

Running Head: OIL AND GAS



**MAC (Main Automation Contractor) Is an Innovative Way to Reduce Risk in
Automation Projects: Oil and Gas Sector**

Thesis Presented by

Group 976 Members

Group Leader : Ali Hussain Alyousef	ID # 20212005328
Wesam Mohammed Altorabi	ID # 20222005788
Ghannam Mohammed Al Muaddi	ID # 20222005367
Ahmed Thaar Alturaysi	ID # 20212005118
Abdullah Alrehaili	ID # 20222005498
Abdullah Bedaiwi	ID # 20222005451
Abdullah Alshehri	ID # 20222005534
Nsreen Alanazi	ID # 20222006023

Supervised by

Dr. Waleed Sulaiman

Dr. Fatma Mostafa

[16th Dec 2022]

Acknowledgement

First and foremost, praises and thanks to the God, the Almighty, for His showers of blessings throughout my research work to complete the research successfully.

I would like to express my deep and sincere gratitude to my research supervisor, Dr. Waleed Sulaiman & Dr. Fatma Mostafa for giving us the opportunity to do research and providing invaluable guidance throughout this research. His/Her dynamism, vision, sincerity and motivation have deeply inspired me. He has taught me the methodology to carry out the research and to present the research works as clearly as possible. It was a great privilege and honor to work and study under his guidance.

I am extremely grateful to my parents for their love, prayers, caring and sacrifices for educating and preparing me for my future. I am very much thankful to my wife and my daughters for their love, understanding, prayers and continuing support to complete this research work.

CHAPTER 1: INTRODUCTION

Introduction	6
Background	6
Problem Statement	13
Research Aim	13
Research Objectives	13
Research Questions	13

CHAPTER TWO: LITERATURE REVIEW

Role of MAC in Automation Project in Oil & Gas Industry	16
Choosing Right MAC Partner in Automation Projects	17
MAC Best Practices	20
Current Projects' Varying MAC Structures	21
Common End User Automation Project Needs	23
Understanding MACs and Realizing the Benefits	25
Key Technologies Use To Reduce Risk in Automation Projects	26
Big Data	26
Semantic Technologies	27

CHAPTER THREE: METHODOLOGY

Research Design	30
Research Approach	30
Research Philosophy	31
Data Collection	32
Data Analysis	33
Ethical Considerations	34

CHAPTER FOUR: RESULTS AND ANALYSIS

RESULTS AND ANALYSIS	37
----------------------------	----

Thematic Analysis	37
Theme 1: Planning of the automation activities	37
Theme 2: Involvement since the early stages of the project	38
Theme 3: Updating of project team in the automation technologies	39
Theme 4: Identification of end user needs	39
Theme 5: Training of operators	40
Theme 6: Reduction of the operators turnover	40
Theme 7: Updating of the execution procedures	41
Theme 8: Integration between automation and electrical package	41
Theme 9: Procurement of the field instruments and valves by the MAC supplier	41
Theme 10: Hiring of the MAC supplier by the end user	42
Theme 11: Training of procurement team of the end user	43
Theme 12: Technical support on site after the project completion	43

CHAPTER FIVE: DISCUSSION AND CONCLUSION

DISCUSSION AND CONCLUSION	46
Discussion	46
Conclusion	48

CHAPTER SIX: APPENDIXES

<i>References</i>	50
English Abstract	53
Arabic Abstract	55

CHAPTER ONE: INTRODUCTION

- ✓ INTRODUCTION
- ✓ BACKGROUND
- ✓ PROBLEM STATEMENT
- ✓ RESEARCH AIM
- ✓ RESEARCH OBJECTIVES
- ✓ RESEARCH QUESTIONS

Introduction

Background

Oil and gas companies, facing an uncertain time, must maintain output while cutting costs, optimising returns on existing assets, and protecting against cost disruptions (Saba, et al., 2021). The use of automation and intelligent technology is crucial to achieving such goals. In the modern, digital age, automation has emerged as a key factor propelling the oil and gas sector. Increased plant availability is a direct result of digitalization, automation, and the use of smart technologies, which put crucial data about the plant and its equipment within easy reach of the engineering, operation, and maintenance staff (Möllers, 2020). The capacity to access such data wherever it is needed is a key factor in achieving operational excellence and making quick decisions.

Operators in the oil and gas industry use MAC to accomplish projects for a number of reasons: The importance of technology is growing (Saba, et al., 2021). Oil and gas businesses need to automate core activities like data collection, process management, and analysis to stay nimble in the dynamic energy industry. As an effective replacement for using several geographically dispersed specialist suppliers, collaborating with a central automation expert who can combine different programmes necessary for precise and dependable automation is a viable option. Reduction costs of 10–15 percent may be realised when the end user collaborates with the automation contractor early in the project's execution (Wu, et al., 2022). Decreased profits. Competition in today's marketplaces is higher, and the pace of change is rapid. Every interested party is putting pressure on operators to reduce costs. Competence and experience that can be relied on are required. Maintaining a team of in-house specialists is a costly endeavour. In addition,

employees who retire take extensive and detailed knowledge about their former workplace's operations and process control with them (Mendoza, et al., 2021).

Config aimed for a certain goal. In order to provide a customised solution that is tailored to the unique automated system requirements of the end user, the MAC draws on its extensive real-world expertise (ZEMRANE, et al., 2019). The MAC method's advantages Time and money saved. Reduction costs of 10–15 percent may be realised when the end user collaborates with the automation contractor from the start of the project, as reported by Frost & Sullivan (Palaniyappan, 2019). The time an end user spends liaising with several EPC contractors and software providers is drastically reduced in MAC-managed projects. Efforts may be streamlined to reduce change orders, confusion, and costs. Control over the solution has been given to the end user. The automation provider cares very much about the user's goals and requirements, and responds much more quickly to their input. Partner MAC checks that the client's FEED-described vision is reflected in the automation system.

The MAC inspects and tests everything put in place, making sure there are no integration systems and that everything is in conformity with relevant policies, regulations, and accreditations. Ultimate achievement in all commercial endeavours. Infrastructure that can scale and grow with business needs is the user of careful collaboration between the business and an experienced MAC partner (Ghobadi, 2018). Project rate of projects is quite high. Through lowered implementation costs, accelerated commissioning, and easy changes to meet future demands, the MAC project boosts ultimate revenues. In project, investments in MAC-managed projects provide rapid returns by virtue of: Cost savings for the project Early go-live date due to pre-start-up testing that minimises commissioning issues Tailored to achieve a specific solution assistance after the fact The Optimal Methods of the MAC The MAC, in contrast to the current automation market where major

companies commoditize SCADA products, takes a holistic approach to implementation, including all phases, with the goal of providing an all-encompassing monitoring and control solution for oil and gas companies, from the wellhead to the executive suite. Value Access Chain The MAC is responsible for managing the whole life cycle of an automated control infrastructure, from the initial engineering and design through the final factory acceptance test (FAT), installation and commissioning, Site Acceptance Test (SAT), start-up, and maintenance (Harbud, 2022). The MAC acts as a client-side partner to ensure each stage of development is "evolve-ready," therefore maximising the project's value.

Implementing the idea of a "Digital Oil Field" paves the way for efficient remote operation of plant operations (Möllers, 2020). It supports for full Health, Safety, and Environment (HSE) compliance while limiting workers' exposure to risk. To guarantee plant availability with minimal output loss, automation delivers a "single window" operation for effective control of plant operation and supports predictive / preventative maintenance. While automation and smart technologies have many advantages, their implementation and actualization are not without challenge (Möllers, 2020). At every step of the deployment process, we encounter obstacles, including but not limited to: selecting technology, developing infrastructure, a shortage of experienced staff to manage the new technologies, various systems interfaces, an abundance of data, an alarm flood, cyber compliance, etc. Each challenge must be transformed into a chance to get the maximum advantages of "automation and smart technology." The EPC is free to concentrate on delivering project knowledge in line with their specific capabilities since the MAC assumes the risk and obligation involved with installing a complicated automation system. Successful MACs have worked with EPCs before, so they know how to tailor their level of participation to the EPC's expertise and risk tolerance (Mendoza, et

al., 2021). The project of the MAC should be strategic and change depending on the capabilities of the EPC(s) and the particulars of the project or application.

The Main Automation Contractor's (MAC) Goal is a Reliable Control System for the Future. The automated system contracting best practises for essential hydrocarbon assets in engineering, procurement, and construction (EPC) (Harbud, 2022). There are a lot of challenges in the essential infrastructure design, development, and implementation processes that oil and gas operators must face today. Completing a project successfully is difficult because of stringent laws and industry standards, tight project timelines, constantly evolving technology, and limited resources. A Main Automation Contractor (MAC) may provide value by coordinating the Engineering, Procurement, and Construction (EPC) activities involved in putting in place a process-of-the-art control system for the oil and gas industry (Ghobadi, 2018). If a skilled MAC is brought in from the beginning, the resulting automated system will be well-integrated, up to code, and able to provide real-time access to critical operational data across the enterprise, allowing for more informed, efficient, and effective decision-making in the interest of safety, security, and efficiency (Gajewski, et al., 2019).

The article shows that how the MAC methodology has been effectively used to several automated process control system projects. A simplified explanation would be that the Main Automation Contractor oversees all aspects of the automated process control system project, from inception to completion (El and Almentheri, 2020). Requirements (including security) (including security) Planning and construction Resulting from the Release of Testing Regulatory Approval for Use of Site Services include warranty, support, and routine maintenance Leadership in Project Management (Davila, et al., 2020). The MAC acts as a liaison between the end user and the team of suppliers under their direction, acting as a partner to ensure everyone

is on the same page and contributing to the project's success (Antwi, et al., 2018). The MAC will be responsible for ensuring the project is completed on time and within budget.

In today's competitive and ever evolving technical and economic contexts, process automation systems are being subjected to more complex demands. Customers want long-term, low-cost options that provide centralised, global oversight of all process plant activities in real time (ZEMRANE, et al., 2019). When the complexity of the project's execution is added to the challenge of establishing a plant in an area or nation where the essential technologies and skills are not easily accessible, the work of meeting customers' expectations becomes very challenging for engineering contractors. We need to reconsider our strategy for implementing projects involving automation in manufacturing facilities in light of the dwindling technical workforce and the lack of professionals in digital process automation (Zhao, et al., 2019). Using first-hand knowledge gained through the worldwide execution, design, engineering, and building of an LNG processing complex in Asia, the author discusses a broad range of factors and considerations that might contribute to the project's success.

Concept of the MAC, or primary automation contractor. Today's megaprojects are usually developed by a group of global corporations working together. In such cases, it may be beneficial to use global technical resources to design and engineer the automation project near to the project site, whether that be in Asia, Latin America, or another developing part of the globe (Zhao, et al., 2019). Consortia may wish to think about including the MAC concept as part of the EPC or as a stand-alone contract with a large MAC provider for process automation and digital system integration. Each project circumstance has its own unique set of possibilities and hazards, and they must be carefully involved. To what end does the MAC concept exist?

- Save money by completing the project on time.
- Benefit from the combined project, skills, and project of the team.
- Act as a cohesive team to achieve the project's savings (Yousif, et al., 2020).
- Achieve and achieve effectively to any technical risks or obstacles that may arise.

The tasks associated with a digital system may be excluded from the MAC's purview, and field instrumentation may or may not be included. It is ideal for the MAC to get involved in the project team at the front-end engineering project (FEED) phase, to collaborate with the EPC contractor throughout the detailed engineering phase, and to give invaluable assistance during plant commissioning and start-up (Wu, et al., 2022). Manufacturing projects have spent the last decade trying to find more industrial and less expensive methods to get their jobs done. Traditional stick-build design approaches for new projects are frequently abandoned in favour of more modular approaches, which integrate many skids from various manufacturers (Sundar, 2021). Modular design, modular skid design, and/or package construction are all terms used to describe this new approach to product development. There are significant integration and project management hurdles to overcome when adopting this new approach, despite its advantages in terms of adaptability, scalability, and speed to completion (Saba, et al., 2021). It is important to choose a MAC who is familiar with the processes of the several skid builders involved in a project, since these large-scale projects frequently need the participation of as many as fifty separate businesses.

A Process Automation System (PAS) is a computerised system that automates and manages a given industrial process by providing the essential control and informational capabilities. In the oil and gas business, the PAS is utilised for automated process control (Palaniyappan, 2019). Safely operating an industrial process and guarding against upsets and failures within the process require Process Automation Systems in

Megaprojects, which typically consist of thousands of field instruments, communications between field devices and the control processors; control networks, human machine interfaces (HMI), and several sub systems. Elements that make up a typical refinery's Process Automation System, able to handle a daily output of 300,000 barrels (Mendoza, et al., 2021).

Two examples of recent Oil and Gas sector megaprojects that included very complex design and implementation of Process Automation Systems are the Reliance Industries Ltd. Export Refinery Project in Jamnagar, India, and the BP Whiting Refinery Modernization Project (WRMP) in Whiting, Indiana. These two projects are the result of a large number of EPCs operating in tandem, with engineering centres positioned all over the world. When Bechtel (Engineering, Procurement, and Construction Contractor) completed the Reliance Jamnagar complex in northwest India, it was the world's largest refinery and petrochemicals complex (Palaniyappan, 2019). Along with a 600 MW power plant and expanded port infrastructure, a second refinery with a 580,000 bpd capacity was constructed as part of the project. The final cost of the project was about US\$6 billion. BP's Whiting Refinery upgrade in Northwest Indiana is the second project (International Oil and Gas Company). In terms of size and complexity, the WRMP is BP's largest and most complex refinery project in recent history (Möllers, 2020). The Whiting Refinery Modernization Project ("WRMP") entails moving the refinery's three largest crude distillation units and adding coking capacity and supporting processing units to increase the refinery's capacity to process oil.

Problem Statement

In the past few years, it is showed that there are huge delays comes in the Automation Projects in Oil and Gas Sector (Zhao, et al., 2019). Multiple reasons has been comes out in the delay of the projects. Most of the oil and gas firms across all over the globe faced numerous problems and comes in a great loss. Most business owners used many methods for the purpose to reduce risks and delays in the automation projects but could not achieve success in a professional manner. MAC (Main Automation Contractor) can be considered as the most useful and effective way to overcome on this issue as compared to the other methods in oil and gas sector (Wu, et al., 2022).

Research Aim

The core aim of the research is to explain the significance of the MAC (Main Automation Contractor) for the purpose to reduce the risks in the Automation projects in Oil and Gas Sector.

Research Objectives

Following are the main objectives which will be very useful for the researchers to accomplish the goals of the research in an effective manner:

- To determine the problems arises in the delaying of Automation Projects.
- To understand the importance of MAC (Main Automation Contractor).
- To describe the significance of the Automation projects to the owners of Oil and Gas firms.

Research Questions

Below questions will be considered as the most crucial questions for the researchers to achieve the aim of the research:

- What are the core reasons of delaying in the automation projects?
- What are the difficulties faced by the business owners during the Automation projects?
- What is the most reliable and effective way to reduce the risks in Automation Projects?

CHAPTER TWO: LITERATURE REVIEW

- ✓ Role of MAC in Automation Project in Oil & Gas Industry
- ✓ Choosing Right MAC Partner in Automation Projects
- ✓ MAC Best Practices
- ✓ Current Projects' Varying MAC Structures
- ✓ Common End User Automation Project Needs
- ✓ Understanding MACs and Realizing the Benefits
- ✓ Key Technologies Use To Reduce Risk in Automation Projects
- ✓ Big Data
- ✓ Semantic Technologies

Role of MAC in Automation Project in Oil & Gas Industry

In most cases, a single company called the main automation contractor (MAC) would be in charge of coordinating and being accountable for every facet of an automation project (Gajewski, et al., 2019). Because many owner-operators no longer maintain large in-house automation teams, they may feel overwhelmed by the complex web of automation contractors and subcontractors necessary for every particular project, especially the large, intricate, and groundbreaking endeavours of the last decade. Once upon a time, MACs were often large, all-inclusive automation firms or significant system vendors. However, in recent years, consumers have grown to anticipate that EPC contractors and certain larger systems integrators (SIs) would also serve as the MAC (Davila, et al., 2020). Even more formally, certain system integrators and automation engineering companies provide MAC services. Because of this, consumers have more options when deciding how to carry out an automation project (Tang and Liu, 2022).

It is customarily the responsibility of the Main Automation Contractor to design, engineer, and deliver all automation-related equipment and systems (field instrumentation, control systems, safety systems, etc.), as well as to guarantee the safe and secure integration of these systems and to provide the necessary support services (Zhao, et al., 2019). MACs are increasingly being required to interface the electrical and other plant systems with the automation systems.

Virtualization and cloud computing are two examples of IT-enabled techniques and technologies that benefit MACs (Mendoza, et al., 2021). These provide a new difficulty in that they let more design and testing to be done before committing configurations to equipment. The IoT is also playing a new role in the creation of novel solutions and business models as more original equipment manufacturers (OEMs) incorporate

internet-accessible intelligence into their products and as more IoT-enabled applications are deployed at the network's edge (e.g., edge computing, analytics, etc) (El and Almentheri, 2020).

The Open Process Automation Forum (OPAF) is also anticipated to have an effect on MAC functionality in the future (Möllers, 2021). A few years ago, ExxonMobil and Lockheed Martin collaborated on an initiative to create a next-generation open and secure process automation system, and Lockheed Martin proposed that the Open Group serve as the project's executive sponsor. The standardised, interoperable modules envisioned by this initiative have the potential to greatly simplify a MAC's workflow by doing things like getting rid of redundant jobs and reducing the number of possible approaches to a problem (Wu, et al., 2022). A MAC would be well to keep tabs on the initiative and, ideally, take part in it, so that it may learn how to provide the most benefit possible to its end customers.

As a result of the steep decline in energy prices over the new few years, a lot of upstream oil and gas sector projects have been put on hold or scrapped (Palaniyappan, 2019). However, it's probable that this kind of activity will resume, at least partially, at some time. One thing is for sure, though: Any new projects that do materialise will be scrutinised like never before. Cost or time overruns on a project will no longer be tolerated. One of the most crucial aspects of a primary automation contractor's value offer is the handover of a fully functional, well-engineered, and cost-effective automation system (Möllers, 2020).

Choosing Right MAC Partner in Automation Projects

The choice of alliance partner is a critical one for owner corporations considering MACs. You may choose from the following three options:

- Providers of Control System
- The Role of EPC Companies

- Third, those who combine several systems into one.

There are benefits and drawbacks to each option. The scale of the automation project is a key consideration when selecting a reliable business partner (Yousif, et al., 2020). Is a DCS vendor the best option if, for system, the project requires extensive work on safety instrumented systems and the integration of process analyser's? Customers often choose control system suppliers as their MAC partners because they view the vendors to be the best knowledgeable about the system. This project may hold water if we're talking about the control system as a strictly technological product, but projects don't always work that case. For most automation projects, the control system is just part of the overall picture (Sundar, 2021). The installation and integration of external systems and applications pose significant challenges for automation projects. While they may be experts in instrumentation and engineering design, many suppliers of control projects lack knowledge in system integration, an essential part of any automation system. If they are critical parts of the scope, then the vendor of the control system may not be the best choice for a MAC partner.

Whether or whether the project has a single control system vendor choice is another factor to think about. It makes no sense to have a vendor write specifications or set standards if these activities are performed as part of the initial MAC process, before a control system vendor is chosen (Ghobadi, et al., 2018). Papers completed by a vendor will be biased in favour of that vendor, rendering the bid documents useless.

In a similar vein, how can one control system vendor ensure uniformity of system on another vendor's system if the MAC covers numerous locations that use different control systems? Finally, early project-vendor linkages for control projects may reduce hardware system savings and increase total cost of ownership. Competitive bidding for control system hardware often leads in a more aggressive corporate discount structure and an improvement in total project costs (Yousif, et al., 2020). The advantages of a

vendor-agnostic, independent-party MAC service provider over a vendor of the control system are obvious in such cases.

Since they don't make money off of selling hardware, MACs that are independent of hardware vendors may be more objective (Zhao, et al., 2019). Providers of vendor-neutral MAC services should actively seek out ways to include the control system vendor in the team's many fruitful iterations. Independent MAC partners don't try to expand the project's remit unnecessarily and instead act as an extension of the owner in their pursuit of the optimal team composition (Bhatt, 2019).

Independent or vendor-neutral MACs may be provided by system integrators or engineering, procurement, and construction (EPC) organisations. Expertise in DCS, PLC/HMI, SIS, historian, analyser's, instrumentation, and other core systems that make up the bulk of automation projects should be a given for any independent MAC (Tang and Liu, 2022). Moreover, independent MACs have the benefit of having a team that is well-versed in the majority of the most knowledgeable vendor platforms, allowing them to provide expertise for a wider range of systems if required.

Sometimes, system integrators have difficulties due to a lack of specified work procedures and project management. You shouldn't overlook these crucial elements of effective MACs.

When a project requires extensive engineering and construction work, EPC projects often become the preferred choice (El and Almentheri, 2020). Some EPC firms see instrumentation and engineering more like a department than an independent discipline, and so lack a dedicated automation section. Here, they often lack in-depth familiarity with the highly specialised sector of automation and have an insufficient number of experts on case. These flaws may necessitate doing extra work just when time is of the essence (Geraldo, et al.,

2019). When looking for a partner, it's important that they have expertise in measuring, tracking, and reviewing automation deliverables.

An EPC company with a specialised automation branch is a great MAC partner. Organizational owners benefit from the entire design skills of an E&C engineering combined with the particular expertise of a system integrator. Assets often brought by EPC businesses to a MAC include defined work procedures and project management competencies (Davila, et al., 2020). Finally, it is up to the owner organisation to identify the most important assessment criteria and choose the MAC alliance partner that best fits their requirements.

MAC Best Practices

MAC's success depends just as much on careful programme management as it does on methodical project execution. During the course of an automation project's execution, it's important to have a few specific instruments at your disposal for monitoring and assessing progress (El and Almentheri, 2020). Using these methods, you can make that productivity goals are being fulfilled and delays to projects are kept to a minimum. Providers of MAC solutions must be able to provide the following services:

- To better define costs and deliverables, we provide front-end loading (FEL) stage gate execution.
- List of FEL deliverables with an emphasis on automation
- Staff-heavy agendas
- Comprehensive schedules incorporating all components of EPC across all relevant automation projects (Mendoza, et al., 2021).
- Earned value monitoring and reporting, in particular on essential software configuration items like points, graphics, and logic
- A well-thought-out and documented cutover strategy and plan

Current Projects' Varying MAC Structures

In, it is looked at how ADMA-OPCO has selected the same OEM as MAC for the aforementioned three new areas. MAC's primary scope is on providing end-to-end automation solutions for process plants, minus the individual packages (Ma, et al., 2018). All ancillary components of the ICSS system, such as field equipment, AMS, automated procedures (such the sequential automation of a plant), and historical data administration, are included. The MAC control network serves as the facility's primary backbone for industrial networks and is in charge of managing all of the network's security protocols. Unlike the MAC selection technique, EPC chooses a Package Supplier during the project's detailed engineering phase to handle the automation of any subsystem packages (Harbud, 2022). EPC is the prime Contractor responsible for overseeing MAC and the Package Suppliers to ensure they adhere to all Company Policies, Project Requirements, and Detailed Engineering Documents. All three of the new facilities may use the data shown above. However, the theory behind the subsystem interface distinguishes Field C's MAC strategy from the other two. All subsystem packages have been organised by ADMA-OPCO into three groups: Different from types 2 and 3, etc. Type-1 packages are smaller, simpler packages such as chemical injection packages, for which the Package Vendor does not provide a control system. Instead, the ICSS is used to construct the full logic for process control and safety.

A Unit Control Panel (UCP) and Human Machine Interface (HMI) are included in Type-2 packages, which are complicated systems (Ghobadi, et al., 2018). In most cases, EPC will allocate a different supplier for the F&G and MMS of Type-2 packages, outside of the scope of the Package vendor. One example of a Type-2 Package is the instrument air compressor. The equipment skids that make up Type 3 packages are often rather complex, having their own dedicated process control, safety, and machinery protection systems, as well as their own F&G System (e.g. Gas Turbine Compressor) (Geraldo, et al., 2019). The hardwired interface

of Type-1 packages is within the MAC's scope in two of the aforementioned programmes. Serial (MODBUS TCP/IP and RS-485) and OPC Protocol are used to connect type-2 and type-3 packages to MAC systems. The third area, in contrast, allows for the full automation of Type-1 and Type-2 packages using systems supplied by MAC in addition to the primary process plant. Although this work is focused on minimising the number of points of interaction between the various plant control systems and their outputs, it is noteworthy that Field C now supplies MAC field instruments in both type-1 and type-2 packages (Gajewski, et al., 2019). Despite this, MAC is free to choose a different manufacturer for appropriate field equipment, and it will have no effect on the facility's control system architecture as a whole.

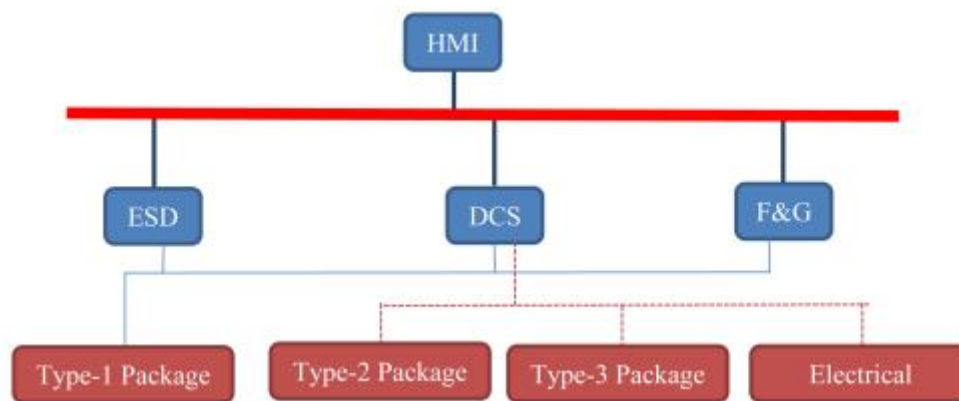


Figure 1: ICSS Architecture for Fields A and B (Scheme-1)

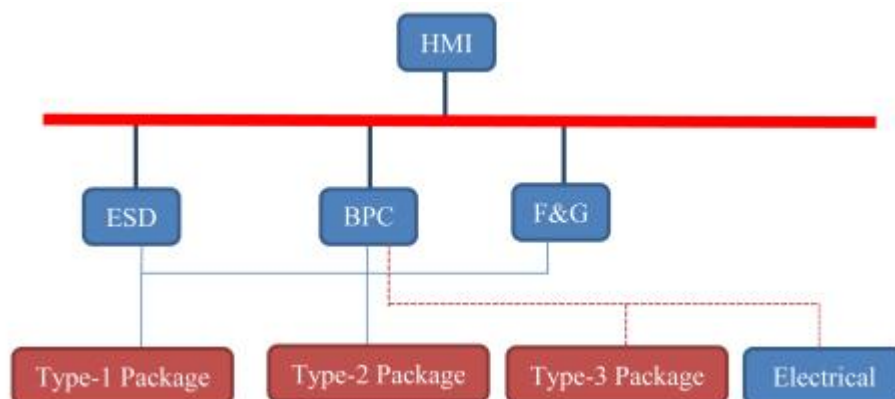


Figure 2: Architecture for Field C (Scheme-2)

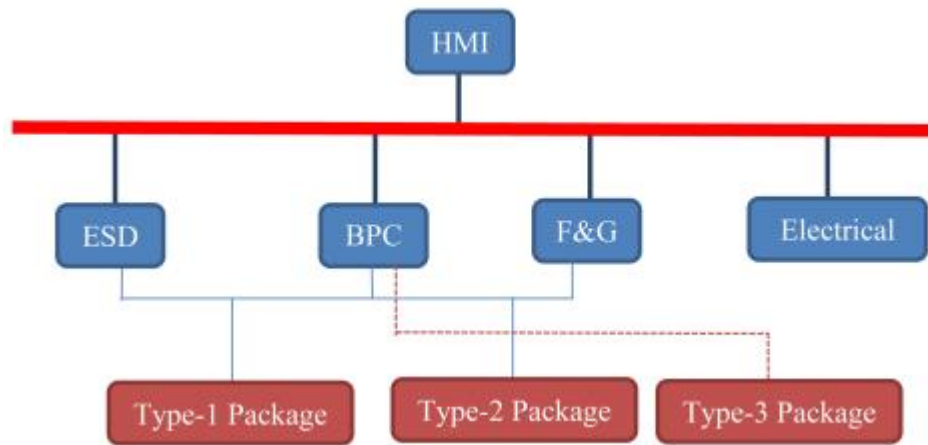


Figure 3: Proposed Extended MAC Architecture for Future Projects (Scheme-3)

Common End User Automation Project Needs

Following are the common end user automation project needs which are considered in any automation project in oil and gas industry.

Low total cost of ownership (TCO): Reasonable project costs are a necessity. This starts with doing a good cost of evaluating costs before starting any automation projects. However, individual cost of ownership (TCO) should be examined in a broader context than just one project at a time (El and Almentheri, 2020). Imagine a chemical plant has three control system migration projects all due at the same time. Each project may wind up being given to a different engineering firm and supplier if the lowest individual costs of ownership (TCO) bids are used to choose the projects. The total cost of ownership (TCO) for all three projects is unlikely to be as low as it might be if shared resources were used to their full potential and commonalities were leveraged. To provide just two examples, the whole lifespan cost, especially for on-going engineering and maintenance, will be higher, and so will the cost of educating employees.

Every automation endeavour strives for the best possible technical answer: The issue is whether the best technical solution for a certain project also happens to be the best solution in individual. For instance, it may be optimal to install a distributed control system (DCS) controller with a 250 I/O capacity if that is what is needed for a certain project (Davila, et al., 2020). An initial investment in a controller with a capacity of 500 points may be preferable if a later project would need an extra 150 I/O. It is important to look at the whole slate of projects, rather than just looking at individual ones, if the optimal technical solution is to be implemented.

Timeliness: Control system migrations, safety-related implementations, and regulatory compliance projects are all examples of automation projects that must adhere to strict timetables (Davila, et al., 2020). Moreover, many automation projects call for unit outages or a plant shutdown, which means that many criteria go into selecting completion dates, with little room for completion delay. For automation projects to have minimal effect on operations, their activities must be coordinated and integrated.

Having success on the first try: A When a project is successfully completed it is due in large part to the quality of its execution. The time and cost required in any necessary rework will increase (Antwi, et al., 2018). The successful conclusion of automation projects is crucial. They may halt operations at the plant and could create safety and environmental concerns if applied incorrectly. Project success may be boosted by familiarity with the space, its resources, and the people working on it.

Automation projects sometimes include retrofits or additions to pre-existing units, therefore it's important that they integrate seamlessly with the current infrastructure (Ma, et al., 2018). This implies that any new automation gear must be compatible with the current automation system. Having a background in plant may greatly improve the odds of a smooth transition.

Understanding MACs and Realizing the Benefits

The meaning of a MAC might vary widely depending on who you ask in the business world. A MAC, in its most basic form, is an alliance service provider that looks out for and helps out with any and all areas of an idea's or plant's automation projects, right from the start of concept until the moment when they become live (Khoso, et al., 2021). Conventional transaction-based automation projects are carried out individually, with dispersed teams. Using this approach, most projects may be finished independently of one another, with no sharing of insights or best practises. Each project's costs are likely to rise under this strategy, and cost differences across projects will widen (Tang and Liu, 2022). The MAC paradigm shifts the emphasis of automation work from isolated transactions to collaborative initiatives.

Over the course of many years, MAC vendors often take part in the vast majority of an organization's or a single facility's automation projects (Zhao, et al., 2019). Depending on the chosen implementation approach, the MAC's responsibilities may include front-end engineering, standards oversight, program/project management, and quality assurance, among other aspects. It is not uncommon for MAC suppliers to be responsible for activities such as project implementation, testing, and commissioning. Many projects in the realm of automation focus on a control system, but it's vital to remember that there are other aspects to these projects as well (Bhatt, 2019). The success or failure of an automation system often hinges on how well these aspects are integrated. Because of the critical nature of this process, it is vital to choose a MAC alliance partner that has thorough knowledge of automation options.

Key Technologies Use To Reduce Risk in Automation Projects

Big Data

Oil and gas companies must acquire and handle more data than ever before and ideally with fewer personnel. According to industry analysis company IDC¹, the digital cosmos presently holds 2.7 zettabytes of data (ZEMRANE, et al., 2019). Companies in every area struggle to store analyse and get usable information from such vast volumes. In oil and gas, innovations in instrumentation, process automation, and cooperation are expanding data volumes even faster. Data comes from sensors, geographical and GPS coordinates, weather services, seismic recorders, and different measuring equipment, as well as data market feeds, social media, email, text, photos and multimedia (Saba, , et al., 2021).

Much of this data is “unstructured” or “semi-structured,” which means it is difficult or expensive to store in typical data warehouses or frequently query and analyse (Zhao, et al., 2019). Managing Big Data needs a methodical strategy and deployment of a composite of hierarchical services geared at solving the difficulties of data volume, velocity, diversity and resulting complexity. These must be handled at each step of the data management process: access; visualisation and analytics; processing and transmission; and storage (Möllers, 2021).

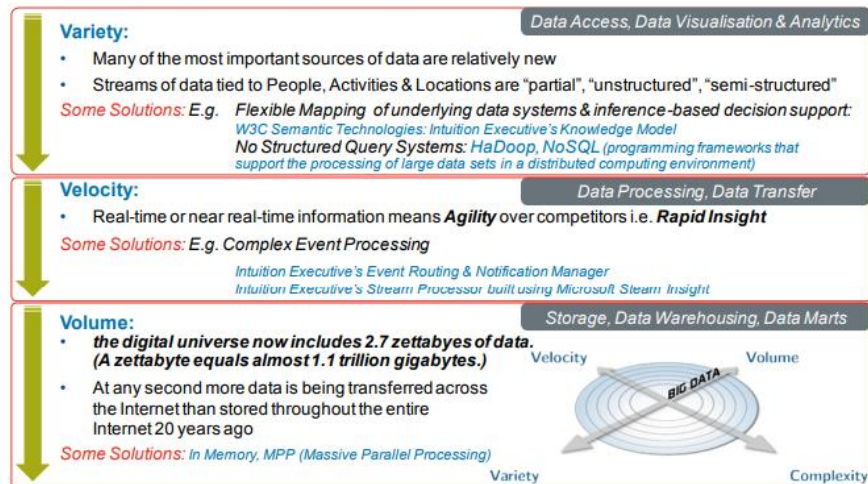


Figure 4: Three facets of the Big Data Challenge

Semantic Technologies

Semantic Web technologies employ W3C semantic web standards, a common basis that allows data to be shared and reused across application, corporate, and community boundaries, and are therefore essential to integrating information from disparate systems and databases across the organisation (Palaniyappan, 2019). The "World Wide Web Consortium", which monitors the web's on-going development, is behind the semantic web, which aims to integrate logic with the WWW. It's the foundation for tools like Yahoo Pipes and Facebook Graph Searches, which rely on inference to facilitate less structured approaches to data collection and analysis. The World Wide Web Consortium (W3C) aspires to standardise the resource description framework, web ontology language, and specific query languages like SPARQL. To facilitate better mapping across the data sets, they effectively reveal any data source and data type in a consistent and normalised manner (Sundar, 2021). This paves the way for data in the oil and gas sector to be shared and reused across applications, community boundaries, and the organisation. Collaboration is greatly aided by this factor. A unified query language allows for real-time access to heterogeneous data stored across disparate data sources.

The end result is enhanced data contextualization and the ability to identify relationships (Wu, et al.,2022). Simply said, it simplifies access to and interpretation of diverse data, as well as reporting and use of that data across the operation, therefore overcoming the challenges of data complexity and variety.

To do this, semantic web technologies like RDF, OWL, and SPARQL normalise otherwise complex data structures into simple "graphs" in which everything has a subject, a predicate, and an object, or triples (Yousif, et al., 2020). Relationships and things may be linked via arbitrary relationships, and behaviour can be inferred from these rules. Your data model more closely resembles a language (hence "semantic" and the label "Semantic Web") the more triples relationships you define, the more triples you have to describe something (such as a well), and the more relationships you have providing context to the triples, and the more inference rules you have to suggest answers (Zhao, et al., 2019). Now, instead of using ETLs and complex queries to access a wide variety of data sources, as was necessary with traditional data sources, users can simply "ask" questions using natural language.

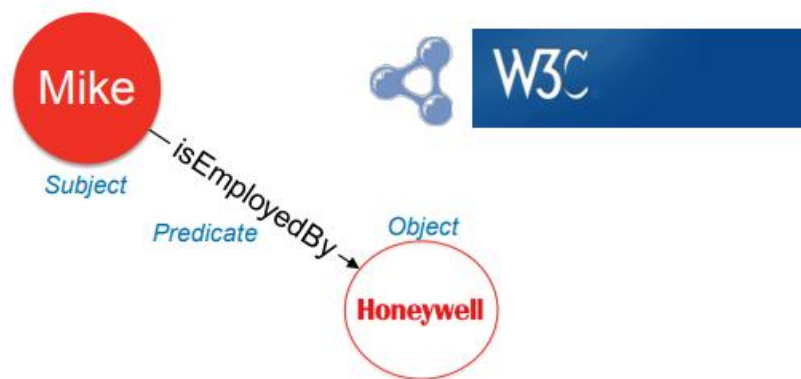


Figure 5: Subject, predicate and object: a triple

CHAPTER THREE: METHODOLOGY

- ✓ Research Design
- ✓ Research Approach
- ✓ Data Collection
- ✓ Data Analysis
- ✓ Ethical Considerations

Research Design

Important aspects of a research design include the methods used to conduct the study (Ghobadi, 2018). The primary goal of the research design is to collect information in the most efficient and effective way possible. The research design is supportive in producing new insights into the topic. Researchers have a wide research of options while investigating a new topic or research (Ma, et al., 2018). However, the secondary design utilised in this work is the most appropriate and effective option given the subject topic. The primary method for going this way is the fantastic means it gives researchers to collect data on the topic at hand.

The secondary method is effective because it allows the reader to pose the issue in a more academic way than the other researchers (El and Almentheri, 2020). The most crucial aspect of the human experience is one that defies numerical description. The researchers also benefit from the secondary qualitative method in their pursuit of an understanding of how MAC mitigates risk in Automation Projects. The important advantage of the secondary research method is that it requires less time investment on the part of the researchers. In a secondary design, participants play no important role in the research. In other words, secondary sources analyse or critique main sources (Heggedal and Mavropoulos, 2022). The fundamental value of secondary sources is that they provide an important perspective on data collected from primary sources (Rachman and Ratnayake, 2018).

Research Approach

In this case, the research approach was chosen as the most suitable plan and procedure. The reason for this is because it skips right past all the different assumptions (Gajewski, et al., 2019). Using a research-based approach has its greatest benefit in the way that the issues' nature is established on solid footing. Researchers might use a number of different techniques to their research, but the qualitative research

approach is what has been chosen for this work. The primary goal of this approach is to facilitate the emergence of research results from the underlying relevant themes in raw data (Harbud, 2022). Using a qualitative approach has the benefit of being based on forecasts of the future, which may help you make more informed decisions. Researchers may learn about the topic's present research and imagine the challenges they could face in the future. An effective and straightforward way of research may be developed by the researcher using a qualitative research approach (Majdani, 2020).

The primary justification for using qualitative methods is that it provides the researchers with the most beneficial systematic approach (Gajewski, et al., 2019). Researchers are led in the direction of their assessment goals by using this approach. Researchers rely heavily on the qualitative approach in this research, which starts with hypotheses and observations on the effect of the MAC (Main Automation Contractor) on the Automation Projects. Consistencies, patterns, and similarities in the research topic are very supportive in achieving the paper's objectives. The research's qualitative approach is supportive to the theory of new theories (Davila, et al., 2020). The research of this research lies in its contextualization. Researchers find the qualitative approach helpful in identifying broad themes and constructing a working theory. Researchers may benefit from using a qualitative approach because it helps them generate meaning from data by highlighting patterns and linkages.

Research Philosophy

Research philosophies are used to assess the merits of the case, the difficulty of the challenge, and the significance of the notion. Ghobadi (2018) found that an individual's philosophical stance toward a research project was influenced by his or her perceptions about the research's chosen philosophy. Value questions may be better managed if the research philosophies are able to boost the research's capacity to

arrange thoughts and problems (Harbud, 2022). The four most common research philosophies utilised by scholars while investigating a topic are pragmatism, realism, positivism, and interpretivism. On the other hand, the researchers in this study use an interpretivist stance in order to make sense of the whole Main Automation Contractor (MAC) process in Automation Projects. Researchers find an Interpretivism philosophy especially useful since it allows for subjective interpretations of the social world. The primary benefit of this research philosophy is its emphasis on identifying and analysing the many ways in which individuals encounter the social world (Ma, et al., 2018).

The research here employs a research of observations filtered via the interpretivism guiding philosophy. Researchers find the observation very useful since it keeps a close eye on the status of Automation Projects. When trying to solve problems that have arisen in Automation Projects, researchers have found that the interpretivism research philosophy is very useful in determining the best and most relevant information on the topic.

Data Collection

When investigating any given issue, researchers used a wide research of techniques. The research used a secondary qualitative method (Geraldo, et al., 2019). In order to compile information pertinent to the "MAC (Main Automation Contractor) that is a new technique to decrease risk in Automation Projects," the researchers consulted a wide variety of scholarly works. The seven articles utilised by the researchers in this research all contributed significantly to the collection of relevant and accurate information. When using a secondary qualitative research method, articles and journals are often regarded as the most efficient and fruitful option (El and Almentheri, 2020). The researchers presented in this work would not have been possible without the assistance of the seven aforementioned articles.

Both Google Scholar and the Google Search Engine have compiled all data pertaining to the Main Automation Contractor (MAC) in Automation Projects. MAC, Risk, Automation, and Projects are the most prominent examples of key phrases utilised throughout this research. Using the Google Scholar database, we see that 200 results have been displayed. On a Google search for "effect of MAC (Main Automation Contractor) in automation projects," 50 results were displayed. The best results that are relevant to the issue have been related with the help of both databases.

Data Analysis

The technique's primary focus is on the analysis of data (Heggedal and Mavropoulos, 2022). In order to analyse a reliable analysis, the data analysis method of choice must be very reliable. There are a variety of possible analyses that may be performed on the data, and they can all provide light on the topic under investigation. However, "Content Analysis" is chosen as the best suitable data analysis method to be used throughout the paper. The purpose of content analysis is to identify recurrent topics, ideas, or terms within a collection of qualitative data (i.e. text). Content analysis allows researchers to measure and analyse the frequency, presence, and interconnectedness of certain words, ideas, or concepts (Davila, et al., 2020). Researchers, for instance, may examine a news article's text for signs of prejudice or partiality. From these writings, researchers may infer time about the texts' themes, authors, readers, and even the historical and cultural text in which the texts were written (Abdussalam, et al., 2021).

Content analysis was chosen in large part because it is often considered as the simplest method of data analysis. When analysing the paper's text for patterns, this method proves to be really useful and beneficial (Llanca, 2019). The method's patience in obtaining comprehensive findings comes from its reason to reread pertinent materials, which is another one of its strengths when dealing with data topics. Data on

wound treatment may be analysed in a number of ways, but content analysis is one of the most useful (Palaniyappan, 2019). Therefore, it is essential to become familiar with the data and do an in-depth analysis. This is where Content analysis's extensive analysis of the data across all stages makes it the appropriate method for analysing the data. Researchers need to employ "Content Analysis," a technique for analysing massive datasets, to acquire an accurate analysis of how wounds are treated in mental facilities (Antwi, et al., 2018).

The most important advantage of the content analysis method is that it analyses textual communication in depth (Wu, et al., 2022). One of content analysis' primary benefits is that it may be used for both qualitative and quantitative analysis. Long-term, it's a great time to learn about our past and our culture. Data may be accessed quickly and easily. The text in its coded form may be analysed statistically. The strategies for use analyse interactions that don't draw too much attention to themselves. It helps us understand intricate mental and linguistic models. Consider a "precise" research method when executed properly (Sundar, 2021). As a research method, content analysis is both simple and affordable to use. When integrated with other research techniques like interviews, observation, and historical documents, it becomes a potent instrument (Möllers, 2021). It's great for analysing the past, particularly for tracking changes over time.

Ethical Considerations

When conducting research on any topic, it is important that researchers keep a number of ethical factors in mind (Zhao, et al., 2019). Ethical concerns are the most important ethics and values in a study since they direct how the research is planned and carried out. Confidentiality, informed consent, and the risk of damage in terms of participation and disclosure are all values that have been embraced (ZEMRANE, et al., 2019). There was a reliance on previously conducted research involving human subjects, which needed

permission from a secondary ethical research (Yousif, et al., 2020). In light of what has been considered from conducting the research on the topic of "MAC (Main Automation Contractor) in Automation Projects," it is clear that researchers must give careful attention to a number of ethical factors.

For researchers, maintaining the confidentiality of vital information about automation projects is the first and most important ethical responsibility (Rissman, et al., 2020). The reason for this is that the people working on automation projects may face troubles in the industry if any sensitive information relating to these projects is revealed in the research. Correctly attributing authors' work is the second most important ethical requirement when working with secondary data. Researchers should check to make important that they aren't using the same secondary sources more than once, since this might skew the findings.

The third ethical factor to show into account is whether or not the researcher presents any negative information regarding the MAC. When studying the effects of MAC, academics seldom provide a concrete example demonstrating why people would rather not use this strategy for risk mitigation in automation projects. This indicates that negative instances of the MAC that the researcher shows about but chooses to ignore. The researchers' impact is warranted, since MAC's negative effects have been clearly shown to have a major impact on the industry.

CHAPTER FOUR: RESULTS AND ANALYSIS

- ✓ Thematic Analysis
- ✓ Theme 1: Planning of the automation activities
- ✓ Theme 2: Involvement since the early stages of the project
- ✓ Theme 3: Updating of project team in the automation technologies
- ✓ Theme 4: Identification of end user needs
- ✓ Theme 5: Training of operators
- ✓ Theme 6: Reduction of the operators turnover
- ✓ Theme 7: Updating of the execution procedures
- ✓ Theme 8: Integration between automation and electrical package
- ✓ Theme 9: Procurement of the field instruments and valves by the MAC supplier
- ✓ Theme 10: Hiring of the MAC supplier by the end user
- ✓ Theme 11: Training of procurement team of the end user
- ✓ Theme 12: Technical support on site after the project completion

RESULTS AND ANALYSIS

In this chapter, all the findings and data collected from authentic resources and experts researchers in the domain with this dissertation's topic has been analysed. Thus, as mentioned earlier in chapter 3 that it is secondary qualitative study. Therefore, the results will be analysed thematically by picking the common areas and create themes.

Thematic Analysis

So, based on the findings this research can verify these important themes for the reasons behind delays in Automation projects in oil and gas sector and the best way to reduce risks and project delays by using MAC (Main Automation Contractor) solution:

Theme 1: Planning of the automation activities

The vast majority of respondents pointed to substantial implications of automation in project delivery, with some referring to it as the "heart" of the factories. It has an immediate influence on the costs of operation (OPEX). The repercussions of this on the timeline, the money, and the resources that were available varied greatly from project to project (Tang and Liu, 2022). The majority of the implications are, most obviously, the result of delays in completing operations linked to automation, which in turn has an effect on the launch of the project. Due to the fact that its worth is quite modest in comparison to the other aspects of the project, the automation's effect cost is relatively low. However, because of the indirect impact it has on expenses, the delay in the start-up of the project can be the single most important financial consideration (Khoso, et al., 2021). The majority of the funds allocated to the project will be allocated to the automation processes that will be implemented at the very end. Because the project as a whole is running behind

schedule, the mobilisation of teams will need to be significantly increased in order to bring it back up to speed (Ma, et al., 2018).

However, due to the low cost of automation within project budgets, it is given minimal attention and is only recruited in the execution of final stages. This is despite the fact that many people have claimed that the most significant cause of negative outcomes is directly related to the planning components of development. Because of this, it is very necessary to include the planning of the automated operations into the overall planning of the project as soon as possible (Antwi, et al., 2018).

Theme 2: Involvement since the early stages of the project

As of its low position in the budget, automation is often only used as a fallback option after all other options have been exhausted. In the end, this results in misunderstandings between those responsible for automation and those responsible for maintaining process discipline (Geraldo, et al., 2019). The majority of respondents are in agreement that automation should be viewed as a strategic issue. This is not because of the initial cost (Capex), but rather because of the influence it has on operations and maintenance throughout the lifespan of the plant. In addition to that, it was observed that the use of automation in the workplace is becoming more widespread, particularly in the latter phases of project completion (Harbud, 2022). The primary rationale for this restriction is because the expenses and time delays in delivery that would result from making any adjustments are often not acceptable to either the contractor or the client. The contractor's recruitment strategy for the automation system made this cooperation feasible, and the greatest results were seen when the automation was implemented from the very beginning of the engineering project development process (Khosro, et al., 2021).

Theme 3: Updating of project team in the automation technologies

The responses almost unanimously pointed to the fast growth of automation technology as the key cause for the sluggish rate of upgrading, and this was cited as the primary reason for the poor pace of upgrading (Ma, et al., 2018). As a consequence of this, it is very difficult to keep teams completely informed since there is not enough time to complete the required training. It was also brought out that many specialists, although having a strong academic background and great technical aspects, have very little field experience, which has an influence on the implementation of even not-so-recent developments. This is an additional essential issue that was brought up. It was said that because of this lack of expertise, the potential included within the automation systems are not being fully used (Davila, et al., 2020). This is due to the fact that the automation suppliers are not acquainted with the applications in issue, and as a result, they are unable to discern the true needs of the end user, which are often a lot less complicated.

Theme 4: Identification of end user needs

Through the use of secondary research, study investigated whether or not the current development and operational efforts were using the full potential of newly developed technology. The overwhelming majority of respondents were of the opinion that just a small fraction of these advantages are really being used. One of the many possible reasons was that there was a connection between the design department and the operations section of the organisation. This explanation stood out as the most relevant (Geraldo, et al., 2019). It is true that plants are advancing and that new enhancements are being implemented, but it was also brought to light that the projects don't give much thought to who will manage them or how they will be operated in "the real world" without taking into consideration that operator. This is despite the fact that it is true that plants are advancing and that new enhancements are being implemented (Davila, et al., 2020).

There was a widespread consensus that it is difficult to locate employees with thorough knowledge of all the many options for automation. This was a point of agreement among those polled. Because automation is so complicated, it makes perfect sense that the market is comprised only of professionals in various fields. Because it is so difficult to find leaders who have the ability to manage such interdisciplinary teams as well as a global perspective, one of the most significant challenges that must be overcome for projects to be carried out effectively is overcoming this challenge (El and Almentheri, 2020). It is a significant contributor to the difficulty of service providers to determine what their consumers desire.

Theme 5: Training of operators

During the course of this investigation, a great number of studies concerning the standard of operator training were discovered. During this training, which often takes place after the end of the project, major deficiencies were also detected. It shifts such an important job to a separate plan, which makes it impossible for the operators to have a comprehensive grasp of the procedures that need to be completed. There has also been discussion over the possibility of tailoring this instruction (Bhatt, 2019). The majority of service providers provide a standard training course, which often makes use of materials produced in other countries and does not take into consideration the difficulties that Brazilian operators encounter (Ghobadi, et al., 2018). In order for the initiative to be successful, the MAC providers need to be able to provide sufficient automation training that is tailored to meet the needs of Brazilian operators.

Theme 6: Reduction of the operators turnover

It has been said that one key element that contributes to the insufficient exploitation of the benefits that may be gained through automation is the high rate of employee turnover that occurs within the operational staff. It is especially difficult to keep teams up to date since there isn't enough time to finish the

essential training, which makes it one of the biggest challenges. It is necessary to decrease the operator turnover rate in order to make the most of the advantages offered by the latest automation technology (Sundar, 2021).

Theme 7: Updating of the execution procedures

It was hypothesised that the legal systems do not adapt to incorporate new technology as they become available. Because commissioning and startup are the phases that make use of information from the field, putting into practise the idea of a digital plant could be most advantageous at these stages (Yousif, et al., 2020). On the other hand, this is not being done since there is a lack of knowledge on how to utilise these tools, as well as because the processes that are used for these occupations have not been altered to take use of new technology. For instance, it is not unusual to manually commission instruments and valves that were installed more than a decade ago (Palaniyappan, 2019).

Theme 8: Integration between automation and electrical package

During the course of this inquiry, a great number of authors who were interested in investigating the integration with electrical packages were found. Electrical components are very necessary for modern projects, particularly in terms of actuation and the provision of energy (El and Almentheri, 2020). According to the interviews, the optimal choice for companies is to employ the same provider for both the electrical and automation packages, or at the at least, the same coordinator for both sets of services (Bhatt, 2019).

Theme 9: Procurement of the field instruments and valves by the MAC supplier

The vast majority of studies have shown that it is better to have the MAC provider in control of the whole system since it facilitates the simplification of the integration of the command centre, software, and field devices (Wu, et al., 2022). In spite of this, there were some interesting observations made by the valves

and other elements of the intrusive line. Many people feel that the contractor ought to be the one to preserve these objects because of their size, the technical skills they possess, and the importance they have to pipeline projects (Palaniyappan, 2019). On the other hand, it is commonly agreed that the MAC provider is required to have an active part in the management of the purchase of these commodities under certain circumstances. Some people believe that the inclusion of field equipment in the MAC might be detrimental to competition due to the fact that so few businesses are capable of providing every imaginable service.

Theme 10: Hiring of the MAC supplier by the end user

In addition to this, the position of this item inside the segments that were taken into consideration was quite varied. There is a compelling case to be made for the employment of MAC being the responsibility of the contractors. This perspective is supported by the arguments listed below: (Zhao, et al., 2019)

- a) There is no room for interpretation in the EPC definition since the project only has one party accountable for it.
- b) The resolution of interfaces between the end user and the contractor, taking into account interference from third parties, is always very difficult due to a variety of commercial factors, most notably the separation of costs and revenues;
- c) The MAC, which acts as an interface between the end user and the contractor, is therefore inappropriate for this type of project;
- d) The resolution of interfaces between the end user and the contractor, taking into account interference from third parties, is therefore inappropriate for this type of project;

For the remaining groups (manufacturers, integrators, and opinion leaders), the end user cited the following justifications for selecting the MAC as their preferred option:

The end user is familiar with the process technology and may, via contact with the MAC provider, contribute to the creation of a system that is more suitable for meeting the end user's requirements. While the contractor is focused on finishing the project at the lowest possible cost, the end user is concerned with the functioning of the facility (long term) (short term). As a direct consequence of this, the necessary attention to its implementation is lacking (Tang and Liu, 2022).

It was also noted that a solution to this problem may be the use of MACs by the contractor on the basis of end-user-developed requirements. However, this is not always possible since the end user has to be familiar with automation technology and have an engineering structure. Neither of these things are often available to the end user because this is not the core line of business that the company engages in.

Theme 11: Training of procurement team of the end user

Following the remarks, it has become quite evident that the procurement staff absolutely need competence in automation. On the other hand, several of the respondents pointed out that technical expertise is often used for undertakings of this kind. As a result, having knowledge and experience in this area on the part of the procurement team is not mandatory (Gajewski, et al., 2019).

Theme 12: Technical support on site after the project completion

During the course of this study, many inquiries about the capabilities of the automation supplier to continue delivering technical help on-site after the development of the project had been finished were carried out. According to the people who were interviewed, there were several instances in which the inability to give

sufficient support after the first setup led to the non-use of or the discontinuation of a number of automated services (Davila et al., 2020).

CHAPTER FIVE: DISCUSSION AND CONCLUSION

- ✓ DISCUSSION
- ✓ CONCLUSION

DISCUSSION AND CONCLUSION

Discussion

The advancement of development tools and computer-based technology has greatly contributed to the growth of engineering execution techniques in manufacturing facilities. These methods include process and automation engineering, which both have the potential and the future to become more important. Through the automation of tasks that are only capable of being performed based on cutting-edge technologies such as domain-independent plant data model-driven engineering, these prospects and possibilities will significantly reduce the amount of time spent on engineering and improve the overall quality of the deliverables (Tang and Liu, 2022). However, adapting to such cutting-edge technology in one's day-to-day job would be challenging and time intensive for engineers. Given the ever-increasing complexity of the ecosystem of engineering software tools and the ever-changing constellations of projects, the most important question that needs to be answered in this scenario is how to provide sufficient technical assistance to process and automation engineers. This is the issue that needs to be addressed. In the past few years, a variety of academic and industrial efforts have demonstrated the growing urgency with which we must find a dependable and effective answer to this question within the current complex ecosystem of engineering software tools and the complications of modern process and automation engineering, taking into account the globalisation of projects, fierce competition, and dynamic business models of companies (Geraldo, et al., 2019). Conventional workflow management tools can't be relied on to support standard practises in process and automation engineering anywhere in the world because they lack key capabilities in areas such as flexibility, adaptability, and context sensitivity. These shortcomings make it impossible for these tools to fulfil their intended purpose (Khosro, et al., 2021). A good engineering support management tool should include at least the features that have been mentioned above, in addition to adhering to the most up-to-date

engineering software technologies, in order to provide assistance to engineers in their day-to-day work of constructing manufacturing facilities (Ma, et al., 2018).

The age of document-based plant engineering is coming to an end, and object-oriented plant modelling will play an important part in the development of the next generation of engineering software tools. It's possible that new ways of thinking may surface as a result of this, which will make it easier to conceive of solutions to the issues outlined above. This dissertation explains an original way for managing technical and non-technical virtual objects in an object-oriented, model-driven engineering software platform. The method is detailed in this dissertation. The new idea of giving a separate attribute to each component of a plant data model served as motivation for the development of this technology (Harbud, 2022). Within the context of the plant data model, this new feature allows for the specification of an object's progression toward its completed, completely planned form. Every item follows a certain course, often known as a "lifeflow," which is defined by the category it belongs to and developed by the engineers. In the end, the continuation of the project beyond the engineering phase, as well as the completion of the project as a whole, is contingent on the accomplishment of each and every step included within the lifeflow of each and every item. It is possible for such occurrences and operations to take place in a great number of separate disciplines of engineering, and they may be carried out by users whose degrees of competence, language proficiency, geographical location, methods of access, etc. might vary greatly from one another (Yousif, et al., 2020). The contextual awareness, adaptability, and flexibility of the system, together with the conformity of contemporary engineering software tools, are the basis of the system.

It opens up new possibilities for engineering approaches and assistance systems, and it improves learning and communication between objects at different stages of their lifeflows and within a plant data

model (Bhatt, 2019). The provided method has broad applicability and can be implemented in a variety of settings.

Conclusion

The results emphasised the necessity for automation across the whole of a company's project life-cycle, beginning with the planning stage and continuing all the way through the execution stage. It was shown to be an essential component for the successful execution of the automation project, which made it possible to give the benefits that are associated with current technology. The empirical investigation paves the way for the development of the final output of the dissertation, which is a suggested model for picking the best solution for an automation system. In this manner, the oil and gas business may profit from this article as a component of the work, particularly for large-scale projects.

CHAPTER SIX: APPENDICES

- ✓ References
- ✓ English Abstract
- ✓ Arabic Abstract

References

- Antwi-Afari, M.F., Li, H., Yu, Y. and Kong, L., 2018. Wearable insole pressure system for automated detection and classification of awkward working postures in construction workers. *Automation in Construction*, 96, pp.433-441.
- Davila Delgado, J.M., Oyedele, L., Beach, T. and Demian, P., 2020. Augmented and virtual reality in construction: drivers and limitations for industry adoption. *Journal of Construction Engineering and Management*, 146(7), pp.302-379.
- El-Sawah, M. and Almentheri, I., 2020, November. Face the Challenge to Reap the Benefits Automation and Smart Technology. In Abu Dhabi International Petroleum Exhibition & Conference. OnePetro.
- Gajewski, M., Batalla, J.M., Levi, A., Togay, C., Mavromoustakis, C.X. and Mastorakis, G., 2019. Two-tier anomaly detection based on traffic profiling of the home automation system. *Computer Networks*, 158, pp.46-60.
- Geraldo Filho, P.R., Villas, L.A., Gonçalves, V.P., Pessin, G., Loureiro, A.A. and Ueyama, J., 2019. Energy-efficient smart home systems: Infrastructure and decision-making process. *Internet of Things*, 5, pp.153-167.
- Ghobadi-Bigvand, P., 2018. An adaptive, context-sensitive, workflow support system for process and automation engineering of production plants.
- Harbud, N., 2022. Process automation life cycles. In *Integration and Optimization of Unit Operations* (pp. 219-237). Elsevier.
- Ma, Z., Cai, S., Mao, N., Yang, Q., Feng, J. and Wang, P., 2018. Construction quality management based on a collaborative system using BIM and indoor positioning. *Automation in Construction*, 92, pp.35-45.

- Mendoza, J., de-la-Bandera, I., Álvarez-Merino, C.S., Khatib, E.J., Alonso, J., Casalderrey-Díaz, S. and Barco, R., 2021. 5g for construction: Use cases and solutions. *Electronics*, 10(14), pp.17-13.
- Möllers, F., 2020. Energy-Efficient Dummy Traffic Generation for Home Automation Systems. *Proc. Priv. Enhancing Technol.*, 2020(4), pp.376-393.
- Möllers, F., 2021. On privacy in home automation systems.
- Palaniyappan, T.K., 2019. IOT Based Energy Efficient Home Automation System. Available at SSRN 3400221.
- Saba, D., Sahli, Y., Maouedj, R., Hadidi, A. and Medjahed, M.B., 2021. Contribution to the Realization of a Smart and Sustainable Home. In *Artificial Intelligence for Sustainable Development: Theory, Practice and Future Applications* (pp. 261-290). Springer, Cham.
- Sundar, S., 2021. Home Automation Using Gesture Control and RF Communication.
- Wu, S., Hou, L., Zhang, G.K. and Chen, H., 2022. Real-time mixed reality-based visual warning for construction workforce safety. *Automation in Construction*, 139, pp.104-252.
- Yousif, J.H., N. Abdul Majeed, S. and JI Al Azzawi, F., 2020. Web-based architecture for automating quantity surveying construction cost calculation. *Infrastructures*, 5(6), p.45.
- ZEMRANE, H., BADDI, Y. and HASBI, A., 2019. IoT Smart Home Ecosystem based on Multiprotocol Label Switching.
- Zhao, J., Seppänen, O., Peltokorpi, A., Badihi, B. and Olivieri, H., 2019. Real-time resource tracking for analyzing value-adding time in construction. *Automation in Construction*, 104, pp.52-65.

- Bhatt, J.G., 2019. Building automation systems. *Rapid Automation: Concepts, Methodologies, Tools, and Applications: Concepts, Methodologies, Tools, and Applications*, p.376.
- Khoso, A.R., Yusof, A.M., Chen, Z.S., Wang, X.J., Skibniewski, M.J. and Memon, N.A., 2021. Embedded remote group environment through modification in MACBETH—an application of contractor's selection in construction. *Journal of Civil Engineering and Management*, 27(8), pp.595-616.
- Wamba-Taguimdje, S.L., Wamba, S.F., Kamdjoug, J.R.K. and Wanko, C.E.T., 2020. Influence of artificial intelligence (AI) on firm performance: the business value of AI-based transformation projects. *Business Process Management Journal*, 26(7), pp.1893-1924.
- Tang, D. and Liu, K., 2022. Exploring the Application of BIM Technology in the Whole Process of Construction Cost Management with Computational Intelligence. *Computational Intelligence & Neuroscience*.

English Abstract

The research aims to: explain the significance of the MAC (Main Automation Contractor) for the purpose to reduce the risks in the Automation projects in Oil and Gas Sector. Automation and intelligent technology are crucial in propelling the oil and gas sector. This review is focused on the contribution of the leading automation contractor in the oil and gas sector. The main automation contractor (MAC) input within the industry is crucial because it automates core activities, reduces operational costs, applies extensive expertise, and reduces response time to information. Investments in main automation contractors result in rapid returns due to cost savings while maximizing and maintaining project value. Automation and intelligent technologies are complex; limitations, including technology selection, infrastructure development, data abundance, cyber compliance, and alarm flood, characterize them. Main automation contractor (MAC) is a futuristic tool that coordinates engineering, procurement, and construction (EPC) for value provision from inception to completion. The main automation contractor is a liaison between suppliers and end users, maintaining a mutually beneficial relationship for the project's success.

The researcher used the secondary design and utilised a secondary qualitative method. The research here employs a research of observations filtered via the interpretivism guiding philosophy. Researchers find the observation very useful since it keeps a close eye on the status of Automation Projects. When trying to solve problems that have arisen in Automation Projects, researchers have found that the interpretivism research philosophy is very useful in determining the best and most relevant information on the topic. **The most important was reached the following conclusions:** The results emphasised the necessity for automation across the whole of a company's project life-cycle, beginning with the planning stage and continuing all the way through the execution stage. It was shown to be an essential component for the successful execution of the automation project, which made it possible to give the benefits that are associated

with current technology. **The most important recommendations:** The empirical investigation paves the way for the development of the final output of the dissertation, which is a suggested model for picking the best solution for an automation system. In this manner, the oil and gas business may profit from this article as a component of the work, particularly for large-scale projects.

Arabic Abstract

الملخص العربي

يهدف البحث إلى:

شرح أهمية MAC (مقاول الأتمتة الرئيسي) لغرض تقليل المخاطر في مشاريع الأتمتة في قطاع النفط والغاز. إذ تركز هذه المراجعة على مساهمة مقاول الأتمتة الرائد في هذا القطاع. وتعد مدخلات مقاول الأتمتة الرئيسي (MAC) داخل الصناعة أمراً بالغ الأهمية لأنه يعمل على أتمتة الأنشطة الأساسية، ويقلل من تكاليف التشغيل، ويطبق خبرة واسعة، ويقلل من وقت الاستجابة للحصول على المعلومات. تؤدي الاستثمارات في مقاولي التشغيل الآلي الرئيسيين إلى عوائد سريعة بسبب توفير التكاليف مع زيادة قيمة المشروع والحفاظ عليها.

مقاول الأتمتة الرئيسي (MAC) هو أداة مستقبلية تنسق الهندسة والمشتريات والبناء (EPC) لتوفير القيمة من البداية إلى النهاية. كما يعد هو حلقة الوصل بين الموردين والمستخدمين النهائيين، إذ يحافظ على علاقة متبادلة المنفعة من أجل نجاح المشروع.

استخدم الباحث التصميم والمنهج النوعي الثانوي والتركيز في الملاحظات التي تمت تصفيتها عبر الفلسفة التفسيرية الموجهة. حيث يجد الباحثون أن الملاحظة مفيدة للغاية لأنها تراقب عن كثب حالة مشاريع الأتمتة. فعند محاولة حل المشكلات التي تنشأ في مشروعات الأتمتة، وجد الباحثون أن فلسفة البحث في التفسير مفيدة جداً في تحديد أفضل المعلومات وأكثرها صلة بالموضوع.

وقد تم التوصل إلى الاستنتاجات التالية ومن أهمها:

أكدت النتائج على ضرورة الأتمتة لكل مشاريع الشركة بأكملها عبر دورة حياة المشروع، بدءاً من مرحلة التخطيط وحتى مرحلة التنفيذ. وقد ثبت أنه عنصر أساسي للتنفيذ الناجح لمشروع الأتمتة، مما جعل من الممكن إعطاء الفوائد المرتبطة بالتكنولوجيا الحالية. أهم التوصيات: البحث التجريبي يمهّد الطريق لتطوير الناتج النهائي للأطروحة وهو نموذج مقترح لاختيار أفضل حل لنظام الأتمتة. بهذه الطريقة، قد تستفيد أعمال النفط والغاز من هذه المقالة كعنصر من عناصر العمل، لا سيما بالنسبة للمشاريع الكبيرة.