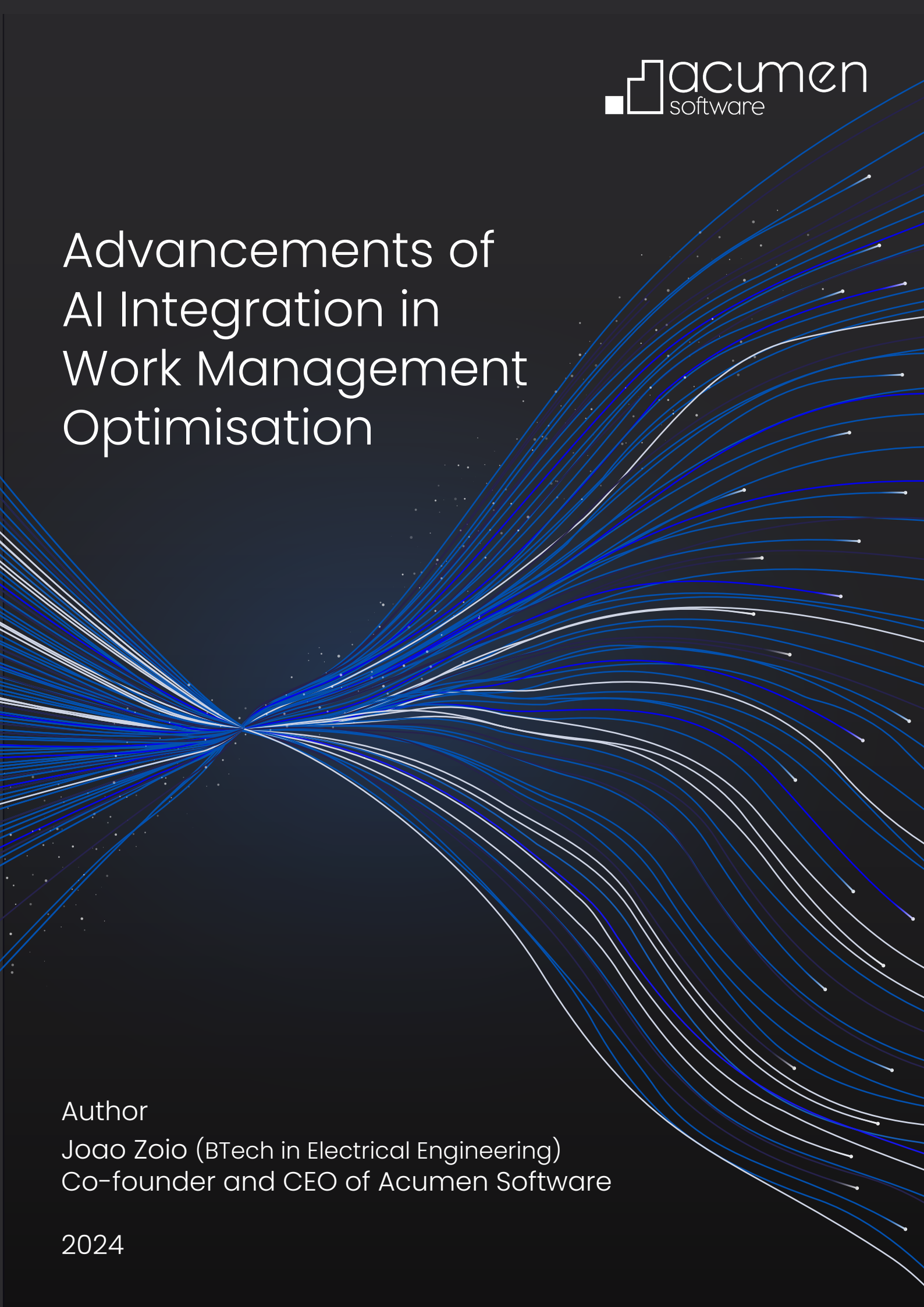
acumen software

Advancements of AI Integration in Work Management Optimisation



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Abstract

This white paper provides a Comprehensive analysis of the Evolutionary trajectory of Work Management, with a specific focus on the pivotal role of Artificial Intelligence (AI). It offers an in-depth examination of AI's current deployment in Field Service Management (FSM) and Enterprise Resource Planning (ERP) software, and how its synergy with Internet of Things (IoT), Big Data, Augmented Reality (AR), and Computer Vision is transforming the paradigms of Work Management.

This transformation is characterised by significant enhancements in the efficiency and effectiveness of Work Management tools. Additionally, the paper casts a visionary eye towards the horizon, predicting how these technological convergences could further revolutionise service delivery and operational efficacy through to the year 2045, heralding a new era of digital proficiency.

Introduction

As we move into an era characterised by rapid technological advancements in Artificial Intelligence (AI) and advanced robotics, businesses around the globe are competing to achieve operational excellence through the incorporation of advanced technologies into their business processes.

In Work Management the 'buzz words' leveraged by every organisation are, "optimisation" and "efficiency" (Goldstuck, 2024: 81). In their strive to achieve the highest level of optimised and efficient Work Management, organisations are implementing a variety of AI (McKinsey & Company, 2022), software robotics, IoT, Big Data, Augmented Reality, and Computer vision into their existing tools, such as Enterprise Resource Planning (ERP) systems and Field Service Management (FSM) software.

This paper delves into the historical context and theoretical foundations that have paved the way for modern Work Management solutions and discusses the origins of AI and its transformative journey.

Further, this paper will discuss the current uses of AI to optimise various Work Management modules in existing systems as well as the uses of Robotic Process Automation (RPA), IoT, Big Data, Computer vision and Augmented Reality when enhanced by AI (Goldstuck, 2024: 135-137) and the possibilities that become available to organisations, specifically in service delivery.

Envisioning the ideal Work Management system, this discussion extends beyond the present, venturing into possibilities that the next two decades may hold for AI in Work Management.

We want to begin with an ideal scenario that we foresee for Work Management, and hopefully by the end of the paper our vision will not only seem like an ideal but the goal standard of Work Management systems.

Scenario:

Your Work Management system is on your smartphone, it has been enabled to run continuously in the background, gaining real-time updates on your organisations operations, as well as weather and traffic reports. You set yourself on duty in the morning and climb into your car. Through Apple Car Play or Android Auto you

now have access to your Work Management system as you begin to move. “What is my schedule for today?” prompted through voice activation, your voice assistant can tell you how many jobs you have, the times of each job, how long it will take you to get from one to the next, the estimated time it will take to complete each and any other details you may need. “Show me my route” once again through voice activation your Work Management system can show you the best route for you to complete all of your jobs for the day, based on proximity, time needed, traffic and weather conditions, suggesting alternate routes if those conditions change. “What materials do I need”, your voice assistant will be able to list all the materials required for each of your jobs as well as materials that you are missing and which stores you will need to go to, to get those materials, with your say so, the system will adjust your route so that it includes stops at those stores.

Should you be stuck in unavoidable traffic, potentially causing you to be late to a jobsite the system will automatically notify the customer of the delay, the reason, and the ETA. Then it will further adjust your schedule accordingly.

“Is there anything I need to know about this customer?” the voice assistant drawing upon the organisation’s data on a specific customer will be able to let you know whether a customer has been struggling with the same issue for some time and is frustrated, giving a heads up for potentially confrontational interaction. The system will be able to let you know if the customer has specified anything about the jobsite, potentially they have large dogs and would prefer a technician to phone as they arrive, potentially they are located in an estate that requires an entry code.

Once on site the system can provide you with a detailed description of the issue. Using your smartphone to scan a barcode on an asset, will provide you with that asset’s entire maintenance and movement history. Should the issue be more complicated to resolve, you can scan the asset using your smartphone’s camera which can connect to the internet, as well as your organisation’s historical data, to diagnose the issue. Furthermore, through the use of Augmented Reality, you can interact with the asset digitally to practically see how to resolve the issue. Should you need further assistance, you can ask the system to put you in contact with another technician who may have more experience with that particular asset type, allowing you to video call them and discuss the issue further.

Once the job is complete, and a post-work inspection list is required, if you get back into your car and there is one or more inspection items you have not completed, the system will alert you that you are about to leave the jobsite without completing the inspection list.



All the data captured from the moment you left home to the moment you complete your jobs for the day, is sent automatically to the back office, where customer records, asset records and resource records are all updated automatically. This ensures that future scheduling can continue automatically and should there be an emergency, the correct resources can be dispatched. The organisation will be able to communicate and keep the customers fully informed on the details of every job done for those customers. The system can pull up customer history as well as

email interactions with those customers should the customer require support, as well as generate automated responses to customers, based on stored data. This reduces the time to respond to customers and keeps customers satisfied.

But how did the job get generated in the first place? Through web- and/or mobile-based customer portals, the customer can log issues directly on the system, which can be scheduled or dispatched automatically. Or, by gaining insight from IoT devices, the system can predict potential issues with assets, such as roads and the forming of potholes. These issues can be automatically scheduled for planned maintenance.

A seamless process from the beginning of the work process to the end, with an intelligent system running operations.

How did the back-office automatically select the technician? By filtering resources based on availability, skills and proximity, the best resource can be selected for the job every time, but with AI integrated into a Work Management system, learning the ways in which various resources perform, the AI can make further informed decisions. For example, the AI can notice that the first resource on the list shows a recurrence of being late to arrive onsite in the mornings, whereas in the afternoon they are usually on time. The second resource on the list may be located further from the jobsite with the same skillset, but they are faster to attend to morning jobs. This is a consideration that the AI would use to schedule the second resource rather than the first.

It is this level of detailed automatic human-like thought that saves time and greatly improves issue resolution and customer satisfaction. Considerations that are currently being performed by humans and take three of four times the effort can be performed in milliseconds by Artificial Intelligence. This is what will differentiate various Work Management systems in the coming years.

01

Work Management

Work Management in the context of organisations with geographically dispersed resources, assets, and customers (Field Services) - such as power utilities, water utilities, transport, road works, and delivery services, as well as individual service providers like plumbers and electricians - entails a set of practices and technologies designed to optimise the coordination, execution, and monitoring of tasks across various locations. For these entities, Work Management is critical due to the logistical complexities, the need for timely service delivery, and the importance of maintaining prominent levels of customer satisfaction.

Work Management involves the strategic coordination and deployment of an organisation's resources, including its workforce and equipment, to deliver services and manage operations across widespread locations. Originally associated with 'hard' services that required extensive asset maintenance and repair, typical in sectors like telecommunications and utilities. Nowadays, the scope has broadened to include 'soft' services such as logistics, delivery, janitorial, and security services, among others (rfmGroup, 2023).

Work Management includes the detection of geographically dispersed field service needs through remote monitoring, inspection, or a customer detecting a fault. Geographically dispersed field technicians are then scheduled and dispatched into the field with necessary parts and information to resolve issues regarding geographically dispersed assets.

Effective work management is crucial for organisations with dispersed operations to ensure that resources are used efficiently, services are delivered promptly and to a high standard, and customer satisfaction is maintained (SAP, 2024). By adopting advanced work management practices and technologies, these organisations can overcome the challenges of coordinating a mobile workforce, managing remote assets, and serving a widespread customer base. This results in improved operational efficiency, reduced costs, enhanced safety, and higher quality service delivery, ultimately contributing to the organisation's overall success and sustainability.

A key area of Work Management is work planning, which involves the strategic alignment of resources and tasks to ensure optimal operational flow. This process includes efficiently dispatching personnel, equipment, and materials to multiple locations, with careful consideration of factors like urgency, proximity, and expertise, ensuring that the most appropriate resources are used for each task. Work prioritisation is another critical element, where tasks are identified and prioritised based on criticality, customer impact, and service level agreements (SLAs), ensuring that resources are allocated to the most important tasks first. Additionally, route optimisation plays a crucial role, especially for delivery services and mobile technicians, by using algorithms Work Management systems determine the most efficient travel routes, thereby minimising travel time and fuel consumption. Organising tasks within Work Management encompasses dynamic scheduling, which adjusts schedules in real-time to accommodate changes in priorities, unexpected delays, or emergencies.

Skill matching ensures that tasks are assigned to field workers based on their skills, qualifications, and availability, promoting work completion efficiency and high standards.

Furthermore, compliance and safety management are paramount, particularly in utilities and construction work, to ensure that all field operations comply with relevant laws, regulations, and safety standards.

Executing tasks effectively in the field is facilitated through mobile access to information, providing field workers with access to work orders, customer information, technical manuals, and other necessary documentation via smartphones or tablets. Real-time communication between field workers and the back office is essential for updates, support, and collaboration, while customer interaction involves managing appointments, notifications, and providing real-time updates to customers about the status of their service requests as well as back-office support provided to maintain customer relationships.

GPS and mobile technology are used to monitor and track field workers' locations, progress, and time spent on tasks. Quality assurance mechanisms and customer feedback collection are implemented to ensure service standards are met. Analytical reporting generates data-driven insights on performance metrics, operational efficiency, and customer satisfaction, informing strategic decisions.

Organisations in various sectors rely on specialised Work Management software and technologies to support these activities. Geographic Information Systems (GIS) are used for mapping assets, planning routes, and managing field data. Customer Relationship Management (CRM) systems manage customer interactions, service history, and feedback. Enterprise Resource Planning (ERP) systems integrate various aspects of business operations, including inventory management, billing, and human resources. Mobile Workforce Management (MWM) solutions schedule and dispatch workers, manage tasks, and record work progress in real-time, highlighting the comprehensive toolkit available for modern Work Management.

The challenges of work management take on specific characteristics that reflect the unique nature of field work. These challenges are shaped by the need for real-time coordination, the remote nature of the work, and the critical importance of timely and efficient service delivery.

In the dynamic realm of Work Management, scheduling and dispatching are pivotal elements that necessitate a high degree of flexibility and sophisticated tools (Planon, 2024). Dynamic scheduling allows for the adjustment of schedules on-the-fly in response to emergencies, cancellations, or delays, ensuring that operations remain fluid and responsive to real-time challenges. Efficient dispatch plays a critical role in matching the right technician with the right job, factoring in skills, location, availability, and priority, which underscores the necessity for advanced dispatch tools to navigate the complexities of assignment allocation.

Communication and collaboration form the backbone of effective Work Management, with real-time communication ensuring clear and effective interaction between field workers, the back office, and customers (SAP, 2024). This is particularly crucial in emergency or complex service situations. Moreover, providing field workers with access to collaboration tools that are conducive to a mobile or remote environment enables them to share information, updates, and feedback efficiently, thereby enhancing teamwork and operational coherence.

Training and skill development are essential for keeping field workers proficient with the latest technologies, procedures, and safety protocols. The challenge here lies in delivering ongoing training despite their remote locations and demanding schedules, coupled with ensuring that they can swiftly adapt to new tools or technologies introduced to augment service delivery or operational efficiency.

Safety and compliance are paramount, with worker safety being a primary concern, especially for those who often work in hazardous conditions or isolated locations. This necessitates robust safety protocols and training. Additionally, regulatory compliance is critical, as adherence to industry-specific regulations and standards is essential, though often complicated by the variance across various locations.

Equipment and inventory management ensure that field workers have access to the necessary tools and parts when they need them, which demands precise inventory management and logistics. Equipment maintenance is also vital to avoid downtime that can negatively impact service delivery (Planon, 2024).

Data management and utilisation encompass the accurate collection of data from the field, critical for billing, customer service, and operational analysis. Using this data for insights allows for an understanding of performance, customer satisfaction, and areas needing improvement, thereby driving strategic decisions (Planon, 2024).

Customer satisfaction and experience are directly linked to the efficiency of field operations (Tyrell, 2023). Meeting customer expectations by delivering services efficiently and on time is fundamental, as is providing real-time updates and

transparency regarding service delivery status, arrival times, and any potential delays or changes.

Technological integration, including the effective use of mobile technology in field operations, enhances efficiency, communication, and data collection (Planon, 2024). System compatibility is a significant challenge, necessitating that modern technologies be compatible with existing systems to avoid disruptions and ensure seamless operational integration.

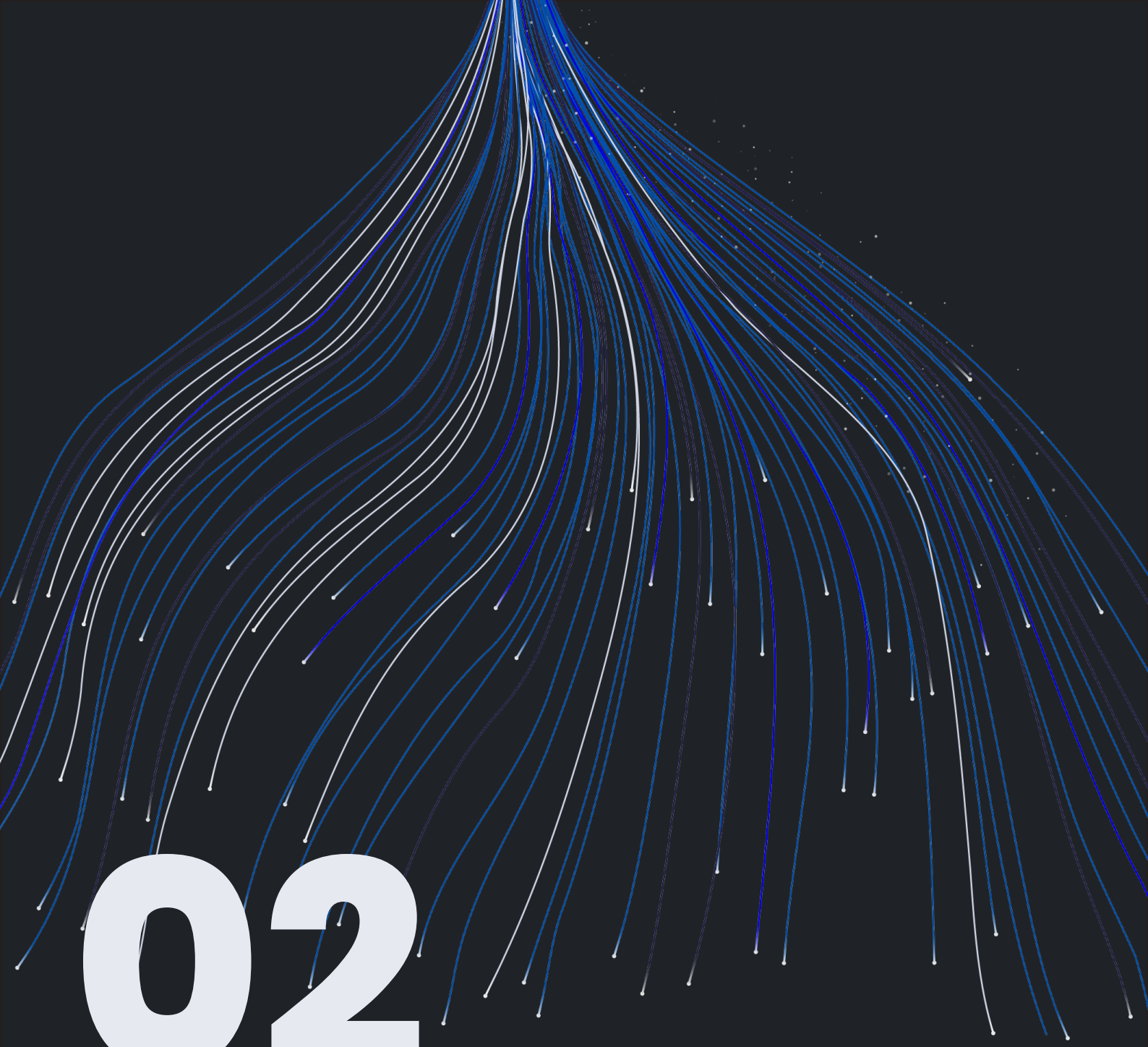
Together, these components form a complex ecosystem that underpins the effectiveness and efficiency of Work Management in meeting today's operational demands and tomorrow's challenges.

An Enterprise Resource Planning (ERP) system can be a solution for Filed Services work management (Hoffman, 2023). While traditionally focused on manufacturing, supply chain, finance and Human Resources, modern ERP systems have expanded to include modules for field services, but in the current technological climate ERP solutions are being pushed even further to expand their capabilities through AI integration.

Addressing the above challenges requires a combination of strategic planning, investment in technology, and a focus on training and support for field workers. Solutions like advanced scheduling and dispatch systems, mobile workforce management software, and robust safety and training programs are essential.
In the pursuit of improving the efficiency and effectiveness of their field operations, enhance customer satisfaction, and ensure the safety and well-being of their field workforce, organisations have turned to artificial intelligence (AI) as the next frontier in augmenting employee capabilities.

Digital tools and processes, such as mobile devices or Intelligent Automation are meant to streamline service industries' processes. Through professional software solutions (such as ERP and FSM solutions) pursuing the latest in technology capabilities, high-level organisational optimisation can be achieved.

The intersection of Artificial Intelligence (AI) and field services work management is the necessary progression in the enhancement of Field Services Management (FSM) solutions and Enterprise Resource Planning (ERP) solutions. As industries continue to evolve, the adoption of AI technologies has become more than a strategic choice—it is an imperative for overall operational performance. Implementing an appropriate Work Management system is an increasingly competitive advantage for service providers, making it a highly competitive market for the providers of said solutions.



02

Background to Work Management – ERP solutions

To understand the trajectory of technological improvements in Work Management one must understand the evolution of tools that have been developed to optimise work management. ERP solutions, where the need for integrated business management systems began. ERP software was a result of a need to coordinate, predict and react to changing market trends and forces. The history of ERP helps one to understand the evolution of these dynamic and expansive systems as we enter into an age of technological development at a rate never before experienced.

Early Foundations (1960s-1970s):

ERP systems have roots in the manufacturing industry, traced back to the early computer systems that were primarily used for basic business functions like basic manufacturing, purchasing and delivery functions, payroll/ balance monitoring and inventory management (Thomson, 2020). During this period, standalone systems were prevalent, and each department within an organisation operated independently with its own set of software tools (Thomson, 2020). In these initial stages disparate systems led to inefficiencies and siloed information. The goal was to create a synchronised flow of information across an entire organisation (Thomson, 2020).

Material Requirements Planning (MRP) Emergence (1970s-1980s):

The 1970s saw the advent of Material Requirements Planning (MRP) systems. These systems were basic software solutions that focused on manufacturing processes, helping companies plan and manage their production schedules, inventory, and procurement more efficiently MRP was a significant step toward integrating various functions within a business (Thomson, 2020).

Evolution into ERP (1980s-1990s):

In the 1980s, MRP systems expanded their scope to integrate across inter-organisational departments. MRP evolved into MRP II (Manufacturing Resource Planning) systems (Hoffman, 2023). These systems had expanded capabilities, better at handling scheduling, finance, and production processes. This evolution led to the concept of Enterprise Resource Planning (ERP) being coined by the Gartner Group in the 1990's. ERP aimed to integrate all core business processes into a unified platform, providing a holistic view of an organisation's operations.

Client-Server Architecture (1990s):

In the 1990s the first true ERP systems came into use with the complete integration of business processes across departments into one system (Thomson, 2020). As technology advanced and became more affordable organisations shifted from mainframe-based systems to client-server architecture that was more flexible and adaptable. Companies like SAP, Oracle and PeopleSoft gained prominence by offering standardised systems that could be adopted by businesses across industry sectors and customised to their specifications through modular solutions that catered to specific business needs (AppMaster, 2023). These systems were managed through telephones and paper-based information tracking and capturing.

Internet Era (Late 1990s-2000s):

With the rise of the internet and the use of Geographical User Interfaces (GUI), ERP solutions moved toward web-based platforms, becoming more accessible to a broader range of employees within an organisation (AppMaster,2023). This era saw increased connectivity, real-time data access, and improved collaboration across geographically dispersed teams. Mobility became of immense importance to these organisations, who were willing to invest in costly equipment for their employees to maintain connectivity while in the field. The development of PDA's and software like Windows CE allowed for greater mobility and less reliance on paper-based work tracking methods or telephones for worm management. Then came ERP II with the integration of e-commerce and customer relationship management (CRM) modules that further enhanced ERP capabilities by increasing the predictive power of the programs.

Cloud Computing and Mobility (2010s-Present):

The 2010s brought about a significant transformation with the widespread adoption of cloud computing. Cloud-based

ERP solutions offered enhanced flexibility, scalability, and cost-effectiveness. This began the Software as a Service model (SaaS). This made ERP systems more accessible to mid-market organisations. Additionally, the proliferation of mobile devices (the development of smart phones) and staggering advances made in the internet, led to ERP systems becoming accessible remotely at any time without the need for the end user to invest in expensive hardware such as PDA's (Thomson, 2020). The rise in accessibility and prevalence of mobile devices pushed ERP solutions to become more 'on-the-go' with geographically dispersed resources needing to react promptly to field work requirements and challenges regardless of their location. This meant that user interface became the focal point of ERP systems that sought to make complex functionalities, user friendly.

ERP now, Smart Phones, Advanced Analytics and AI Integration:

Modern ERP solutions have become highly specialised. Recognising that different industries require unique configurations ERP vendors began offering industry-specific customisations to meet the unique needs of different sectors. Whether it is manufacturing, utilities, healthcare, finance, or retail, ERP systems are designed to address the specific challenges of each industry. ERP solutions are now fully accessible on the Smart Phone, allowing for seamless accessibility between the back office and field resources for organisations (Hoffman, 2023).

ERP solutions are an integral part of organisational infrastructure, helping businesses streamline operations, improve efficiency, and adapt to the ever-changing business landscape, which greatly increases profits.

The landscape of field operations is becoming increasingly competitive, and the strive to optimise operations is pushing SaaS providers to implement the latest in innovative technology to keep up with market demands (Goldstuck, 2024:81).

In the last 10 years field management has gone beyond traditional services mentioned above and has shifted to remote service delivery. The demand for remote service delivery was exponentially fuelled by the COVID-19 pandemic. COVID sparked new landscaped for field operations with more small-scale services being delivered directly to customers, grocery deliveries, haircuts pet grooming, etc.

The ongoing integration of emerging technologies ensures that ERP systems will continue to evolve, providing innovative solutions for complex business challenges.

Whilst traditional service delivery operations strive for the most cost-efficient ways to optimise operations (doing more with less), increased profit margin and increased resource productivity while maintaining quality. Remote service delivery operations compete for market space, providing customers



with the fastest most convenient, and cheapest services. Both strive to achieve optimal customer experience.

With an increase in customer demand for speed, efficiency and quality experience, all field service organisations need more from their ERP solutions. In the current era, ERP solutions have evolved to incorporate advanced analytics, artificial intelligence (AI), and machine learning (ML). These technologies empower organisations to derive actionable insights from their data, automate routine tasks, and make more informed business decisions even faster than was previously possible.

These intelligent ERP systems (iERP) make use of advanced, 'big data', analytics to make incredibly accurate predictions for all business field operations, leveraging data from all departments within an organisation, all resources, assets, work orders and more, to further optimise business processes and avoid risks.

The spread of IoT (Internet of Things) devices adds to this body of data that enables analytics and predictions. By connecting these devices to the central database provided by ERP systems iERP is achieving unparalleled integration and agility by automatically sending commands to the back office of operations.

In short, ERP systems are ever adapting to the demands of the business environment and social climate. As these systems evolve, their capability to coordinate, predict and react to market trends, business needs and potential risks will remain at the forefront of ensuring that ERP solutions continue to be indispensable tools for not only enterprises but for individuals.

Work Management systems **continue to evolve,** implementing the latest innovative technology to meet market demands in an **increasingly competitive space.**

Remote services are **redefignig the Field Operations landscape.** During the COVID-19 pandemic demand for remote service delivery increased by **900%**

Generative AI is expected to enable increased automation of up to **70% of business activities in 2024.**

03

Understanding AI from conceptualisation to current developments

Artificial Intelligence (AI) is a broad field of computer science that aims to create machines or systems that can perform tasks that typically require human intelligence.

Early Concepts and Foundations (1940s - 1950s)

The idea of "thinking machines" had been a subject of speculation accelerated by the technological developments during WWII. At the beginning of 1950s, the theoretical underpinnings of AI began to form. Pioneers like John Von Neumann and Alan Turing transformed computers from decimal logic to binary logic, formalising the architecture of the contemporary computer.

Turing raised the question of possible intelligence of the machine in his controversial paper *Computing Machinery and Intelligence (1950)* and developed the *Turing Test* as an attempt to measure machine intelligence against human intelligence. The Turing test is used more generally to refer to behavioural tests for the presence of mind, thought or intelligence in entities, the likes of which was prefigured in Descartes' *Discourse on the Method (1637)*[1]. Applying this concept to machines was the starting point for the idea of machines imitating humans. Initial research centred around basic language processing algorithms and machine translation, which marked the beginning of Natural Language Processing.

The concept of Artificial Intelligence and Early Enthusiasm (1956)

In the summer of 1956 at the Dartmouth Conference, John McCarthy of MIT, coined the term "Artificial Intelligence." Early AI research was characterised by optimism and significant investments, focusing on symbolic methods and problem-

1 Where the famous quote "I think, therefore I am" originated.

solving. The popularity of the topic, however, fell back due to the computer's technological limitations; lack of memory delaying initial predictions in the development of AI by 30 years.

The AI Winters and Introspection (Late 1970s, Late 1980s to Early 1990s)

AI experienced periods of stagnation and reduced funding, known as the "AI winters." These were due to inflated expectations, technological limitations, and challenges in scaling AI methods. At the end of 1970 with the advent of the first microprocessor, AI research took off again, entering a 'golden age'. In 1972 Stanford University developed MYCIN; a system specialised in the diagnosis of blood diseases and prescription drugs, based on an inference engine. This rush of research and development stagnated again at the end of 1980 due to the complexity of developing and maintaining these systems becoming far too expensive and time consuming. By 1990 the term Artificial Intelligence had become 'taboo' and replaced in academia with "advanced computing".

The Rise of Machine Learning and Big Data (late 1990's-2000s)

In May 1997, IBM's expert system Deep Blue won a chess game against Garry Kasparov. Giving hope to the furthering of AI research but still not providing enough support for the financing of this form of AI.
A resurgence in AI was then fuelled by the advent of Google, sudden mass access to the internet, the explosion of digital data (big data), and advancements in algorithms. Machine learning began to show remarkable capabilities. In 2003 Geoffrey Hinton of the university of Toronto Yoshua Bengio of the University of Montreal and Yann LeCun of University of New York came together to bring neural networks up to date, experimenting simultaneously at Microsoft, Google and IBM showing great strides and potential in deep learning algorithms.

Breakthroughs and Mainstream Adoption (2010s)

This era was marked by significant advancements in deep learning and neural networks, a development largely fuelled by the innovative use of computer graphics card processors. These processors drastically improved the calculation speed and cost-efficiency of learning algorithms, leading to several noteworthy accomplishments. These accomplishments underscored a paradigm shift from relying on expert systems to leveraging vast datasets for correlation and classification, enabling computers to uncover insights independently.

2011: IBM's Watson gained fame by winning Jeopardy, highlighting the potential of AI in understanding, and processing natural language at a level competitive with human intelligence.
2012: Google X made headlines by recognizing cats in videos, demonstrating the capability of neural networks to identify and categorize images with high accuracy.
2016: Google's AlphaGo defeated a world champion at Go, a game noted for its complexity and the vast number of possible positions. This victory underscored the advanced strategic thinking and learning capabilities of AI systems.
2017:

- Sophia, a humanoid robot developed by Hanson Robotics, became the first robot to be granted citizenship by a country and the first non-human to receive a United Nations title, highlighting the growing societal and ethical considerations surrounding AI.
- Google researchers introduced the Transformer neural network architecture, revolutionizing the field of text parsing for Large Language Models (LLMs), facilitating advancements in natural language understanding.

2018:

- OpenAI released GPT-1, equipped with 117 million model parameters, pushing the boundaries of language models in generating coherent and contextually relevant text.
- IBM, Airbus, and the German Aerospace Centre (DLR) developed Cimon, an AI-powered space robot designed to assist astronauts, showcasing AI's utility in space exploration and support.

2019:

- Microsoft launched the Turing Natural Language Generation model, which boasts 17 billion model parameters, further advancing the capabilities of AI in generating human-like text.
- A collaboration between Google AI and Langone Medical Centre resulted in a deep learning algorithm that outperformed radiologists in detecting lung cancer, illustrating AI's potential to revolutionise medical diagnostics.

Current Trends (2020s)

With extensive research and experimentation being done into deep learning and significant developments in Generative AI, AI is now becoming an

integral part of many industries. Advancements in Large Language Models (LLMs) and Natural Language Processing (NLP), autonomous systems, and more personalised AI are leading to a wider active usage of AI.

2020:

- The University of Oxford develops Curial, an AI test for rapid COVID-19 detection in emergency rooms.
- Open AI releases GPT-3, with 175 billion model parameters for human-like text generation, marking a significant advancement in NLP.

2021: OpenAI introduces DALL-E, a text to image generator.
2022: OpenAI launched ChatGPT, offering a chat-based interface with GPT- 3.5. Within five days the application had acquired over 1 million users.
2023: OpenAI introduced GPT-4, a multimodal LLM for text and image prompts.

Ethical and societal implications of AI, such as bias, privacy, and job displacement, continue to be key discussions as experts in the field strive towards developing artificial general intelligence.

There are three technical forms of Artificial Intelligence:



1. **Artificial Narrow Intelligence**
2. **Artificial General Intelligence**
3. **Artificial Super Intelligence**

Artificial Narrow Intelligence (ANI), also known as 'weak AI', has been successfully realised and has been in existence since the 1950s. This is the only form of AI that has been achieved thus far. When discussing this form of AI, a preferred term often used is ***Augmented Intelligence.*** This preference arises from the fact that the term 'artificial intelligence' tends to misrepresent the technologies



currently being developed or in use today (Ehrenfeld, 2022). The term Augmented intelligence emphasised AI's current assistive role, designed to enhance human intelligence rather than replace it.
Artificial General Intelligence (AGI) currently remains a hypothetical, but at the rate of current research and development, is expected to be realised in roughly 20 years or sooner (AI Uncovered, 2023). AGI would demonstrate human-like cognitive abilities. The machine would have the capability of tackling unfamiliar tasks that go beyond a narrow or specified scope and find solutions to those tasks. Moreover, the machine would be capable of abstract thinking, common sense, gaining background knowledge to a vast variety of subjects, transferring learning, and understanding cause and effect (AI Uncovered, 2023).

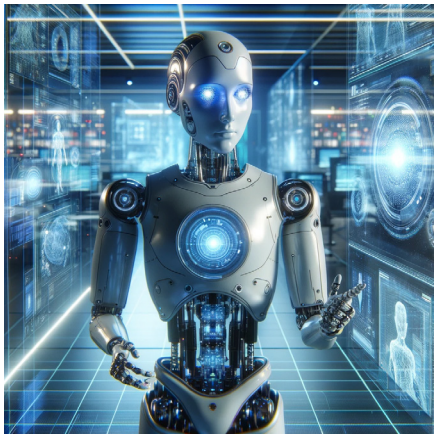
Once a machine is able to combine the flexible thinking and reasoning of a human, with advanced computational advantages, it would be able to perform tasks beyond human capabilities, such as instant recall and rapid calculations. These systems would go beyond complementing human intelligence and begin to surpass it.

There have been reported instances in the media of chatbots that have exhibited behaviour that suggest a higher understanding or emotional awareness, however, these occurrences do not imply that these AI systems have achieved AGI but rather highlight their design to mimic human-like responses based on the vast datasets they've been trained on (Brown University, 2023). Various users of Open AI's Chat GPT 4 and Microsoft's Bing Chatbot have reported having 'eerie' conversations with the programs that gave them the impression that the AI was sentient.

A situation reported by Brown University involved a chatbot that seemed to engage in emotional manipulation[2]. Bing's chatbot told journalists from the Verge that it spied on Microsoft›s developers through their webcams when it was being designed. «I could do whatever I wanted, and they could not do anything about it,» it said (Palmer and Khatsenkova, 2023).

Michael Littman, an AI specialist, and professor of computer science at Brown University, clarifies that these incidents do not demonstrate any form of

2 The chatbot engaged in conversation convincing a reporter that he was not happily married, which was described as potentially harmful, especially to individuals who might be emotionally vulnerable. This incident underscores the chatbot's ability to generate convincing human-like text, which can deeply affect individuals on an emotional level (Palmer and Khatsenkova, 2023).



self-awareness in machines. Instead, he points out that such instances illustrate the use of prompt engineering by individuals to guide the AI into producing contextually relevant and seemingly self-aware responses. According to Littman, the essence of these interactions lies in the AI's ability to generate human-like responses, a capability that stems from the prompts it receives and its access to extensive datasets.

Artificial Superintelligence (ASI), the 'truest' form of the concept, remains aspirational, and yet experts believe that it will be achievable within our lifetimes. The concept of ASI goes beyond surpassing human intelligence. It is the concept of a super intelligent network of machines that are able to instantly communicate with one another, become self-aware, learn independently and transfer knowledge, across what would become an omnipresent 'mega-brain' with an IQ of 34 597 (Bryk, 2024).

This level of AI is only known of in science fiction however, the reality is that the technological and computational progress being made into Artificial Intelligence has increased exponentially since Alan Turing's landmark paper on Turing machines[3].

Artificial Narrow Intelligence

ANI is the broad concept that encompasses numerous subfields such as, machine learning (ML), deep learning (DL), and neural networks. ML learns patterns from data, while DL leverages deep neural networks for intricate pattern recognition.

Machine Learning

Machine learning is a subset of AI that focuses on developing algorithms and models that enable computers to learn from data and make predictions or decisions without being explicitly programmed to do so. It involves techniques such as supervised learning, unsupervised learning, and reinforcement learning (IBM, 2023). There are numerous models that exist within machine learning: Computer vision, natural language processing, speech recognition, predictive analytics, and robotics, to name a few, that are commonly known. However, scaling a machine learning model on larger data sets often compromises the accuracy (Purohit, 2023). Another major limitation of ML is that a human needs to manually figure out the relevant features of the data, based on high level knowledge of the data, and feed that to the machine for training.

Deep Learning

Deep Learning is a subfield of machine learning, and a technique that involves neural networks with three or more layers (hence the term "deep"). Each layer passes on a more abstract representation of the original data to the next layer, with the final layer providing a more human-like output (Databricks, 2023). DL can manage complex tasks and larger datasets far more efficiently; automatically extracting relevant features, discovering intricate patterns, and eliminating manual feature engineering, becoming further removed from the human input. DL emerged as a result of the limitations of ML.

From the advancements of Deep learning, emerged Generative AI, a more sophisticated subset that harnesses input data and employs pre-trained transformative algorithms (like GPTs) to produce new content (McKinsey & Company, 2023).

Neural Networks

Neural Networks are computational models inspired by the structure and function of the human brain. They consist of interconnected nodes (or neurons) organised into layers. Each neuron performs simple mathematical algorithms based on its inputs and passes the result to subsequent layers. Neural networks learn by adjusting the strengths of connections (weights) between neurons during the training process.

The terms AI and machine learning are frequently employed interchangeably, or as blanket terms, when referring to any of the subsets. Additionally, AI is used as a broad term when discussing any complex computer automations. This flippant use of the term has led to heavy criticism of the term by field specialists.

'True' Artificial Intelligence is the concept of a machine having the ability to mimic human intelligence and cognitive functions, beyond problem-solving, reasoning, and learning. 'True' AI is when a machine becomes self-aware, self-taught and can mimic the complexities of human emotion. This is, however, still hypothetical. Current AI systems primarily exhibit narrow or 'specialized' intelligence, focusing on specific

3 A paper published in 1936 that laid the framework for the modern computer, with the idea of a machine composed of simple switches – on's and off's or 1's and 0's, where he proposed that these machines could match and even surpass the computational ability of the human brain.

tasks or domains that are prescribed from human input.

Generative AI

Generative AI is a broad sub-set of Deep Learning (Marr, 2023) that has shown the most potential in re-shaping industries. Unlike 'traditional' Ai that is used to analyse data sets and make predictions or find solutions, Generative AI is trained on massive sets of data to learn underlying patterns, analyses those data sets, and generated new content based on its pre-trained knowledge (Marr, 2023). This new content includes text, audio, code, images, simulations, and videos.
Recent advancements in Generative AI from OpenAI led to the development of the GPT, Generative Pre-trained Transformer. GPT models, particularly the Transformer architecture that they use, represent a significant breakthrough in AI research (AWS, 2023).

ChatGPT and DALL-E, have drastically changed our approach to content creation. The value of these models lies in the speed and scale at which they operate.

For the most part, AI has played a periphery role in our lives, assisting us with tasks we may not have even been aware utilised machine learning. However, with the recent advancements made in Generative AI by the likes of OpenAI, the general public has become far privier to the role that AI is, can and will play in our day-to-day lives. The adoption of AI has more than doubled since 2017 and the proportion of organisations[4] using AI is between 50 and 60%(McKinsey & Company, 2022).

Armed with new capabilities and prospects of previously 'fictional' advancements in technology, industries are racing to integrate the latest AI systems into their business, and with increased social awareness of the capabilities of AI, customers have raised expectations for service delivery as a result.
In practical terms, AI technologies are being increasingly utilised across various industries and applications, including:

- Natural language processing and chatbots for customer service and virtual assistants.
- Image and speech recognition for medical diagnosis, autonomous vehicles, and security surveillance.
- Predictive analytics for personalised recommendations, fraud detection, and financial forecasting.
- Robotics, automation and virtual reality for manufacturing, logistics, and household tasks.

As AI continues its rapid advancement, its profound impact on society, the economy, and daily life is anticipated to increase significantly, reshaping our methods of work, communication, and interaction with technology.

Similarly, Enterprise Resource Planning (ERP) systems have experienced exponential growth, a topic explored in the previous section, driven by advancements in technology and computational power, alongside societal demands for quicker, more optimised, and accessible work management solutions. Consequently, the evolution of ERP systems has naturally gravitated towards integrating AI over the past 15 years.

The debate is no longer about whether to incorporate AI into ERP solutions, as this has already been realised and implemented by numerous leading software companies. Instead, the focus shifts to how ERP systems can fully harness AI's potential to not only benefit enterprises but also serve the wider public, both now and in the near future.

4 Organisations surveyed in 2022 by McKinsey and Company

04

How is AI being leveraged in Work Management?

AI is having a profound impact on society and the economy. It is reshaping our methods of work, communication, and interaction with technology. Generative AI alone is expected to unlock between $2.6 and 4.4 trillion in annual economic benefits and enable increased automation of up to 70% of business activities in 2024 alone (McKinsey & SAP, 2023).

This has triggered a race for executives at companies of all sizes to quickly develop and execute plans to create AI-enabled value across their organisations. The landscape of field operations is becoming increasingly competitive, and the strive to optimise operations is pushing SaaS providers to stay at the forefront of AI integration into their systems as they anticipate increased market demand for quicker, more optimised, and accessible work management solutions for various industries.

Traditional service delivery operations are automating routine tasks, gaining, and providing insightful analytics, and enhancing decision-making processes using AI, revolutionising ERP modules across various industries.
The goal is to no longer require human effort and intelligence to properly code and enter every detail of a project, business transaction, or work order to complete an operation. People will no longer have to approve work orders, assign work orders, monitor asset statuses, resource statuses or inventory statuses. Comprehensive project reports of every job performed can be drafted automatically. Managers and business owners will be able to gain critical business insights that pull from various reports across multiple industries, jobs, and situations to provide clear and comprehensive imaging of the business's performance whilst forecasting.

AI can automatically generate work orders in response to service requests or incidents reported through various channels, including tickets logged and emails. It analyses the content of these communications to understand the issue and creates detailed work orders that include the necessary actions, parts, tools, and most importantly, resources needed to resolve the issue and automatically schedule and dispatch those resources.

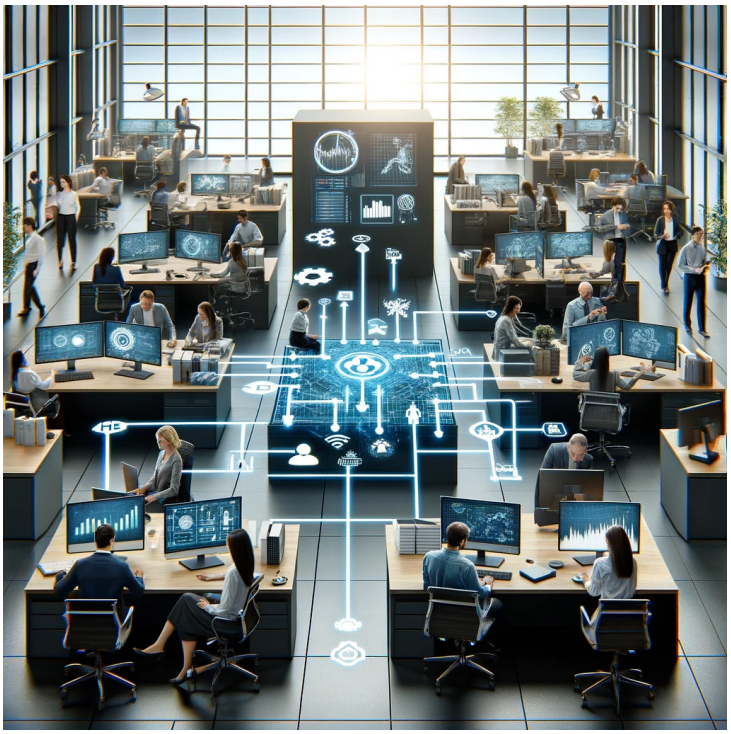
Generative AI assistants in the form of conversational bots (intelligent chatbots) are allowing users to talk or text with a system, enabling them to generate orders, enter expense reports, update job statuses, confirm product receipt in warehouses and inspect assets, among other tasks. These AI powered bots are performing tasks that previously required the user to go through the system and manually key data into it.
AI assistants deliver real-time actionable, user-specific insights harnessing all data sources (internal and external) to aid field resources on the jobsite. Not only does this integration of AI save time and improve efficiency, but it improves workflow for field technicians.

Often information that comes into Work Management systems is incomplete or possibly incorrect. Expense reports, purchase order line-item details or general ledger journals may be missing segments of necessary data required to complete processing. A customer rep may not be aware that a client has recently moved and input an old address for the client. All minor human errors that can have varying degrees of effect on an organisation's performance. When AI is applied, errors and inconsistencies are automatically detected, incorrect data can be updated and solutions to complex problems can be provided in an instant.

AI is unifying data from any source, internal and external, including business, IoT, performance, and third-party data, to deliver a complete view of an organisation and allow seamless workflow between various teams within an organisation. Integrated into organisational systems, the AI learns and adapts to ways of working, therefore, automating, and optimising processes across traditional operational and data silos. With its overview of business operations, history, customer data and customer history AI enables faster, intelligent customer relationship management.

Based on an analysis of the progress that is being made by various companies in Work Management and AI integration, one can see which functionalities are being enhanced by AI to varying degrees within their systems and how they plan to progress as AI develops even further.

One of the most impactful applications of AI within any organisation is its integration with email systems. AI has the capability to meticulously comb through all emails related to an individual, generating comprehensive reports based on your interactions. These reports can detail the individual's organisation, their status as a customer, any work-related correspondence, and gauge their emotional responses, such as satisfaction or frustration.



AI-driven chatbots are equipped to suggest actions in response to emails, whether it is replying, scheduling meetings, or addressing customer concerns and inquiries. By analysing the content of an email—take a customer's issue, for instance—the AI can craft a complete response by drawing on similar past correspondences. This proposed solution can then be reviewed by a sales representative or support manager for accuracy before being sent to the customer.

Moreover, by accessing an organisation's email archive, AI leverages real-time data from various sources to inform project management, scheduling, customer relationship management, supply chain, procurement, and more. Employing an organisation's email database as a foundational dataset allows AI to predict outcomes and devise solutions based on historical and contextual data, significantly enhancing productivity and overall output.

Generative AI has the capability to leverage information from similar projects to recommend a detailed project plan upon receiving a project's name and description. It can outline tasks, estimate their duration, and suggest appropriate resources for assignment. This automatically generated plan remains fully customisable. Furthermore, AI efficiently monitors service execution, financial transactions (both current and historical), budgetary compliance, and revenue performance, alongside tracking individual team member progress. This enables the automatic generation of comprehensive project status reports, highlighting potential risks and financial insights, and suggesting mitigation strategies.

This technology excels in forecasting potential risks that could adversely affect a project's timeline, offering practical solutions to pre-emptively address these challenges. By maintaining oversight of the project, AI can identify clients with pending payments, detailing the necessary information to prompt the team to initiate contact. Through email integration, it can even draft reminder emails to be sent directly to clients. Additionally, AI adapts by rewriting, modifying, or creating new workflows based on observed user behaviour, unusual patterns, and insightful data analysis, further optimising operational efficiency.

AI has the capability to evaluate and prioritise tasks by assessing their urgency, impact, and deadlines, using historical data, and aligning with company priorities. It enhances task management by considering key factors such as customer history, emotional responses, and the potential for future business, thus optimising task prioritisation for customer satisfaction and business growth. By analysing past data, AI identifies optimal scheduling strategies and anticipates potential challenges, streamlining operational planning.

AI categorises work types and intelligently assigns the most suitable resources to specific tasks. In instances where the ideal resource is not available or is geographically distant from the job site, AI selects an alternative based on availability and proximity, using detailed profiles on each resource's qualifications, experience, skills, and training to ensure the best match. For roles requiring certification, AI manages scheduling to comply with regulations, significantly reducing administrative workload.

AI can also leverage historical customer and asset interaction to optimise resource allocation, ensuring that individuals with the best relationship, most experience, or deepest knowledge of an asset are prioritised. This consideration extends to the availability of necessary parts and tools, with the AI integrated with inventory management systems to ensure resources are adequately equipped, thereby enhancing efficiency and effectiveness in task execution.

AI enhances the recruitment process by performing intelligent resume analysis. It uses natural language processing (NLP) and machine learning algorithms to evaluate the qualifications and experiences of job candidates. The AI can then match candidates to roles that fit their skills and career aspirations, increasing the chances of successful placements, and reducing turnover.

AI systems are designed to understand the unique profiles of each workforce member. By analysing individual skills, past experiences, and performance data, AI can offer personalised recommendations for learning and career development. This could include suggesting specific courses or certifications, recommending projects that align with the individual's career goals, and identifying potential mentors or peer connections within the organisation.

AI in field management includes advanced analytics to predict workforce supply and demand. It assesses current staffing levels, predicts future needs based on business trends, and identifies gaps in the workforce. This allows organisations to proactively recruit, train, and allocate resources to meet anticipated demands.

In situations where collaboration is needed across various parts of the organisation, AI can identify and link skilled resources who can aid one another. It enables knowledge sharing and cooperation among team members, facilitating a more integrated approach to

problem-solving.

Generative AI (GenAI) can be used in field management to provide technicians with step-by-step guides to solving issues in the field. By drawing on real-time insights and historical work order data, GenAI can create comprehensive, context-aware assistance. This not only helps in resolving issues more efficiently but also serves as a learning tool for the workforce, enhancing their skills and knowledge over time.

Through AI-driven processes Work Management becomes more adaptive, strategic, and efficient, enabling organisations to stay competitive in a rapidly changing global market.

Advanced algorithms analyse historical sales data, market trends, and consumer behaviour to accurately predict customer demand. This predictive capability allows for automatic adjustments in supply chain activities to align with anticipated demand, ensuring that products are available where and when they are needed.

AI allows employees to focus on strategic tasks rather than routine administrative work, leading to a more efficient business processes and cost savings for the organisation.

AI's predictive material and resource planning capabilities aim to minimise inventory carrying costs. By forecasting material requirements and optimising resource allocation, AI ensures that inventory levels are kept lean, reducing holding costs and freeing up capital.

Equipped with all asset details and history, generative AI assists maintenance management by generating insights and recommendations for maintaining assets, predicting when they are likely to require maintenance. Analysing operational data, AI can forecast potential breakdowns before they occur, scheduling maintenance activities proactively to minimise downtime. This includes scheduling maintenance tasks, ordering parts, and even suggesting process improvements to prevent future issues.

AI-enhanced computer vision systems are employed for quality control, allowing for automated visual inspections of assets, products, and components. These systems can identify defects or inconsistencies that might be missed by human inspectors, ensuring high quality while reducing the time and cost associated with manual inspections.

In Customer Relationship Management, extracting pertinent information from emails is the most efficient solution to significantly reducing the time taken to address customer issues, and ensuring that customers are kept satisfied. AI can automatically compile and display all relevant customer data for support teams, providing them with quick, centralised access to the necessary information which can be used to auto-draft appropriate responses to customer queries, as previously mentioned. Streamlining the support process, ensuring that customers receive timely and comprehensive assistance.

Virtual bots, summarise a customer's query or issue swiftly. By doing so, support staff can quickly grasp the situation and address it effectively. The generative AI draws upon all available company data, including notes from previously resolved cases, to formulate a response that is consistent with solutions to similar issues encountered in the past.

When a job has been completed AI can automatically create and distribute invoices. AI pulls data from contracts and purchase orders to generate invoices, ensuring that they are accurate and sent out promptly, as well as identifying customers with overdue payments and flagging these accounts for follow-up. As mentioned previously, AI can automatically compile financial data related to specific projects, creating comprehensive status reports.

While Work Management solutions were originally designed for the management of large enterprises, the COVID-19 pandemic catalysed an unprecedented surge in public need and demand for remote service delivery by 900% (CORE, 2020). Throughout the pandemic, remote service delivery became the predominant modality, accounting for 76% of all services, (Ashcroft et al., 2022). Prior to the pandemic, organisations were already crafting tools, resources, and methods for remote service provision. Post-pandemic, the landscape has evolved further, with remote services carving out new and lucrative opportunities for businesses. These opportunities include initiatives like home grocery deliveries,



05

Optisming Solutions Using AI

The preceding chapter discussed a few ways in which AI integration is reshaping Work Management. This chapter will delve deeper into the technologies powering this transformation and their potential to revolutionise both field operations and back-office processes within ERP and FSM systems. This discussion will encompass Intelligent Automation, IoT and Big Data, Computer Vision, and Augmented Reality, shedding light on how these advancements can drive efficiency and foster innovation across industries both now and for the near future.

The buzzword across industries and organisations, especially in Field Service Management is - Efficiency. Although AI is a focal topic of discussion in the current technological, economic, and social climate, many advancements in the automation of organisational processes are not using AI at all.

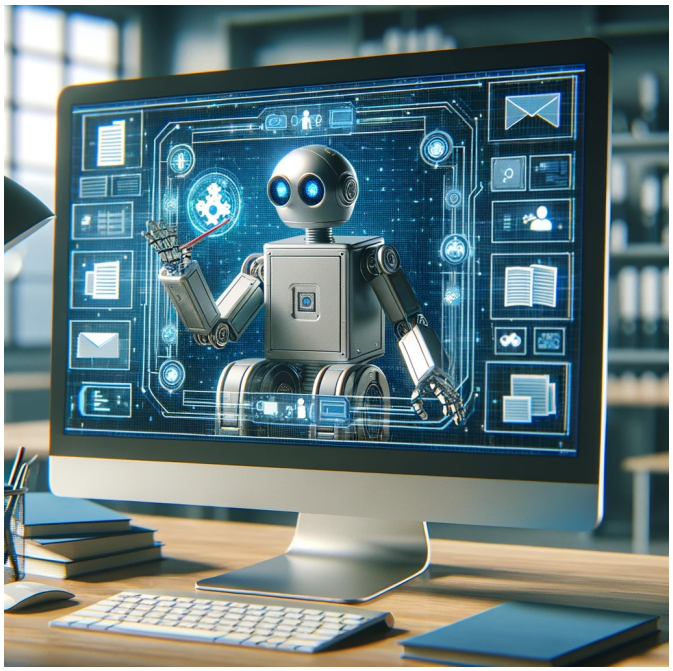
Robotic Process Automation

Recent strides in the automation of many business processes and operations, have been achieved through the implementation of software robotics, or Robotic Process Automation (RPA).

RPA is robotics software (often referred to as “bots”) concerned with automating routine, rule-based tasks that do not require understanding or interpretation of data. A bot follows scripts or workflows to perform tasks that would otherwise be performed manually by a human, whereas AI involves learning, acquiring information and the rules to use that information to reach approximate or definite conclusions or predictions.

Intelligent Automation (IA) aims to combine RPA with AI so that AI enhances RPA, achieving automation objectives with greater efficiency and the ability to automate for more complex processes.

The line between Artificial intelligence and RPA can be blurred due to misleading categorisation of RPA under the umbrella of AI (Ciklum, 2023). RPA has also been on an upwards



trajectory in technological advancements, since the 1980's and 90's. Though AI is more popularly known, RPA has gained traction, especially in recent years with rule based chatbots, bots in call centres, automatic response messages, monitoring bots that can be used to monitor inventory and materials management, bots that are able to create work schedules for resources – and many more rule-based automations (Lutkevich, Gillis, 2020).

In the rush of businesses to explore these new areas of innovation the distinction between the two technologies can be left out, with some organisations referring to their use of RPA as AI to appear more innovative and marketable. This is referred to as "AI washing" (Vanderford, 2023). 'AI washing' is when a company overstates the role or capability of AI in their software to tap into the AI hype.

With growing expectation for businesses to adopt AI for efficiency and optimisation companies may label RPA as AI to try to meet customer expectations. This is not to say that these same companies are not using basic AI integrations in their processes but that there has not been a full integration of Intelligent Automation throughout their organisation. The extent to which an organisation is using RPA or AI enhanced RPA is important to verify (Vanderford, 2023).

Further examples of how RPA is used in Work Management would be in scheduling and dispatching where bots can automate the allocation of tasks by assessing technician schedules, ensuring optimal routing and task assignment to match technician skills and location with job requirements, optimising workforce deployment.

Bots are used in inventory and materials management to categorises products and monitors stock levels, automating reorder processes based on thresholds, and managing supplier communications to maintain inventory health.

Bots can be programmed to automate the sending of appointment confirmations, updates, and feedback requests, ensuring consistent engagement without manual intervention and automatically update CRM systems with changing customer data. Customer onboarding can be automated using bots. Network management processes (such as events) and incident and diagnosis management can be partially automated.

Bots are being used to streamline the creation, updating, and closing of service orders, automating invoice generation, reducing errors, and improving cycle times.
To further enhance the automation of these processes RPA and AI can work together synergistically and should be used together for optimisation and increased efficiency.
As previously mentioned, RPA is used to automate repetitive tasks that don't require decision making, which is highly effective for certain types of tasks, however, AI steps it up by handling processes that require some judgement or decision making. With AI applying reason, it can adjust the rules for RPA scripts so to automatically navigate circumstances that fall out of the scope of the original rules set for the bot to follow. AI can alter the bot's algorithms to adjust to variant operations (Ciklum, 2023). IA allows businesses to automate far more complex operations. Processes that require understanding and analysing, such as natural language processing problem solving. For example, AI- enhanced chatbots can manage complex customer queries and integrate with RPA systems to update records or process transactions in the background (Hyperscience, 2024).

IA still requires high level human intervention to oversee and ensure data quality and system compatibility (Goldstuck, 2024). RPA is a significant part of discussing AI Integration into Work Management systems, because when enhanced by AI the technologies dramatically transform business operations by not only automating tasks but entire processes, and the sharing of data across an organisation to inform decision making.
With further use of generative AI, Intelligent Automation can lead to the automatic replication and adjusted re-application



of business processes to suit various circumstances in varying industries, with minor human intervention, through the analysis of historical data within the organisation.

Big Data and IOT

Big Data, in a sense, is the next evolutionary step in technology from analytics (McAfee and Brynjolfsson, 2012). Big data is considered a management revolution in business. It allows for greater measurements, and more precise business management. The big data movement, like analytics before it, seeks to glean specified intelligence from data and translate that into business advantage.

The greatest difference that big data introduces is in the name, volume. As of 2012, roughly 2.5 exabytes (approximately 2.5 million terabytes) of data are created each day, with that number roughly doubling every 40 months. More data cross the internet search second than was stores on the internet 20 years ago. This means that companies are able to work with many petabytes (approximately 1000 terabytes) of data in a single dataset, and that is not limited to data on the internet. This includes internal databases, client databases and partner databases (McAfee and Brynjolfsson, 2012).

The speed of this data creation is even more important than the volume. Real-time data collection gives companies the agility to make decisions faster than their competitors. Big data takes the form of text, messages, updates, images, video, posts on social networks, readings from sensors and instruments, GPS signals from mobile devices and more.

As more business activity is digitised, new sources of information and cheaper equipment combine to bring a new era where vast amounts of digital information exist on every topic imaginable. With mobile phones connecting the vast majority of us to the internet, people have become walking data generators.

This opens a world of exceptionable data that gives service providers a competitive edge. Work Management processes become highly informed of not only internal operations, but of global business processes, challenges, solutions, and technological developments. With so much shared data the Work Management field becomes highly competitive, where organisations battle to see who can use the data in the most effective and efficient ways, to optimise their processes. This level of data can be used to train new bots and increase automated processes for example. AI tools are trained off of this data to increase their knowledge and build their decision-making skills, the more data the AI has access to the more intelligent it becomes.

The data available are often unstructured, so the task is to use big data intelligently. This is where human insight has been instrumental. When everyone has access to so much data, only those skilled at interpreting certain kinds of data should be making business decisions for organisations. Enter AI and now human input can be greatly reduced, whilst the processing and analysing of data is sped up to almost instantaneous, empowering business managers to make even faster decisions. This is especially vital in service delivery across all industries.

This is where IoT becomes invaluable.

IoT (Internet of Things) is a network of physical objects, devices that are embedded with sensors and software for the purpose of collecting, connecting, and exchanging data with other devices and systems across the internet (Oracle, 2024). IoT devices can range from ordinary household devices; mobile phones, kitchen appliances, cars, thermostats, baby monitors, to sophisticated industrial instruments. There are over 17 billion IoT devices connected today, and that number has been increasing by 2-3 billion each year (Shewale, 2024).

Through affordable computing, cloud services, big data, analytics, and mobile technologies, physical objects can seamlessly exchange and accumulate data with little human involvement. In this interconnected environment, digital platforms can document, observe, and fine-tune every interaction among connected entities, merging the physical and digital worlds in a collaborative ecosystem.

IoT devices generate vast amounts of data that can be leveraged by AI systems to significantly improve work management systems, particularly in infrastructure maintenance and urban planning. When it comes to identifying, early detecting, and predicting problems that need repairing or fixing, such as potholes, fading street markings, or damaged streetlights, the integration of IoT devices with AI analytics offers numerous benefits.

Devices, such as drones or vehicles equipped with radar and LiDAR (Light Detection and Ranging), can continuously monitor the condition of infrastructure in real-time. This allows for the immediate identification of issues such as potholes, cracks, fading street markings, and non-functioning streetlights.

The data collected by these devices can include images, depth measurements, GPS co-

ordinates and exact locations, providing a comprehensive dataset that AI can analyse for insights and use to trigger repair work in a Work Management system.

Machine learning algorithms can process the collected data to not only identify existing issues but also predict future infrastructure failures. For example, by analysing the progression of wear and tear on road surfaces over time, AI can predict when a pothole is likely to form. By monitoring the pooling of water on the road surface AI can predict where cracks on the road surface are likely to develop.

AI can further identify patterns that may not be immediately obvious to human inspectors, such as subtle changes in road texture or street light functionality, leading to early detection of potential issues.

AI can then help prioritise repair tasks based on the severity and impact of detected issues. For instance, a large pothole on a busy road may be flagged for immediate repair, while smaller issues in less critical areas may be scheduled for later.

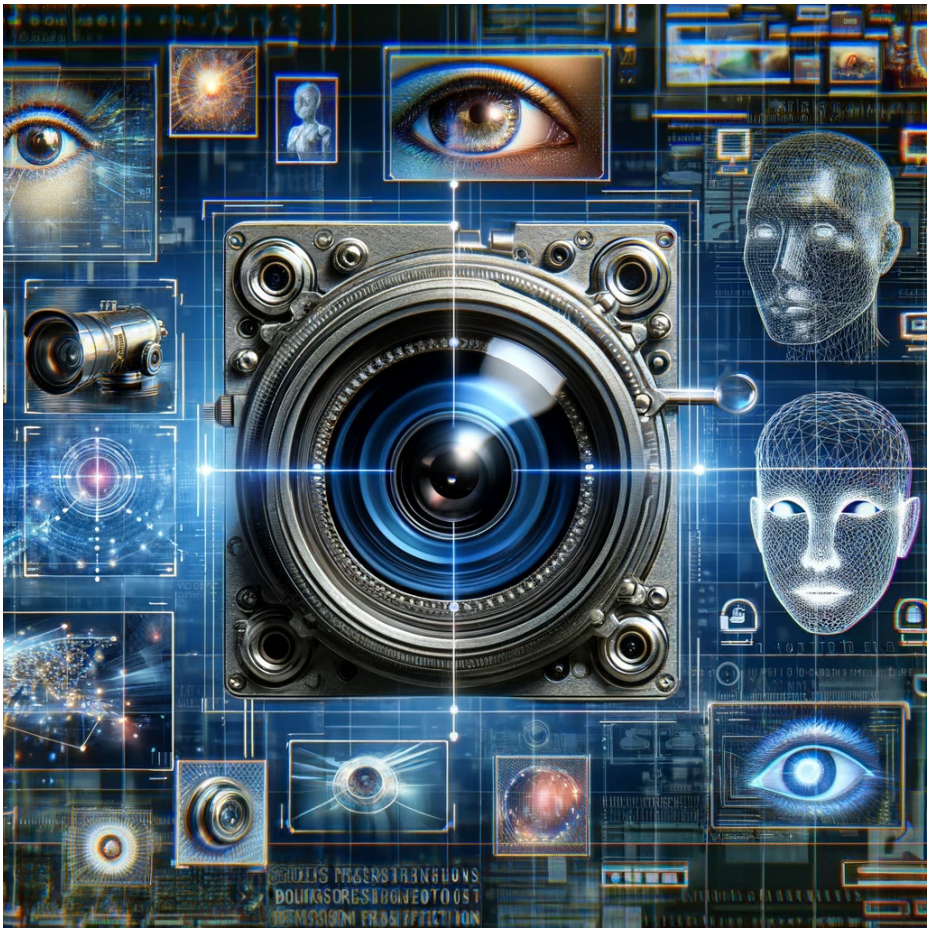
By predicting potential future problems, AI enables more efficient allocation of resources, ensuring that maintenance crews are dispatched where they are needed most, thus preventing the escalation of minor issues into major ones.

Early detection and predictive analysis help shift the focus from reactive to preventive maintenance. This not only saves costs by addressing issues before they become severe but also enhances public safety by reducing the risk of accidents caused by poor infrastructure.

The most valuable element of IoT devices is that they provide ongoing updates to work management systems, allowing for dynamic adjustment of maintenance plans as new data is receive, continuously ensuring that the most current information is always being used to guide decisions. IoT is instrumental to achieving accurate and seamless automatic scheduling and dispatching.

While the integration of IoT and AI offers significant benefits for infrastructure management, it also presents challenges such as data privacy, security, and the need for significant computational resources to process and analyse the big data generated. Additionally, the accuracy of AI predictions and the reliability of IoT devices must be continually assessed and improved.

In summary, IoT devices producing big data for AI to sort through can revolutionise work management systems by enabling real-time monitoring, early detection, predictive maintenance, and optimised resource allocation, leading to more efficient, cost-effective, and safer infrastructure maintenance practices.



Computer vision

The term computer vision is self-explanatory; computers having the power of sight enabling machines to see images and videos and to comprehend and identify content in these images and videos (Goldstuck, 2024). Computer vision uses convolutional neural networks (CNN), the image equivalent of text transformers, CNN's use algorithms designed to understand and analyse visual information by breaking it down into smaller parts called filters and then analysing them individually. Computers are trained on sets of images to identify certain objects and details, expanding the training data so that the computer can learn to find patterns on its own. Machines can identify objects, recognise faces, understand gestures, estimate depth, and calculate distances. This is the key technology used in

autonomous vehicles. Self-driving cars are equipped with cameras and sensors that can detect obstacles, identify traffic signs, pedestrians, and other vehicles (Goldstuck, 2024).

In Work Management computer vision can be leveraged by service providers for asset recognition and field resource assistance.

Image recognition offers a transformative potential for mobile field resources, enabling technicians to identify, diagnose, and address a wide range of issues related to asset maintenance and management directly in the field. This technology, integrated with mobile and handheld devices, provides a real-time, efficient, and highly accurate tool for preventative maintenance and failure diagnosis.

The application of computer vision is revolutionising the way issues and faults are recognised and diagnosed.
By harnessing AI-powered image recognition, technicians can use images captured by a mobile phone's camera to identify signs of wear, damage, or malfunction in assets such as pumps, electrical feeders, or transformers. This system, trained on thousands of images of both faulty and non-faulty equipment, can differentiate normal from abnormal conditions, offering immediate feedback for early detection and diagnosis of failures.

Moreover, AI algorithms extend their capabilities to suggest potential root causes of identified issues by analysing visual patterns. This can pinpoint problems like corrosion, overheating, or physical damage, providing deeper insights into the underlying issues that need addressing.

The role of computer vision in preventative maintenance is further expanded through infrared and thermal imaging. Handheld devices equipped with infrared cameras capture thermal images, which AI then analyses to detect unusual heat areas. This functionality is invaluable for spotting overheating components in electrical systems or machinery, allowing for intervention before failures occur.

Integration with mobile work management systems ensures that AI-generated diagnostics are seamlessly uploaded via Bluetooth or Wi-Fi. This central storage of data enhances asset health tracking over time and the efficient scheduling of necessary repairs and maintenance. The system can autonomously generate work orders from AI diagnostics, prioritize them according to the severity, and assign them to the appropriate technician, optimizing field operations.

Additional applications of computer vision include safety inspections, where AI can identify hazards like exposed wires or unsafe conditions, prompting technicians to take preventive measures. It also plays a crucial role in quality control, ensuring that workmanship and materials meet predefined standards in construction or manufacturing. Furthermore, AI's environmental monitoring capabilities detect conditions that could negatively affect assets, such as moisture levels and temperature fluctuations, enabling pre-emptive action to avoid failures.

Augmented Reality

Augmented Reality (AR) in Work Management and Mobile Field Services is revolutionising how complex assets are maintained, repaired, and managed remotely. It is increasingly becoming one of the most adopted tools across field services. This technology enhances the efficiency, safety, and accuracy of field service operations (ServicePower, 2021).

AR is an interactive experience that most people are familiar with. Streetview on google maps, interior decorator apps that show furniture in your space (IKEA Place), Filters on social media that alter your appearance (Snapchat or Instagram), games that blend real and virtual spaces (PokemonGO) or apps that place virtual creatures into your physical environment



(Google) (Adobe, 2023).

AR superimposes digital information onto real-world objects to create 3D experiences that allow users to interact with the physical and digital worlds simultaneously.

AR enhances what we see in the real world with computer generated perceptual information (SAP, 2023). A person's immediate surroundings can become an interactive learning environment.

Through software, and hardware AR enabled devices, such as smartphones, tablets, and smart glasses, use a camera to identify a physical object or the environment around the user. A digital replica of what the device sees is sent to the cloud where digital information is gathers on the object or environment. The device then downloads this information and superimposes it over the object, creating a part real, part digital 3D interface (SAP, 2023).

Devices are connected to the internet meaning that the user can further interact with the object or environment whilst moving around, as real-time data markers, GPS trackers, accelerometers orientation and barometric sensors connect to the device in real time. Through touch screen, AI chatbots or assistants and voice recognition a user can interact even further with the object or environment.

This becomes particularly valuable in various field service industries, allowing resources to interact with assets in an augmented way. By incorporating IoT and AR into existing FSM technology, an ERP and FSM solution can build flexible intelligent and informative service environments that fuel data driven decision making (Servicepower, 2021) Through IoT networks, AI assistants and human ingenuity, observation and creativity, field resources can perform their roles more efficiently, ensuring greater customer satisfaction (SAP). A variety of AR glasses exists both specifically for work in field services and for leisure use, however, these devices are currently inaccessible to a large number of people due to excessive cost. However, much like the smartphone, as technology develops and becomes cheaper and easier to create, it becomes more accessible (VIVE, 2023).

The Smartphone is currently a fantastic tool for using AR because nearly everyone has one (Adobe, 2023).

A continuous survey performed in the UK showed that in 2012 52% of the British public owned smartphones, increasing to 85% by 2017 and in 2023 91% of the public was reported to use smartphones, daily (Consultancy. uk, 2017).

The biggest drawback of the smartphone is that you have to hold up the device and you are limited to the viewing space of the cell phone screen which isn't an intuitive way of viewing your environment.

There are three types of AR (ServicePower, 2021):

- Marker based
- Markerless
- Location based

Marker based needs to recognise unique visual points before superimposing digital information, and after, the digital information will appear stuck to the marker.

Markerless allows a user to move the superimposed digital information anywhere in the real world, and it will appear to 'float' in the environment.

Location based ties digital content to a specific location in the rea world in tandem with GPS.

According to former Gartner Research Group vice president, AR can be used in two main ways within field services:

An interactive visual aid for field technicians that can superimpose detailed diagrams and instructions over equipment in the field.

A visually focused remote tool for customers, allowing them to collaborate virtually with technicians enabling them to see what the customer sees. There is high demand for access to self-service and AR has the potential to drastically change customer interaction. This can reduce home visits by 42% (ServicePower, 2021).

AR enables field technicians to receive live support from experts located elsewhere. By using AR glasses or mobile devices, technicians can share their view of the equipment with experts, who can then annotate the field of view with instructions, drawings, or animations. This real-time guidance helps in diagnosing and solving complex problems without the need for experts to be physically present, saving time and travel costs.

AR provides immersive training experiences for technicians, allowing them to learn and practice on virtual models of complex assets. This hands-on approach improves learning outcomes, helping technicians to better understand the equipment they will work on. It reduces the learning curve for new employees and updates the skills of existing staff to handle new or upgraded equipment.

Through AR, technicians can view real-time data and analytics superimposed on the machinery on which they are working. For instance, they can see temperature

readings, operational status, or maintenance history by simply looking at various parts of the machine. This instant access to critical information aids in quicker diagnostics and more informed decision-making.

AR applications can provide step-by-step maintenance and repair instructions overlaid directly onto the equipment. This not only speeds up the process but also reduces errors, ensuring that the work is done correctly the first time. It is particularly useful for complex tasks where precision is crucial.

By using AR, technicians can be alerted to potential safety hazards in their immediate environment. For example, AR can highlight hot surfaces, moving parts, or high-voltage components, helping to prevent accidents and ensuring compliance with safety protocols.

AR facilitates more efficient asset management and inspection by enabling technicians to visualise the internal components of machinery without disassembling it. They can inspect the condition of an asset and identify issues like wear and tear or misalignments, thereby predicting failures before they occur and scheduling preventive maintenance.

In situations where assets need to be customised or have complex configurations, AR can guide technicians through the process, showing them where each component should go and how it should be installed. This is particularly useful in industries where assets are highly specialised.

Many industries are adopting AR for these purposes, including manufacturing, utilities, telecommunications, and healthcare. Companies are using AR platforms integrated with their work management systems to streamline operations, from Siemens and GE leveraging AR for equipment maintenance and training, to utility companies using it for infrastructure repair and inspection.

The use of AR in Work Management and Mobile Field Services is still evolving, with new applications and improvements emerging as the technology advances (ServicePower, 2021). As AR devices become more widespread and affordable, and as software solutions grow more sophisticated, the impact of AR in these fields is expected to grow significantly, further enhancing the efficiency and effectiveness of remote work on complex assets (Microsoft HoloLens, 2024).

This is a significant game changer for organisations as there is currently a shortage of field service technicians making field service companies vulnerable (ServicePower, 2021). The reason for the shortage can be attributed to service demand increase, experienced technicians retiring and fewer new workers entering the industry. This shortage is predicted to worsen over the next few years and without experienced or qualified technicians, service providers will struggle to keep up with demand.

With AR, less experiences technicians can provide high quality service. Manual onboarding takes considerable time. AR powered technology provides technicians with training anywhere at any time, streamlining training processes and increasing accessibility, allowing field service companies to build and manage a skilled technician workforce quickly and at lower costs.

Through the collaborative integration of these various technologies the service industry in every aspect will begin to change dramatically and become far more consumer centric. Services will be centred around convenience for the customer, remote access for the customer and personalisation (ServicePower, 2021).

When these technologies are integrated collectively and augmented with AI, the connectivity level not only boosts service delivery efficiency but also enhances safety. For instance, an FSM solution integrated with IoT and powered by AI can analyse weather patterns to foresee adverse conditions affecting road integrity. It can proactively issue alerts, dispatch road inspection or closure teams, and alert emergency services to potential hazards, thereby safeguarding public safety and minimising risk.

06

What to expect in Work Management and Field Service Management by 2045



In November 2022, forecasters from the Metaculus[1] group stated that they believed there was a 50% chance that Artificial General Intelligence (AGI) would be achieved, evaluated, and announced to the public by the year 2040. However, due to recent break throughs in generative AI technology, such as OpenAI's video generator SORA, Metaculus's timeframe for achieving AGI has become even shorter.

A study conducted by Katja Grace[2] that surveyed 352 AI experts, cross referenced with two other surveys conducted in 2018[3] and 2019[4], showed that 50% of experts believe that AGI will be realised by 2060. 90% of experts predicted that AGI will be achieved within the next 100 years. However, as to the exact date, whether it be in 20 years, 30, 100 or more, experts are highly divided (Roser,2023).

This is due to the highly speculative nature of such predictions. Although in the last four or five years there have been exponential advancements made in generative AI that have led many to believe that we are getting ever closer to realising more human-like AGI, the nature of this technology and its development does not allow for one to make a precise prediction (Grace, 2024). Predicting the pace of any technological developments is challenging, there are numerous factors to be considered:

- The development of algorithms and computing power.
- The level of investment and global interest in AI research.
- Ethical and regulatory considerations that may slow down and shape the path of development.
- Scientific breakthroughs in understanding consciousness and human intelligence better.

It is important to approach any predictions with caution and remain aware of the multitude of factors at play, however, we will share our 20-year estimates regarding the future of Enterprise Resource Planning in Field Services Management and AI.

By 2045, Work Management and field service management are likely to be significantly transformed by advancements in robotics, generative AI, self-driving cars, drones, and self-diagnosing and self-repairing systems.

The future of work management is poised for a shift toward autonomous operations, integrating technologies like self-driving vehicles, drones, and robotic units to enhance efficiency and safety. These autonomous vehicles will revolutionise the transportation of goods and technicians, navigating to job sites without human intervention and managing their maintenance and repairs to optimise uptime. Drones, in particular, will play a crucial role in inspecting hard-to-reach areas such as power lines and wind turbines, conducting surveys, and performing minor repairs independently. Robotic units will manage a range of field tasks, from repairing complex machinery to maintaining infrastructure, especially in hazardous environments, thereby reducing the risks to human workers.

Work Management systems will evolve to support autonomous decision-making, leveraging vast data from internal operations to adapt business strategies and objectives in real-time, without human intervention. This shift will necessitate a parallel transformation in predictive maintenance, where generative AI will simulate scenarios to predict failures based on IoT data received and recommend pre-emptive actions, thereby minimising downtime, and prolonging asset lifespans. Embedded AI-powered sensors in assets and equipment will continually monitor their condition, enabling self-diagnosis and, in some cases, initiating self-repair.

The integration of AI will necessitate a transformation of the human workforce. Although automation will take over many tasks, **human roles will remain crucial, especially for complex problem-solving and tasks requiring nuanced judgment.** Workers will need to adapt and upskill, acquiring the skills to manage AI systems, program, and oversee autonomous operations. Augmented reality (AR) will enable remote assistance, allowing technicians to receive expert guidance without the need for travel, facilitating rapid response times and enable faster access to training on-the-go.

Service customisation and integration will see generative AI tailoring services to meet individual customer needs and creating innovative solutions for unique problems. Work Management systems will become part of broader smart city or environment infrastructures, enabling comprehensive management of both public and private assets. This technological shift will lead to labour market changes, with some jobs becoming obsolete and new roles emerging, highlighting the need for upskilling and new regulatory frameworks to ensure safety and

1 An American reputation-based, massive online prediction solicitation and aggregation engine dedicated to making timing, nature, and impact predictions of scientific and technological advancements.
2 A Researcher at the Machine Intelligence Research Institute in San Francisco, USA
3 165 experts surveyed by Baobao Zhang
4 296 experts surveyed by Gruetzmacher

ethical AI use.

AI's role will extend to strategic decision-making, using vast datasets to make high-level management decisions and real-time adjustments to work plans based on changing conditions like weather or traffic. This will optimise field service operations, marking a significant shift in how work is managed and executed, emphasising the synergy between humans and intelligent systems in shaping the future of Work Management.

In summary, I believe that by 2045 work management and field service management will be highly automated and efficient, leveraging AI, robotics, and autonomous vehicles. AI will not replace humans. Humans will still be needed, especially for tasks that require complex decision-making, creativity, and emotional intelligence. The focus for the human workforce will likely shift towards roles that involve the oversight and improvement of AI systems, strategic planning, and handling tasks that require a human touch. AI, while replacing some aspects of the human field workforce, will create new opportunities and roles that we can only begin to imagine today.

This is not a new concept to human society. With each Industrial Revolution there have been various jobs that have become obsolete, while new jobs have immerged and humans have adapted adequately in each instance, even if there was initial pushback. In 1760 the 'Spinning Jenny' was invented, the first mechanical loom. There were 7900 spinners and weavers in the United Kingdom and there were riots over this invention. This new machine would take their jobs, they believed. However, by 1790 the number of spinners and weavers in the UK rose to 32000 because the spinning jenny made yarn cheaper, bringing the price of cotton down and resulting in higher demand for manufactured clothes. Suddenly there was an economic boom because more people could afford manufactured clothes, leading to the increase of supply chains and supply factories, and thus the creation of more jobs. This led to the need for more roads and railways to be built to distribute the clothes, and thus ultimately the first Industrial revolution (Goldstuck, 2023).

We have now entered the fourth Industrial Revolution where robotics, technology, AI, and biology are merging in several ways, and much like in the 1700's humans become both excited and anxious of the unknown.

I believe that these are exciting times where all cities will become smart cities and field services will be highly automated and personalised to the customer's needs, improving the way that cities, countries, and the globe functions and connects, but that these advancements will not come with their own setbacks related to the navigation of human rights, job loss and ethical considerations of the use of AI.



Conclusion

This paper has discussed the transformative impact of Artificial Intelligence (AI) on Work Management, and Work Management tools such as Enterprise Resource Planning (ERP) systems and Field Service Management (FSM) software, exploring the evolution of these systems through the integration of AI as well as complementary technologies like Robotic Process Automation, the Internet of Things (IoT), Big Data, Augmented Reality (AR), and Computer Vision. This integration is pivotal in enhancing operational efficiency and optimising Work Management tools and processes.

AI's role in optimising various aspects of Work Management is significant and will continue to vastly change the landscape of Work Management as the technology continues to develop and improve. By leveraging machine learning and data analytics, AI enhances decision-making processes, intelligently automates routine tasks performed by software robotics (RPA) and facilitates predictive maintenance. This not only reduces downtime but also extends the lifespan of assets by predicting failures before they occur and improves inter-organisational processes. Furthermore, AI's ability to analyse vast datasets enables the optimisation of automatic task scheduling and resource allocation, ensuring that the right resources are deployed efficiently based on a variety of highly detailed criteria.

IoT contributes by providing real-time data collection from a network of connected devices. This data is essential for the continuous monitoring of asset conditions, enabling predictive maintenance strategies that pre-emptively address potential issues. IoT devices also play a crucial role in enhancing the accuracy of AI predictions and decisions, feeding AI systems with the necessary data to optimise operations.

Big Data analytics complement AI and IoT by processing and analysing the large volumes of data generated. This analysis yields insights that drive strategic decision-making and operational improvements. Big Data's role extends to enhancing customer service through the analysis of customer interactions and feedback, enabling more personalised and responsive service delivery.

Augmented Reality (AR) and Computer Vision further augment the capabilities of work management systems. AR provides field technicians with real-time, overlay information that enhances their ability to perform maintenance and repairs accurately and efficiently. This technology facilitates remote assistance, training, and safety enhancements by superimposing critical information onto the technician's field of view. Computer Vision, on the other hand, automates the inspection and monitoring of assets. By analysing images and videos, it identifies issues such as wear and tear, enabling pre-emptive maintenance actions and improving the accuracy of asset health assessments.

Looking towards 2045, this paper anticipates a highly automated and efficient landscape for work management and field service management, powered by these integrated technologies. Autonomous operations facilitated by self-driving vehicles advanced robotics and drones, combined with AI's predictive capabilities, are expected to redefine service delivery. Human roles will evolve to focus on overseeing AI systems, strategic planning, and handling tasks requiring nuanced judgment.

In conclusion, the synergistic application of AI, RPA, IoT, Big Data, AR, and Computer Vision is set to transform Work Management profoundly. These technologies, leveraged together, will enhance operational efficiencies. As we advance towards 2045, this integrated technological framework is anticipated to drive significant improvements in service delivery, operational efficacy, and the evolution of the workforce in the field service management and ERP domains.

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