need to be kept in mind: in particular, the quality of the training input data, the accuracy of language model prompt engineering, difficulties in providing the necessary domain fine-tuning, and potential legal liability issues with AI Chatbot-generated text.

A variety of finance sector applications in the areas of anti-money laundering, credit scoring, loan servicing, financial reporting, customer service, IT operations, document verification, insurance, human resources, sales operations, oil and gas operations, and transaction monitoring. Data such as transaction descriptions, amounts, locations, customer information, historic transaction patterns, and sentiment analysis of news/media posts are some of the input data requirements for these case studies. Weather data could be integrated into loan servicing to account for the delayed payments resulting from adverse weather conditions. The majority of the applications rely primarily on classification, prediction, and compliance-monitoring activities rather than active outputs of an enforcement action, such as freezing bank accounts and reporting/flagging unusual transactions. Moreover, continual governance or management for ongoing model validation is a key implementation component to improve the overall effectiveness of the operations and is now mandated by bank regulators, which requires the involvement of both data scientists and domain experts.

10.6. Conclusion

The last years have shown incredible advancements in the automation of mundane and tedious operational work that is necessary to keep any business productive, efficient, and responsive to customers. Copying and processing data, sending simple responses to repetitive customer emails and chats, performing constant monitoring of systems and services, filling out forms, or sending automatic notifications are some of these

situations. And what we are seeing is just the beginning. We are at the beginning of a long-term progress in the automation of any decision-making and operational workflow activity in any business. Still today, most of the implementations only cover the simple cases for repetitive activities and pre-defined operational decision-making workflows. These activities are often not done by humans but are efforts done by robots or robots simulating humans.

More complex activities are already being attempted, with variable or sophisticated decisions. For these cases, humans are typically still in charge of deciding and directing what options need to be followed. For the implementation of these capabilities, there are some recent starts that are showing how it might be done mainly through workflows made of flows of agents. But these are still isolated experiments, and there are many challenges in operationalizing them within the work environments of disjointed tools and services that need to be combined for them to scale. As the intelligent decision-making and operational workflow disciplines progress in automation, there will be multiple aspects that will need to be reconsidered. Some of them are ethics-driven, like workforce disruption, and others are risk-driven, like increasing operational exposure. With this chapter, we hope to have made a valuable contribution to understanding automation and Robotization, with a practical IT roadmap.

10.6.1. Future Trends

The importance of incorporating decision models into cloud services and AI methods will only increase in the coming years. This is demonstrated by the rapid increase in research and investment aimed at advanced natural language interfaces that can support knowledge capture, maintenance, and use of a business's operational decision models. For decision management use cases, AI services focus on decision framing and NLP-based knowledge capture of decision models. For operational workflows, we are seeing an increased investment in hyper automation technologies, including new advances in decision modeling, Robotic Process Automation, Data Integration, and Process Mining technologies. Done effectively, these investments in technologies dedicated to IDES can help with three pressing challenges: unlocking the value of existing business process automation, scaling the number of hyper automation use cases for partners outside of IT, and meeting the demand for Operational AI-enabled intelligent automation. We will consider each of these challenges in turn.

The value of intelligent process automation without the requirement for expensive custom development has largely been seen in the context of RPA technologies. However, the high reuse rate of the currently deployed RPA automations indicates that unlocking the remaining value is difficult. Automated identification of opportunities for new or improved process automation is a key focus area of many RPA vendors. Adding

Operational AI decisions to the back-end integration points for these RPA solutions will significantly improve their value and can even provide appropriate audit processes. Combining process mining with decision modeling for IDES decision scopes can provide the automation business case acceleration services necessary. Routine business decisions are a significant contributor to backlog and delays in the digital transformation process.

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