

# MERGERS & ACQUISITIONS IN ELEVATOR INDUSTRY: THE ROLE OF ICTs TO AVOID INFORMATION ASYMMETRY

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April 16, 2024

## Abstract

Mergers and Acquisitions operations continues to be one of the most explored growth strategies globally in all markets, and also in the Elevator Industry. Volume of investments grows year after year. It is the fastest way to grow in international and domestic markets, but the reality is that a high percentage of the operations carried out do not meet the expectations of the investors when the integration phase, called the post-acquisition phase, has been completed. There are several causes of failures on mergers and acquisitions processes, such as lack of commitment from the management, unrealistic business plan, cultural shock, etc ... But the most common and the one with the highest risk in an acquisition decision, is the asymmetry of information. During the negotiation phase a large amount of data is collected, and subsequently analyzed during the Due Diligence period, but does not correspond to reality during the integration phase. That is, the information that the seller has provided, and has been studied and analyzed to take a decision of acquire by investors, has not been the real and complete one. In this article we will propose how the asymmetry information can be avoided by the application of Information and Communication Technology (ICT) through the IoT of the elevators. Same can be applied to other industries.

## MERGERS & ACQUISITIONS IN ELEVATOR INDUSTRY: THE ROLE OF ICTs TO AVOID INFORMATION ASYMMETRY

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## SUMMARY

Mergers and Acquisitions operations continues to be one of the most explored growth strategies globally in all markets, and also in the Elevator Industry. Volume of investments grows year after year. It is the fastest way to grow in international and domestic markets, but the reality is that a high percentage of the operations carried out do not meet the expectations of the investors when the integration phase, called the post-acquisition phase, has been completed. There are several causes of failures on mergers and acquisitions processes, such as lack of commitment from the management, unrealistic business plan, cultural shock, etc ... But the most common and the one with the highest risk in an acquisition decision, is the asymmetry of information. During the negotiation phase a large amount of data is collected, and subsequently analyzed during the Due Diligence period, but does not correspond to reality during the integration phase. That is, the information that the seller has provided, and has been studied and analyzed to take a decision of acquire by investors, has not been the real and complete one. In this article we will propose how the asymmetry information can be avoided by the application of Information and Communication Technology (ICT) through the IoT of the elevators. Same can be applied to other industries.

**Keywords :** IoT, IT Due Diligence, ICTs, Digital Strategy, Information Asymmetry, Adverse selection, M&A Performance, M&A Success.

## INTRODUCTION

In the Elevator segment of all markets, historically there has been a lot of activity in Mergers and Acquisitions (hereinafter M&A) between companies of different sizes to accelerate strategic growth in some international markets, or just in domestic markets. The challenge is to be present in areas where the presence of the buyer is small or just non-existent. The operations consist of the purchase of a company that has maintenance service contracts for Elevators, and Escalators (hereinafter E&E), or simply the purchase of the portfolio of maintenance service contracts for said E&E.

These M&A processes between E&E maintenance service companies are led by multinational manufacturing companies. As a general rule, the candidates to be acquired are local companies that, for the most part, still work without a defined digital strategy and with a much simpler quality management system than multinational companies. They use incomplete or poor procedures with a work methodology based on experience, such as: “This is how we have always done it”, which is not enough for obtaining, processing, and analyzing subsequently, the information. In the M&A processes between E&E maintenance companies of different sizes, the calculations and premises used by multinational companies to evaluate the suitable candidates to be acquired, are therefore, based on experiences and Excel-type spreadsheets. The data provided by the selected candidate may differ from reality, causing that M&A projects that seemed to be beneficial in the pre-acquisition phase, to be a failure in the integration, as we have already studied, damaging the “Profits & Losses” accounts and the brand value of the purchasing companies. That is, they are based on subjective criteria that cause an overestimation of returns and an incorrect business plan due to asymmetric information obtained, that does not is adjusted to reality (Akerlof, 2001).

Why is there asymmetric information? Because the data used for the analysis and case study in the pre-acquisition stage, have not been obtained, treated, and processed correctly due to the simple digital tools that the candidate to be acquired has. When an M&A operation happens between different sized E&E maintenance companies that have different digital strategies, the information asymmetry is the most important source of failure.

## BACKGROUND

Currently, mergers and acquisitions processes are growing significantly around the world (Cartwright & Schoenberg, 2006). As an example, in 2004 there were 30,000 M&A operations in a global level, equivalent

to 1 operation every 18 minutes. However, despite the growth it means, investors continue to experience low returns in the months following to integration. For investors, the return on investment is still highly questionable. For the authors Cartwright and Schoenberg, there are fundamentally three reasons that cause this poor performance: The first, that managers make decisions that do not maximize the value of the operation, the second that academic research has not yet reached the joint of investors and they are not totally aware about many lessons learned from operations already carried out, and the third and last, that the investigation of the causes that produce the failures is not yet complete.

Other authors who investigate the factors that motivate M&A operations as well, (Calipha, Tarba & Brock, 2010), affirm that the success rate of M&A operations is below 50%. There is a lot of information and research on M&A processes that allows us to analyze what has been learned so far from the pre-acquisition and post-acquisition phases, and what is not yet known. The factors that motivate M&A operations can be, among others, the entry into new markets, the acquisition of resources and talent, or simply the application of synergies. In the research of the aforementioned authors, the phases, reasons and success factors of the M&A processes are addressed, and it is shown that the operations have grown and are growing drastically in the United States, Europe, and globally in the World as we already mentioned, but still with low performance rates. In a survey (Accenture and Economist Intelligence Unit, 2006) to Executives of companies involved in M&A operations, the following responses were obtained: 47% answered that the causes of failure come from the coordination and integration of the process, 43 % responded that due to the execution of the Due Diligence, and 40% responded that the causes of failure were due to lack of motivation of the organization and lack of business cultural integration. A common argument in explaining the failures in M&A operations are excessive attention to financial parameters and insufficient attention to business and human organization, as well as operational parameters.

About the phases, different authors define different phases. In some cases, two phases, pre-acquisition and post-acquisition, in other cases 3 phases, in other cases 4 phases, and in other cases up to 7 phases. But all agree that the steps in an M&A operation are: Strategic planning, candidate search, candidate evaluation and negotiation, execution of the integration plan, and finally the integration phase. And in terms of success factors, it can be summarized in identifying and evaluating strategic objectives, diversification, candidate selection criteria, staff integration, business culture, company size, information technology, and reduced ambiguity.

By ambiguity it is understood to resolve all doubts and questions during the pre-acquisition phase, since continuing with doubts and uncertainties that are not resolved during the process, can be critical in the integration phase. The different information that appears in the integration or post-acquisition phase with respect to what have been analyzed in the pre-acquisition phase, is what we call information asymmetry. Therefore, reducing ambiguity, that is, information asymmetry, is a success factor.

Coming back to the motives, was mentioned above that knowledge and talent about a specific Industry is one of the goals of M&A operations. (Coff, 1999). Many times, this objective is not achieved due to the asymmetry of information since the information can be found in work teams and not individually. Russell W. Coff argues that knowledge is generally the main cause of M&A, and analyze its impact on M&A strategies. Although knowledge may be the focus of acquisition, in many cases it is not acquired due to information asymmetry. This creates information dilemmas and ambiguities and can lead to overpricing risk. Therefore, the information asymmetry is linked to the risk that the buyer could pay an overprice.

In addition to the reasons, we also mentioned that many things can be learned from the reasons of the successes and failures of M&A operations. A lot of research has been done and is being done to find out these reasons and there is a lot of evidence on the causes of failure. (Schoenberg, 2006) In an investigation carried out on a sample of British companies, operating in foreign markets, researcher Richard Schoenberg states that the success rate of the investigated operations were between 44% and 56%. Regardless of the variables that are measured to evaluate the performance of the operation such as accumulated returns, evaluation of the management, evaluation of expert informants, and others, again the asymmetric information between

the management of the company and the investors appears again as one of the great reasons for failures.

Therefore, the information asymmetry that appears between the pre-acquisition and post-acquisition phases is clearly one of the problems still to be solved in M&A operations. (Dierickx,1991) During the negotiation phase, this problem already appears at the moment in which the seller cannot or does not want to transmit certain information to the buyer, so the buyer does not have all the real information he needs. Unfortunately, in many operations there is still a differential between the target value and the obtained value, and this obtained value is dependent on the level of information asymmetry. (Cuypers I., Cuypers Y., & Martin X., 2017). The authors Ilya Cuypers, Youtha Cuypers and Xavier Martin have carried out an investigation on 1,241 articles in a period of 30 years, and they argue that the part that obtains the greatest value in a M&A process is the one with the most experience. These investigations detected how the experience contributes to the creation of value in the transaction and improves the performance of the acquisition. It is argued that the difference in experience between the acquirer and the acquiree determines that one party negotiates the terms and conditions of the acquisition better than the other.

If we put an example of the valuation of tangible products, information asymmetry also plays a relevant role. (Afzal, Roland, & Mohammad Nasser, 2009). In a study carried out by those researchers , for two different groups of people, one of them receiving symmetric information of a product, and another group receiving asymmetric information from the same product, different evaluations were obtained. The most real about the product, was being made by the group of people who received the symmetric information.

As we mentioned at the beginning, some M&A operations aim to penetrate international markets, and in these cases the cost of the operation is still much higher due to information asymmetry (Boeh, 2011). The author Kevin K. Boeh carries out a study of 3,000 M&A operations and recreates a theoretical model of reduction of information asymmetry based on the hiring of a Consultancy Firms for the management and coordination of the operation and maintains that the use of mechanisms for reducing information asymmetry in international processes are more expensive than in domestic processes. While for most companies that carry out M&A operations, asymmetric information can be one of the biggest cost drivers, for other Consultancy Firms, can be a source of opportunities. (Nayyar,1990). To obtaining information is expensive. The author Nayyar points out that information asymmetry is usually the most important source of costs for both parties, seller and buyer. Information asymmetries present a problem for both the seller and the buyer, but also a benefit for Consultancy Firms since they can help to lower investment costs for buyers. There are alternatives to face the costs of information asymmetry, such as including responsibilities, guarantees, signaling in contracts, etc. But normally they are not sufficient or satisfactory. In fact, in some companies there is a specific function to improve the performance of M&A operations, since through lessons learned, capacities can be developed (Trichterborn, Zu Knyphausen, & Schweizer., 2016). Certainly, learning generates experience and skills to identify incomplete and / or ambiguous information in the pre-acquisition phase. More and more companies that are active in M &A processes, incorporate departments that are responsible for the valuation of the possible acquisition.

Authors Jun-Joo Kang and Jin-Mo Kim investigate a long history of acquisitions of foreign companies in the US and theorize that the asymmetric information experienced by foreign investors in their acquisition operations in the US, is a notable determinant for their investment objectives in the US. (Kang & Kim, 2010).

With all the research carried out on M&A processes and information asymmetry, an attempt has been made to find out how to reduce such asymmetry, and some reduction mechanisms have been proposed. The authors Jeffrey Reuer and George Akerlof propose three methods to resolve information asymmetry (Reuer, & Akerlof, 2005), which are: Select a different purchase structure, enter into a contractual agreement, and use information from other markets.

But there are proposals for other possible ways to reduce information asymmetry, one is through previous alliances (Reuer, Jeffrey J. & Ragozzino, 2008), and another is through an early interaction between seller

and buyer. (Brueller & Capron, 2021).

Through previous alliances, according to the authors Reuer, and Ragozzino, because the shareholders of two companies are often more favorable to Joint Venture than to acquisitions when both companies do not have much information about each other. There may be a potential “lemon” problem (Akerlof, 2001) that can generate costs. According to Akerlof, asymmetric information exists when the seller has more information than the buyer. The seller can hide part of the information to avoid the risk of reduction of the offer prices by the buyer. Authors Srinivasan Balakrishnan and Mitchell P. Koza support this claim by comparing the results of abnormal returns between 64 Joint Ventures and 165 acquisitions. (Balakrishnan & Koza, 1993).

And through early interaction between seller and buyer to achieve the success of the transaction from the pre-acquisition phase to the post-acquisition phase. Authors Nir N. Brueller and Lawrence Capron in a study carried out in Israel about start-up acquisitions by two ICTs Companies, they have called this early interaction as the three 3Cs phases, that consist of: A first phase in which the seller has to be Complementary to the buyer, since buyers are more defenders of their key business, a second phase involving key Clients who validate the operation, and a third and final phase, using executive Champions who sponsor the transaction.

When an investor decides to acquire a company, a general strategy is always defined, but many times a specific strategy for IT integration is not defined. (Ournal & Nline,). Digital strategy disparity can have an impact on ROI and on integration effectiveness in the post-acquisition phase. The authors Sundberg, Tan, Baublits, Lee, Stanis and Tanriverdi, in their research they refer to a study by Accenture Consulting on the integration of IT in 57 acquisitions between 1997 and 1999: 42% did not carry out a Due Diligence in IT and the consequence was that the acquisitions did not produce the expected returns. In the Elevator Industry, this situation also occurs when the two companies have different digital strategies.

With the recent development of digital technology and the large amount of data recorded by devices, companies are increasingly driving digital transformation to create value. Value creation only can come when the strategy formulation and the strategy implementation are connected. (Correani, Massis, Frattini, Messeni, & Natalicchio, 2020)

But small-sized Enterprises (hereinafter SMEs), susceptible to being bought, do not invest in technological resources, and do not have ICTs to manage their maintenance portfolio and their clients, even in many cases the information is processed in simple Excel spreadsheets and databases made manually, fed by data from different departments of the company itself. SMEs are still at a low intermediate level of digitization compared to Industry 4.0, but they are aware that they have to identify a more appropriate digital strategy to tackle the fourth industrial revolution 4.0 (Pirola Cimini, & Pinto, 2019). All companies have the need to exploit the opportunity that digitization offers, to have their data available to increase knowledge and decision-making. Profitability is not only achieved through the experience and talent of people, but also through the collection and processing of information through technologies and processes such as BIG DATA for making correct decisions. The information processing, internal and external, is needed for any efficient growth strategy, such as expanding in new markets or in new business opportunities. (Garcia-Canal, Rialp-Criado A., Rialp-Criado J., 2007)

With globalization, the mortality rate of SMEs has increased notably. They must adopt digital strategies and decisions to meet the challenge and survive. One of the global challenges is the application of ICTs. (Gamage et al., 2019). In contrast, multinational companies have higher driving forces and lower barriers for Industry 4.0. The desire to increase control and allow real-time performance measurement is reason enough and rationale today to involve SMEs in the digitalization. (Horváth & Szabó, 2019)

*“Technology alone does not benefit the organization, it needs to be incorporated into daily activities through employee training. Likewise, isolated technology does not change the production or commercialization processes, if it is not supported by business plans that control and define the objectives of its use. To extract all its potential from ICT, its implementation and development, they must be considered in the context of a sustainable technological strategy over time.”* (Galo & Cano-Pita, 2017)

SMEs, by not investing in technology and in their own R + D + i, can be left behind and stop being competitive. The IIoT (Industrial Internet of Things) is impacting on the business model of companies and in the future business. It is the interaction of industrial objects with information technologies, with companies and their employees, and there are very few small companies that are applying ICTs that promote this interaction of companies and people with computers, making tasks therefore more productive. (Jiwangkura, Sophatpathit, & Chandrachai, 2018).

The IoT (Internet of things) arises as the search for the interaction of people with everyday objects through the internet. With the IoT, communication between objects and companies means the entry into the era of industry 4.0 and has improved the availability of data in large companies, as well as the efficiency of their processes. But SMEs are a step back, and also on the defensive, although it is a tremendous potential for increased efficiency (König et al., 2019).

## DESCRIPTION OF THE PROBLEM

In E&E maintenance services companies, such in other maintenance service industries, the greatest volume of failures in M&A operations is the asymmetry of technical information existing in the operational variables that are established for the measurement of the technical parameters between the pre-acquisition phase and the post-acquisition phase. This asymmetry of information causes uncertainty and confusion in the integration stage, as we have explained, and is not detected in the operational Due Diligence. This asymmetry of information comes from the different digital strategy that each party has developed and implemented, since most of the M&A operations are carried out by large multinationals or Investment Funds with resources to have powerful IT tools, while SMEs do not.

In the research carried out to find out more information about the causes of general M&A operations failures, and this specific problem of information asymmetry, 155 articles have been reviewed, of which 86 have been selected from different disciplines with different keywords. Among these articles, we have also studied the different digital strategies that companies have, based on their size and resources, and how this different digital strategy can affect an M&A operation between companies of different sizes, already known that small companies are not yet facing Industry 4.0, the fourth industrial revolution. A collection of articles focused on the failures and successes of M&A operations that describe the real situation for decades.

## WORK HYPOTHESIS:

In all the reviewed and selected articles about M&A processes, there are important conclusions about the failures and successes. It can be said that there is a very extensive literature with many research studies over decades in which many conclusions are reached and new lines of research are recommended, but, even so, it is also concluded that there is still a lot of pending work that can contribute to the academic research and the successful practice of M&A processes.

There is a lot of research on the different phases of the processes, on how to name them, and how to define them. Also, on the different motivations of the processes and the interests of the different stakeholders within each process.

It has also been written about the pre-acquisition phase, where much reference is made to ambiguity, difference in experience, and information asymmetry. Many failures are attributed to unresolved ambiguity in the prior phase of the Contract of Sale signed, the pre-acquisition phase.

This article wants to focus mainly on the operational Due Diligence of the pre-acquisition phase when the candidate has already been selected and an audit process has begun before the signature of the definitive contract. In this phase is where the real information is not detected in many cases. That is, it is the origin of an unresolved ambiguity that appears in the integration phase as information asymmetry, that must be minimized or avoided. In addition to the fact that there are specialized consulting companies that can accompany the investor in the negotiation phase with also the collaboration of expert's business informants and considering that legal and control mechanisms can also be implemented in the Contract of Sale that adjust the acquisition price in the financial and legal Due Diligence, technologies provided by Industry 4.0

must also be adopted in the operational and financial Due Diligence. That is, mechanisms that through the IoT of the E&E and ERPs, provide us with a reality of the measurement of variables.

Own E&E have a lot to contribute with their daily, weekly, and monthly records of all the failures and behavior statistics. Thanks to the IoT they have their own voice, and it is only necessary to register it to be analyzed properly. Obtaining this information on operational parameters directly, allows us to understand from a technical point of view how are operating the E&E of the maintenance contracts. If the purchased capital goods are not in proper working operation due to poor service maintenance, it may involve moderate or serious additional risk to future improvements or repairs not attributable to the owner, unforeseen and undesired, which reduce the contract profit.

According to all what we have exposed, we can formulate the following hypotheses:

"Information and communication technologies (ICTs) can reduce the information asymmetry between E&E maintenance companies that participate in a M&A process, and consequently increase the success of the transaction."

Therefore, it can be stated that:

1. Information asymmetry appeared in the integration phase reduces the success of M&A processes

In previous sections we have defined information asymmetry as the difference of information between companies of different sizes, that develop different digital strategies. On the one hand, the buyer is not able to distinguish in many cases the quality of information offered by the seller and does not have all the information, and on the other hand, although the seller generally has more information, he does not share it entirely.

George Akerlof (2001 Nobel Prize), in his book "The market for Lemons", from his research in markets with information asymmetry, defined the "junk market" model, where the second-hand product seller knows if his product is good or bad, while the buyer does not. Normally the buying party does not have the necessary information to know the negative characteristics of the seller's product, and this is a disadvantage that can be exploited by the party that has more information. (Akerlof, 2001).

Where does the information asymmetry usually reside in M&A processes between E&E maintenance companies?:

- Existing relationship in the terms of the contracts, between the client and the acquired company.
- Real knowledge and skills of the employees of the acquired company.
- Relationship between the official reported remuneration, and the possible remuneration agreed with some group of employees of the acquired company.
- The technical conditions of the E&E to provide maintenance service.
- The relationship between the BIG DATA that the acquired company has, and the information that is processed and obtained.
- The relationship between the quality management system of its procedures and the usual work methodology.

What variables are considered in M&A processes in E&E maintenance companies?

The variables considered are the ratios of the financial statements of the company to be acquired, and the operational variables from the Key Performance Indicators (hereinafter KPIs) of the balance scorecard or dashboard of the acquired company, and their subsequent analysis for the study of synergies and profitability. An example of some important operational variables about maintenance service are shown below in figure 1:

## Hosted file

image1.emf available at <https://authorea.com/users/451711/articles/712733-mergers-acquisitions-in-elevator-industry-the-role-of-icts-to-avoid-information-asymmetry>

Fig 1: Example of dashboard with Maintenance Key Performance Indicators (KPIs).

Some of these variables must be quantified, qualified, and compared, in addition to the average service levels of the industry where the seller is operating and the competitors, also compared with the objectives established in the 5-year horizon in order to have information and a management control once the transaction has been carried out, in the post-acquisition phase. The role of information technology in M&A has gained greater importance due to the globalization of digitization and it creates value in the processes of a Company. It is a support for the risk-free evaluation of the mentioned variables, and therefore can analyze the appropriate acquisition price. (Stein, Zureck & Jäger, 2018).

## 2. Technology can reduce information asymmetry:

How can technology reduce information asymmetry? With correct data collection and its subsequent analysis and processing through BIG DATA tools, of the acquired company.

Nowadays, it is possible to store files and BIG DATA through remote access to software, which is called “cloud computing” and which has become an essential tool for the development and growth of SMEs. (Zabalza et al.). This tool makes possible have all the stored data for processing and treatment. As operations become more complex, technology and people who provide and support IT are critical drivers for resolving ambiguities. ICTs are essential in the previous phase of integration. (Larsen & Larsen, 200505-01).

There are ICTs that allow communication through the Internet of Things (IoT). In the US auto insurance market, for example, some insurance companies track driver behavior through technology to apply the correct insurance premium. For example, a driver who takes risks will pay more than a driver who is more conservative and does not assume them. It is therefore about monitoring the habits and behavior of the driver through a direct recording of the information from the vehicle’s IoT. This monitoring through technology reduces information asymmetry and adverse selection. (Chen & Jiang, 2019)

## ANALYSIS: ECONOMETRIC MODEL

To support the exposed theory regarding information asymmetry, an economic analysis is carried out about how would imply in an M&A process the acquisition of E&E that are *not in good operational conditions* and have not been identified during the DD process. Generally, around the 5-10% of the portfolio are generating more than the 50% of breakdowns. The key is to identify all those elevators that are damaging the Profit & Losses statement (P&L).

For this we propose an econometric model that relates operational variables from the E&E operation and how they affect each other, allowing us to obtain future predictions and estimates of profitability and the return of the investment. The proposed model tries to quantify the cost of acquiring a E&E in unsuitable operating conditions, and as consequence depending on the volume of these E&E acquired, how can cause a non-return on the investment. To carry out the econometric model, first of all, is needed to define the average price values of the local and regional companies that can be acquired, both for preventive maintenance, and annual repairs. The econometric model proposed can be applied to any market in any region, but we have taken the average values of the Spanish market as an example.

We define preventive maintenance as that which is carried out periodically according to the Country Regulations and execution program of each company that maintains E&E. And we define corrective maintenance as all that which is not predictive maintenance represents an economic cost for the company.

In the Spanish elevator market, we have to differentiate two segments, the residential segment composed of elevators installed in residential buildings, whose average type of installation is 450Kg (6 people), 1 m / sec of speed and 8 stops. And the commercial segment that It is composed of E&E, both elevators and escalators, in buildings such as Hotels, Shopping Centers, Offices, Airports, Train or Metro Stations, and whose diversity of average characteristics makes it impossible to determine an average type of E&E installed.

The average normal preventive maintenance contract in the Spanish market contemplates the periodic review according to the RAE and the Regulations published, which implies the periodic mandatory inspection, the



attention in a maximum time of 30 min from Monday to Friday and 2 hours from Saturday to Sunday for rescue of passengers. Rest of breakdowns, the time should not exceed 24 hours, and includes labor only in preventive and corrective maintenance, and does not include material in case of corrective maintenance. Repairs are budgeted separately.

Therefore, and given the evidence that local and regional companies which are the ones that are mostly bought by multinationals, have 99% of their portfolio of elevators corresponding to the residential segment, we will carry out the econometric study in the Spanish residential market. The premises we use are the average price values of the Spanish market in the residential segment shown in figure 2:

### Residential Segment

Average elevator contract value/Year	900 \euro / Y
Average elevator repair value/Year	\euro / Y

Fig 2.: Values obtained from different market studies: Alimarket S.A and DBK Informa

To calculate the profitability of a maintenance contract, the costs of preventive maintenance and the costs of possible corrective maintenance must be analyzed. The best corrective maintenance is the one that is not done.

Figure 3 shows how the Gross Margin (GM) and the profit before interest, amortization, and depreciation (EBITDA) of each maintenance contract are calculated, which is the sum of the GM and EBITDA of each elevator. In the aforementioned figure an example is specified, based on the average market cost values of a local or regional company, which are lower than the average cost values of a multinational. Depending on each company and its market prices and operating costs, GM and EBITDA may vary.

Where Direct cost of sales is direct labor cost, which represents the salary, training, and social security cost of each maintenance Technician who intervenes in the service operation that must not exceed a certain maintenance time, which the average is approximately 60 minutes per each elevator. Where the tool cost is the prorate of the depreciation of each tool used for the operation, where the transport cost is the time the Technician travels to the location of the installation, including non-desirable times, and where the cost Corrective maintenance is the cost of any action that does not correspond to preventive maintenance.

Elevator	Elevator 1	Elevator 2	Elevator 3
Sales	75\euro (monthly)		
Direct cost of sales	40\euro		
Tools costs	3\euro		
Technician transport time	3\euro		
Corrective cost	X\euro		
Absolute GM	29\euro - X\euro		
% GM	38,6% -X%		
SG&A	Y%		
EBITDA	GM%-Y%	...	...

Fig 3.: Profit & Losses (P&L) example of each elevator

The operational variable that measures the breakdowns that occur in the elevators is the "Breakdown Index", which means how many breakdowns occur per elevator in a period of time of operation, normally is 12-month period. This KPI that appears in figure 1 is one of the most important parameters to know the profitability of a maintenance contract. The ratio that should not be exceeded, as a general rule, in multinational companies is 10%, which comes from the maximum allowable number of breakdowns on a maintenance route

(geographic group of elevators usually made up of 120 elevators maximum). Each route is serviced by a maintenance Technician who, as a general rule again, should always be the same.

In other words, a 10% rate of breakdowns on a route means that 12 breakdowns of different or the same elevator, occur throughout the year in the mentioned route.

Figure 3 shows that the uncontrolled cost that can damage the Profit & Losses (P&L), is the cost of corrective maintenance. The better the preventive maintenance is performed, the lower costs of corrective maintenance. The uncontrolled cost must include the opportunity cost of not performing preventive maintenance on other elevators in the daily planning and the cost of overtime for the maintenance Technician.

Following figure 3, a normal preventive maintenance contract of one elevator that has a monthly income of \euro 75, which means \euro 900 per year, has a direct preventive maintenance cost of \euro 46 per month which means \euro 552, provides to the company a GM of 348\euro, which means 38.6%, without breakdowns.

To obtain the EBITDA, the general and administrative expenses (GG&A) of each individual company shall be applied.

## RESULTS

Let's take as an example, shown in figure 4, the elevator 1 from figure 1. Let's suppose that has had 1, 2, or 3 breakdowns this year and have meant 1 hour of resolution for each breakdown, but also 1 extra hour of the Technician to recover the hours not invested in maintenance preventive of the other elevators belonging to the route that were planned. Let's calculate the variation in profitability of the maintenance contract in all cases also assuming that the local company has 15% of GG&A:

Elevators	Elevator 1	Elevator 1	Elevator 1	Elevator 1
Breakdowns	0	1	2	3
Sales	900\euro	900\euro	900\euro	900\euro
Direct cost of sales	480\euro	480\euro	480\euro	480\euro
Tools costs	36\euro	36\euro	36\euro	36\euro
Travel costs	36\euro	42\euro	48\euro	54\euro
Corrective costs	0	80\euro	160\euro	240\euro
GM	348\euro	262\euro	176\euro	90\euro
GM	38,6%	29,1%	19,5%	10%
SG & A	15%	15%	15%	15%
<b>EBITDA</b>	<b>23,6%</b>	<b>14,1%</b>	<b>4,5%</b>	<b>-5%</b>

Fig 4.: Comparative example of P&Ls with and without breakdowns.

The reason why the multinationals are not accepting more than a 10% rate of breakdown index in their portfolio is because the lack of profitability. Has to be considered also that when the integration phase is completed, the labor cost of a multinational company is higher than in a local company. In an M&A process, the potential incoming orders of repairs, not included in above calculations, is either very important for decision making.

During the DD there is a very high percentage of E&E that are not inspected and therefore their operating status is not really known, except for the information on breakdowns that the acquired company may provide. These E&E can represent an uncontrolled cost during the negotiation process and can damage the bottom line after integration and even destroy company value in the event of an accident.

## CONCLUSIONS

The real operational variables could be obtained in real time by means of a connection interface (hardware)

with the electronic board of the E&E, which incorporates a SIM card. This SIM card provides an internet connection to the interface, so that through the IoT of the E&E itself, and during a certain period of time, all the operational variables of the E&E would be recorded, which would allow an analysis and a data projection to be carried out and take the correct decisions. It would allow to have a history that anticipates the present and future behavior of each E&E that is in the maintenance portfolio. These operational variables, together with the data of each maintenance contract extracted from the database, and together with the financial variables that would also be collected through the connection to the ERPs, would form a pool of data that would be subsequently processed by tools of BIG DATA.

The digital strategy applied by the big multinationals companies currently consists of a digital platform that is able to connect the E&E with the technicians, passengers and customers. The information obtained from the IoT of the E&E is used to predict the maintenance service in order to reduce the corrective one. Each multinational company is using their own devices compatible with their own E&E brand, but these types of devices are already existing in the market and are universal for different brands.

Can be used to record the operational variables during a defined time of period to learn the E&E technical status? Yes, can be used.

With this information, the operational ambiguity of M&A processes between companies of different sizes with different digital strategies in the E&E maintenance sector would be resolved. Normally, a visual and technical check is carried out on a small sample, about 10%, of the portfolio of the acquired Company in the Due Diligence phase due to the lack of time and high cost of resources. However, the use of this technology would allow not using human resources, not making large investments, and making a 100% sample, eliminating the risk of asymmetric information.

In other words, through the IoT of E&E we can have accurate and complete technical information. Then that information can be analyzed and processed thanks to the BIG DATA tools. In this way we will have the necessary information to gain economic efficiency in M&A operations.

IoT devices will be the norm in the future and will assist humans in daily routines. Authors Souza, Carlson, Ramos, Loureiro and Oliveira, in their article “*Internet of Things device authentication via electromagnetic fingerprints*” describe several scenarios where IoT can communicate and interoperate. To any other interlocutor. One of those is the scenario of vehicle-to-everything. We can consider an E&E a vehicle (Souza, Carlson, Ramos, Loureiro & Oliveira, 2020).

What cannot be measured, cannot be managed.

Information and communication technologies (ICT) can minimize/avoid information asymmetry and increase the success of M&A operations, not only in the Elevator sector but also in other service operations sectors.

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