Resumo
Este artigo é parte de uma dissertação de mestrado na Universidade Federal Fluminense, localizada na cidade de Niterói (RJ), região Sudeste do Brasil. O referido artigo apresenta parte dos resultados de uma pesquisa qualitativa conduzida com diretores, gerentes e consultores de empresas usuárias de sistemas de óleo e gás natural, companhias especializadas em contratos EPC, fornecedores e integradores de sistemas de automação - todos eles operando no Brasil. O objetivo principal da investigação foi identificar os fatores críticos de sucesso na execução dos projetos de automação baseados no modelo MAC (Main Automation Contractor).

Palavras-chaves: Automation, Process Control, Main Automation Contractor (MAC)
1. Introduction

The automation projects are becoming more sophisticated and the new technologies can create several benefits in terms of both investment costs (CAPEX) and in operation costs (OPEX). But it is only true if the execution procedures are also accompanying this development.

The literature has presented many reports about of these benefits mainly when the industrial automation is hired with a model called MAC, in which one company is responsible for all system including materials, software and services.

The dissertation that is being developed has considered the automation evolution in recent decades. Such research culminated in the state of the art available today which are the latest versions of DCS's (Distributed Control Systems), called hybrid systems, designed to be used with modern digital networks. With this focus, the work examined different forms of hiring for large projects, especially EPC contracts applied in the oil and gas areas. On this basis, we have studied the feasibility of using the MAC model (Main Automation Contractor) for large projects and we have considered that the automation can be hired in the early stages of the project as a solution to the maximization of profits with the digital plant concept. The strategy of anticipating the specific items is advocated by the Construction Industry Institute of the University of Texas in Austin (USA) (VORSTER and MCNEIL (1998), and our study indentified that automation can be a strategic item for large projects.

The complete dissertation had the following steps:

a) Search of the conceptual framework in order to base the instruments and concepts of the study;

b) Preparation of the first versions of the survey instruments;

c) Selection of respondents for the application of survey instruments;

d) Conduction of individual interviews and application of pre-test questionnaires in order to criticize the instruments;

e) Transcription, content analysis and comments on interviews and pre-test questionnaires;
f) Preparation of final survey instruments;
g) Data collection;
h) Transcription of interviews and tabulation of quantitative data;
i) Implementation of quantitative analysis;
j) Implementation of content analysis;
k) Preparation of final report.

This article reports the results of a specific part of the field research, obtained through personal interviews with directors, managers and consultants of O&G market including end users, EPC contractors, automation vendors and system integrators that have operations in Brazil. We used a standardized and structured questionnaire to get the viewpoint in terms of processes, people and technology.

2. Methodology

We conducted twenty-five individual interviews that was the basis for analysis content, which is a technique that can be used to obtain information expressed in verbal or written form, summarized and organized (FREITAS 2000). We had the following distribution for the interviewees (Figure 1):

![Interviewees by Segment](image)

Figure 1: Distribution of Interviewees by Segment

Source: author (2010)
The case study was conducted in an exploratory way (YIN 2001) and a survey was developed with twenty-two questions designed to allow responses to the four main subjects:

Q1) Why do not the current structures maximize the gains of digital plants?
Q2) Could the hiring of automation bring impact to the project implementation?
Q3) Could the hiring of automation in the early stages of projects, provide gains to the enterprise?
Q4) What are the successful critical factors for a hiring model that maximize the gains of digital plants?

These subjects were responded and have led to conclusions considering the aspects of the processes, people and technology.

The interviews were conducted through a semi-structured instrument (YIN 2001). Such instrument based the quantitative and qualitative analysis of perception. The research method is therefore qualitative and quantitative. "While the quantitative method measures the object, the qualitative method measures the categories and their attributes" (OLIVEIRA 2000).

3. Interview Analysis Summary

The current hiring model based on the lowest price entails the delivery of the minimum necessary to meet the specifications. Given the very low importance to the budget in relation to the other project values, the automation is left to a second plan. So, it is hired in the final stages of the projects, limiting the implementation of improvements. This leads to a little involvement of end users, contractors and suppliers in the development of projects.

The speed of automation technological evolution is as fast as the information technology, making it very difficult to let the teams trained. There is also a lack of field experience for the personnel who are involved in project execution. There is a shortage of generalist professionals in all features of automation, hindering the coordination of multidisciplinary teams needed for the development of automation projects.

There is still an excessive conservatism in the project implementation and the procedures are not updated with the technology advances. This technology used is also not considering the real world of the operators due to lack of applicative experience in the project execution.
There is also a lack of proper integration (communication) among the various parts that make up the technological packages for an automation system.

The current hiring model is based on general register and vendor list and there is still little engagement through partnerships, especially in the public sector, despite the many reports of success with this kind of model. There are a great number of benefits in the use of the MAC concept mainly due to reduction of interfaces. This model is recommended for new plants, it must provide the integration with the electrical packages and the benefits are clearer when we have a large project with many EPC contractors because, in such case, the MAC can standardize the automation among all of them. The MAC concept is much more than simply to supply instruments, hardware, software and inherent automation services – it must be part of the project development for the advantages to be visible. The answers informed us that the MAC should consider the full scope of automation, including the field part. We had many doubts if intrusive equipments should belong to that package, but in this case, all comments were that the purchasing management of these intrusive items must have the participation of MAC provider. There is a trend that the MAC hiring should be made by end user because it is aware of the process. But it should be considered possible interface problems with the contractor.

There is a consensus that the personnel involved in the project would be interested in working with the MAC supplier because it would allow the simplification of project activities. Most believe that the current existing features justify the MAC hiring due to the complexity of automation systems and the lack of qualified labor.

There are gains in the strategy of the advanced purchase (PEpC model), especially if the item is an important source of information for project development. But what is being noted in ongoing projects in Brazil are delays in the delivery of items purchased by end users, who are jeopardizing the implementation of projects. Currently, the automation is been hired in the detailed design, which ends up limiting the implementation of improvements. There is a clear acceptance that automation should be seen as a strategic item and purchased in advance.

There is a consensus that there would be a very large acceptance of the teams responsible for the project implementation in working with the automation supplier. The main reason for this is the reduction of project uncertainty that would be obtained. Most believe that the
existing functionalities in automation systems justify their engagement in the early stages of project development.

The creation of a model based on four stages (scope definition, preparation of quotations, quotation in the market and criteria for the choice of provider) was considered adequate for the choice of the best vendor. It was considered that the technical analysis and technology of a vendor are important points to define the best price despite the fact that this kind of analysis is not practiced in Brazilian market, as a rule. It was considered that a standard hiring model would be beneficial to the market due to exemption in the choice and to provide the correct analysis of the parameters.

It was identified the need of the procurement teams to have, in its staff, people with specialization in automation. But we received many comments showing that for the large projects, the procurement team has the support of the engineering team. In this case, it is not necessary a special qualification for the procurement team. It was quantified, based on the responses, the importance of successful critical factors for choice of the automation provider.

4. Successful Critical Factors

The term “successful critical factors” was introduced by ROCKART (1979) in an article that examines the different methods used to provide information to business managers, discussing advantages and disadvantages of each method. The problem addressed by ROCKART (1979) comes from the excessive quantity of available data on the companies and the need to determine which data that managers really need. As a solution, through a systemic approach, he proposed the "method of critical success factors” developed by a research team from MIT's Sloan School of Management.

It consists of key factors essential to achieve goals, which are strategic or tactical in an organization, assuring your competitive performance, even if other factors are neglected. In other words, "the few things that must occur in a correct way, even in detriment of others, to achieve the goals” (FURLAN 1994). Thus, the critical success factors are areas of activity that should receive constant and careful attention of managers.

Although the model developed by ROCKART (1979) is focused on the needed information for companies’ CEO, further studies show that the method can be used in various management levels, bringing the following benefits (FURLAN 1994):
a) It helps to determine the factors in which managers should keep in focus and which must be monitored by information systems;

b) It allows to define which data should be collected avoiding overload and waste of information;

c) It recognizes that some factors are specific of a situation, of an individual or an organization;

d) And "it may be used as an important means of communication to the management, facilitating the integration among critical topics and ensuring synergy in the pursuit of goals " (FURLAN 1994).

Therefore, we can say that our objective in identifying the successful critical factors in the choice of the MAC supplier means to get the key elements to reach these goals. Or, find out what is necessary to happen properly for a MAC to be successful.

Thus, the use of the term “critical success factors” is based on the ROCKART´s original concept (1994), but the research method is not based on his studies, which examines different methods to provide information to managers. However, we have used some strategies to recognize the successful critical factors, as mentioned by FURLAN (1994), “one of the ways to identify successful critical factors is through the denial of existing problems - if there is a significant problem, it is because a successful critical factors was not found”.

So, based on the interviewees performed we can verify these important points for the successful of the automation project execution:

a) Planning of the automation activities;

b) Involvement since the early stages of the project;

c) Updating of project team in the automation technologies;

d) Identification of end user needs;

e) Training of operators;

f) Reduction of the operators turnover;

g) Definition of automation architecture;

h) Updating of the execution procedures;
i) Integration between automation and electrical package;
j) Procurement of the field instruments and valves by the MAC supplier;
k) Hiring of the MAC supplier by the end user;
l) Training of procurement team of the end user;
m) Technical support on site after the project completion.

4.1 Planning of the automation activities

Most of the responses confirmed that there were significant impacts of the automation in the project execution because the automation is the "heart" of the plants. It directly affects the operational expenditure (OPEX). There were positive and negative impacts depending on each project, in terms of price, time and resources.

Notably, most of impacts are more the result of delays in carrying out activities related to automation and therefore, with impact in project start up. The automation impact cost itself is small because the automation represents very little compared to the values of other parts of the project. However, its impact on the project cost is indirect: the delay in the project start up is what may represent the most significant financial aspect. In terms of resources, the biggest impact is the fact that as the automation is triggered at the end of the project. So, it is necessary the mobilization of teams, greater than expected, to compensate the delays in the entire project.

There were many who reported that the main cause of negative impacts is directly related to the planning aspects of development: as the automation has a low cost within the project budgets, it is given little importance to it, then it is only hired in the implementation of final stages.

For these reasons is very important that the planning of the automation activities be considered seriously in the project general planning since the early stages.

4.2 Involvement since the early stages of the project

Given little importance that the automation has within the project budgets, it is only hired in the final phases of the project. It ends up causing miscommunication between the automation and process discipline. Most of the responses were favorable to the automation was considered as a strategic item, not due to the initial investment (Capex), but function of
the automation importance in the cycle of plant life, because it influences the philosophy of operation and maintenance.

Another aspect mentioned was the moment when the automation is hired, much more in the final stages of the projects. The biggest cause of this limitation is that any changes have costs and impacts in the delivery time, which normally are not accepted by both the contractor and the end user.

The best experiences were reported when the hiring model, defined by the contractor for the automation system, created the conditions for this engagement to take place and when the automation was hired in the early stages of the engineering project development.

4.3 Updating of project team in the automation technologies

There was almost unanimity in the responses: the lack of updating is mainly caused because the development of automation technologies is growing nearly at the same rate as information technology. Therefore it is very difficult to keep teams properly updated because there is no time available for completion of the required training.

It was also mentioned another important aspect: there are even many professionals with good academic background and excellent technical aspects, but with very little field experience which even affects the use of not so recent technologies. It was mentioned that such lack of experience is causing the lack of use of various resources available in the automation systems. It happens because the automation suppliers do not know the practical applications and because of this, they cannot identify what the end user really needs which is usually much less than what is available in systems.

4.4 Identification of end user needs

In the survey we verified whether the latest development projects and in operation are using all the advantages of new technologies. We also had almost unanimity: what is in use is very little of these benefits. Several reasons were reported, but the main aspect was the distance between the teams responsible for design and the teams responsible for the enterprise operation. It was mentioned that the plants are evolving and new enhancements are being applied, but the projects do not have the focus on who will operate, in other words, without considering the operator of “the real world”.

There was unanimity that it is very rare to find a staff with a broad knowledge of all automation features. What is found on the market are specialists in certain areas, which is understandable because of the complexity of automation. For the implementation of the projects, the great difficulty is to find leaders who have an understanding of the whole and who are able to coordinate these multidisciplinary teams. It is the main reason that the suppliers do not identify the end user needs.

4.5 Training of operators

We received many comments about of the operator training quality. Huge gaps were also mentioned in this training, which is typically in the end of the project completion. It relegates such important activity to a second plan, not allowing the operators to be fully aware of the procedures that must be performed.

Another point mentioned is related to the customization of this training. Many suppliers present a standard training program, often even using material produced abroad and without considering the difficulties of the Brazilian operators. The ability of the MAC providers to provide appropriate automation training tailored according to the needs of the Brazilian operators is very important for the project success.

4.6 Reduction of the operators turnover

It was mentioned that the turnover among the operation staff also contributes greatly to the non-use of the automation benefits. It is very difficult to keep teams properly updated because there is no time available for completion of the required training. So, the reduction of the operator turnover is part important to improve the advantages of the new automation technologies.

4.7 Definition of automation architecture

Another aspect was also mentioned: the lack of integration among the various parts of the automation systems, field instruments, control room, applicative software and communication links, eventually does not allow the information flow to be appropriate. The intelligence available in the field equipments needs to be collected by the operation system and is necessary a appropriated automation architecture considering the communication protocols, drivers, licenses, gateways and the interface devices. The correct automation infra-structure is fundamental to get the results with the new technologies.
4.8 Updating of the execution procedures

It was mentioned that the execution procedures do not update with the new technologies. Perhaps the biggest gains in the use of the digital plant concept could occur in the commissioning and start up, taking advantage of the available intelligence on the field. However, this is not being used because the procedures of these activities were not adapted to the new technologies and there is a great lack of information in the use of these tools. It is very common, per example, the commissioning of the instruments and valves been made as twenty years ago without use of diagnostics.

4.9 Integration between automation and electrical package

We received several comments about of the integration with the electrical packages. For the today´s projects, the electrical components are very important mainly for the actuation and the energy supply. The position of interviewees is that the best solution for the enterprises is the same supplier for automation and the electrical package or, at least, the same coordinator for both packages.

4.10 Procurement of the field instruments and valves by the MAC supplier

Most respondents confirmed that the MAC supplier shall be responsible for the whole package: due to the reduction of interfaces and to allow better integration among the control room, applicative packages and field equipment.

But we observed some important comments on the part of valves and intrusive line components. Due to the size of these packages, their technical features and impact on projects of pipelines, many believe these items should stay with the contractor. Regardless, there is consensus that in such cases, the MAC provider must have active participation in the purchasing management of these items.

There were also comments that the inclusion of the field equipment in the MAC scope could limit the competition among the companies because there are few that can supply a complete package.

4.11 Hiring of the MAC supplier by the end user
This item also had a serious different position among the considered segments. For contractors, there is a clear position in favor that the hiring of MAC should be their responsibility. And this position is based on the following:

a) The EPC definition is clear: there is a unique responsible for the project. So, the MAC, which is an interface between the end user and contractor, is not appropriate for this kind of project;

b) The interfaces between the end user and the contractor, considering interference of third parts, have always a very tough resolution due to the various commercial aspects, notably by the detachment of costs and revenues.

For the remaining segments (end users, manufacturers, integrators and opinion leaders), the following reasons were mentioned for the MAC hiring by the end user:

a) The end user has a concern with the operation of the plant (long term) and the contractor with the delivery of the project at the lowest possible cost (short term);

b) The end user knows the process technology and can, interfacing with the MAC supplier, help in the developing of a more adequate system to its needs;

c) Automation has little relevance to the contractor. So, it is not given the proper importance to its implementation.

It was also mentioned an alternative to this problem: the MAC hiring by contractor based on specification elaborated by the end user. However, this is not always possible because the end user needs to be updated with the automation technology and to have an engineering structure, which is not always available because it is not its core business.

4.12 Training of procurement team of the end user

The responses showed that the procurement team needs a specific qualification for automation. However, we received several comments that, for large projects, the expertise of the engineering sector is always used. Thus the procurement team does not need to have any specific qualification in this area.

4.13 Technical support on site after the project completion
We received many comments about the condition of the automation supplier are able to continue providing technical support on site after the completion of the project development. The interviewees report us many cases the lack of adequate support after the start up was the main cause to non-use or discontinuation of several of automation features.

5. Final Conclusion

The study in progress showed the importance of automation within the enterprises particularly related to aspects of the complete project life cycle, including its operation. It was demonstrated the successful critical factor for the automation project execution to get the benefits of the newer technologies to be provide.

The field research allows the elaboration of a suggested model for choice of the best solution of an automation system, which will be the final object of the dissertation to be presented. So, this article, as part of the work, it can help the oil and gas market mainly for the large projects.

References


