

Manufacturing Outsourcing As A Strategy For Increasing Production Capacity And Reducing Production Costs

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Abstract:

This work addresses the increasing demand for smartphones in the electronics industry and the need for manufacturing expansion to keep up with this growth. Smartphones have become an integral part of society's routine, both for personal use and as a work tool. To meet this demand, outsourcing has been widely adopted as a strategy, aiming for cost optimization and improvements in business process efficiency. Several studies have analyzed the factors influencing the outsourcing decision, such as the degree of product or process standardization, the costs involved, and the correlation between companies and services provided. The article proposes an empirical outsourcing model for manufacturing in an electronics devices industry located in one of Brazil's Industrial Hub, aiming to increase production capacity and reduce costs. The research seeks to contribute to studies on outsourcing as a business alternative and provides a model for business managers and researchers exploring this topic. The feasibility study and introduction of outsourcing are conducted through the action research method. The action research process is illustrated in main six stages: planning, data gathering, data analysis and action planning, implementation of actions, evaluation of results and report, and finally, continuous monitoring, which occurs simultaneously with the other activities in the cycle. In this paper, the proposed action research is applied in three main stages: searching for concepts, building an empirical methodology based on the specific needs of the company in question for outsourcing implementation, and implementing it in a real practical case, resulting in the evaluation of the outcomes and decision-making regarding the capacity of the contracted company to produce the products of the contracting company. The construction of an evaluation model for companies aiming to implement outsourcing, starting from the selection of possible third-party companies, evaluation criteria based on the needs of the contracting company, set-up of the production process in the chosen company, validation of the third process, and continuous monitoring of this new implemented process. This study serves as a model for companies seeking to apply outsourcing not only to peripheral areas but also to core activities, providing an alternative for business expansion and operational cost reduction.

Key Word: Outsourcing, manufacturing, cost reduction, productivity growth.

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I. Introduction

With the increasing demand for the use of smartphones, the electronics industry has recognized the need for manufacturing expansion to keep up with this growth. The use of these devices is becoming more integrated into society's routine, whether for personal use, such as communication and interaction through messaging apps or social media. Its use can be even broader, as a work tool, as it combines functions of a phone, computer, camera, locator, and other features. According to Alves et al. (2021), since 2013, this market has been on a steady upward trend, receiving investments from international companies in Brazil, despite some variations. In Santos et al. (2018), the authors found that, from the study of retail demand for smartphones in Brazil, there was a strong adoption of this product from 2014, proportionally to the increase in sales in retail stores. In response to this need for productive expansion to meet the demand, research has been conducted. A study by Leeman and Reynolds (2012) demonstrates that the practice of outsourcing has been used for some time as a business strategy to stay ahead of other companies and be more competitive in the market, primarily seeking optimization of costs.

The authors Chang and Phan (2018) conducted a study on outsourcing in the manufacturing sector, proposing three factors to assist in the outsourcing decision: the degree of product or process standardization, transaction cost, and labor cost. The results show that the higher the degree of process standardization, the greater the capacity of companies to outsource their production. Applying these results to this proposed work, the development of a

methodology to standardize the production process between plants (main company and third-party company) increases the likelihood of a successful outsourcing process, in addition to evaluating the costs of this transaction.

For the economists Danyliuk and Mokhniuk (2020), outsourcing is an alternative to make the company more competitive and brings various benefits, such as cost reduction, reduced operation time, increased profits, improved business relationships, among others, when applied consciously. The authors emphasize the importance of surveying the correlation between companies, whether in management or processes, and the type of service provided, to ensure that outsourcing is managed clearly and with good results.

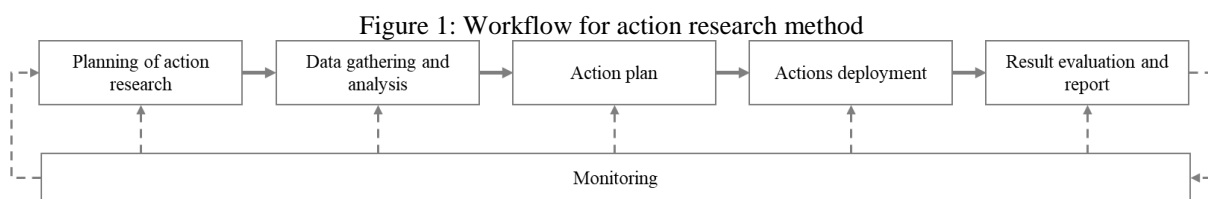
This article proposes an empirical model for introducing manufacturing outsourcing as a strategy to increase capacity and reduce production costs in the electro electronic device industry in one of the Industrial Hubs in Brazil. For practical application, based on internal criteria of the company under study, and in conjunction with local departments related to this practice named Task Force (TF) Team, including Quality, Engineering, Production, Purchasing, and Materials areas, it was possible to define the processes in which outsourcing would be performed, enabling the set-up of process facilities in another external production plant, selected according to the method proposed in this work. Thus, the goal is to expand the factory to meet the forecasted demand, without the need to build new warehouses and structures at the contracting company's production plant, using external spaces from third-party companies as a business strategy, which also resulted in a reduction in manufacturing costs per device.

This research aims to contribute to studies covering the topic of manufacturing outsourcing as a business alternative, as well as demonstrate the decisive factors for its implementation, providing a model for business managers who intend to adopt this strategy and for researchers exploring this subject.

II. Material And Methods

A good way to approach the introduction of outsourcing when you have an experienced team that knows the business and its routine activities is through Action Research. This is one of the methods that covers many forms of action-oriented research. It is a type of social research based on empirical evidence, which is conceived and carried out in close association with an action or the resolution of a collective problem, in which researchers and participants representative of the situation or problem are involved cooperatively or participatively (Cauchick et al., 2012). At the same time, Bryman (1989) adds that this is a technique where the researcher and the client work together to develop a diagnosis and solution to a problem based on the empirical knowledge discovered during the research.

The flow of Cauchick et al.'s work (2012) illustrated in Figure 1 indicates six phases that guide the action research process: plan; data gathering; data analysis and action plan; implementation of actions; evaluation of results and generation of final report; in addition, there is monitoring, which is a phase that occurs simultaneously with the others.



Source: Authors based on Cauchick et al. (2012)

According to Thiollent (2007), the planning of action research is carried out in an exploratory manner, consisting of discovering the research field, the stakeholders, the objectives or targets, the expectations, and establishing an initial analysis of the situation to be addressed, identifying the problems that are priorities for potential actions. Still, for this phase, Cauchick Miguel et al. (2012) suggest defining the team that will work on the research and the criteria for judgment based on the problem and objectives to be achieved, to avoid the incorrect selection of the unit of analysis.

During the data gathering phase, Coughlan and Coughlan (2002) understand that data can be collected in different ways, either through interviews, observations, and direct discussions, which the authors refer to as primary data, or through operational statistics, financial reports, and marketing reports, referred to as secondary data.

For the data analysis and action planning phase, Coughlan and Coughlan (2002) suggest that it be carried out collaboratively between the company interested in outsourcing and the third-party company. For example, planning actions that respond to key objectives and questions such as "What does need to change?", "Which part of the

organization need to be changed?", "What types of changes are necessary?", "What kind of support is needed?", "What kind of resistance needs to be managed?". Based on this plan, the actions should be implemented.

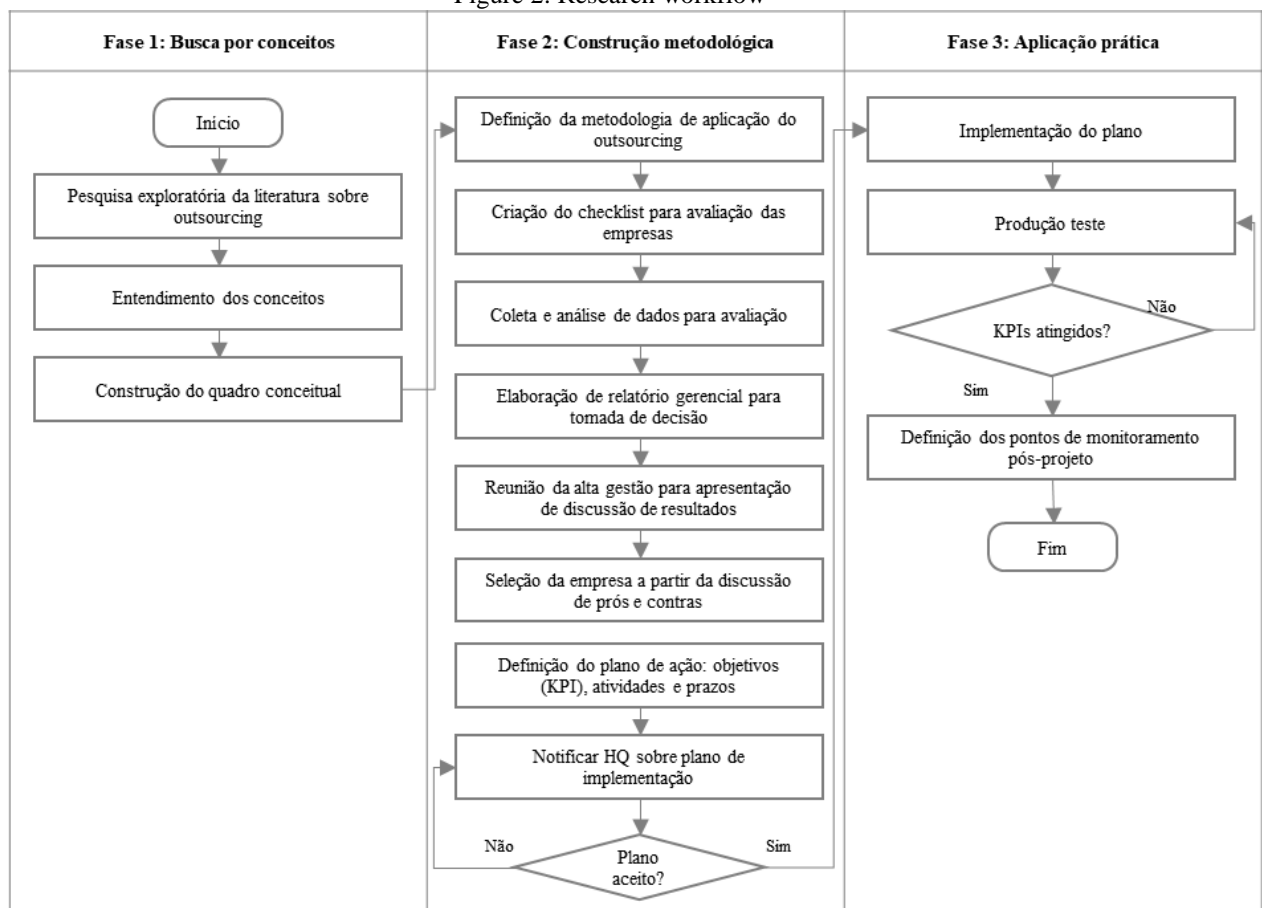
According to Westbrook (1995), for successful evaluation of results, it is necessary to base them on the proposed objectives and expectations raised at the beginning of the research, and the result depends on both project management and evaluation and analysis of the data in the action plan.

Additionally, Healy and Perry (2000) mention that the quality of scientific research can only be judged in terms specific to the paradigm in which the researcher is working, which means, the same criteria used in particular research may not work for another research. Each model is specific to the presented case study.

Applying the proposal of Cauchick et al. (2012) for the conduct of action research, a flow was created for the methodological process to be applied according to the illustration in Figure 2 related to this paper. In summary, the outsourcing process consisted of three stages:

- The first stage involves searching for concepts in order to analyze the existing techniques in the literature to find the one that best suits the company's requirements.
- The second stage involves creating an empirical methodology for applying outsourcing in manufacturing based on the team's needs and technical knowledge.
- The third stage involves implementing the defined methodology in a real practical case, resulting in the evaluation of the obtained results, allowing for a decision on whether the evaluated company is suitable for producing the products of the contracting company.

Figure 2: Research workflow

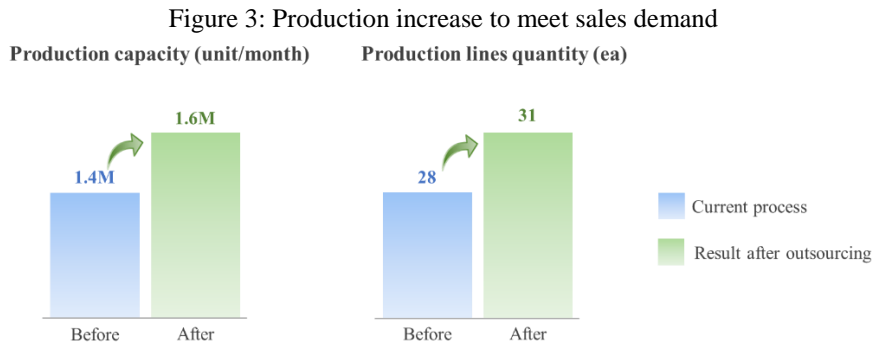


Source: Authors (2023)

III. Result

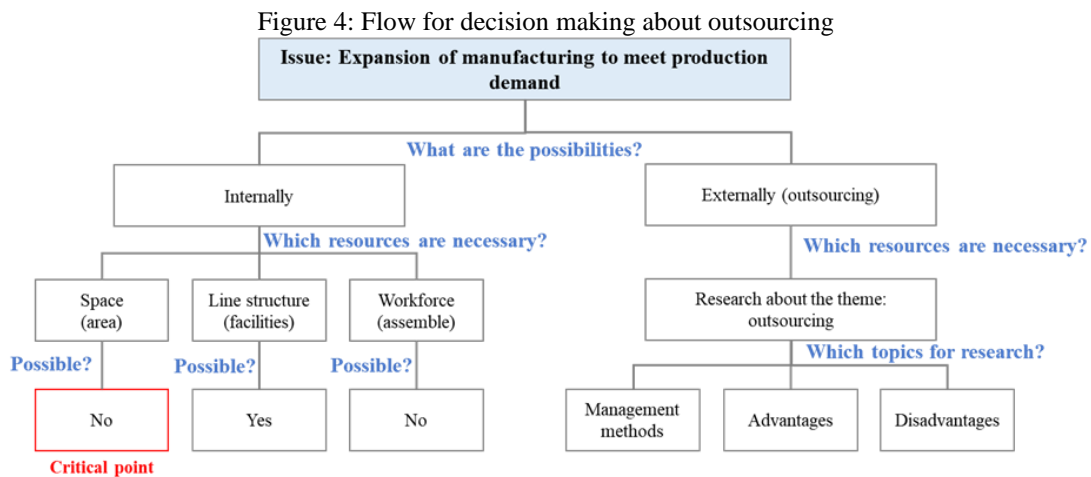
Motivation: Increase production capacity

This research has started due to a 14% increase in the sales demand for smart products in an industry located in one of Brazil's Industrial Hub. In order to increase production capacity, the Production Planning team calculated that it was necessary to add three manufacturing lines in order to meet the sales forecast as shown in Figure 3.



Source: Authors (2023)

Initially, the possibility of expanding the warehouse of the manufacturing plant was considered. The only available space with some basic structure was the logistics center area, location where the finished product is stored before being shipped to the customers (stores). After a few analysis, it was concluded that the logistics warehouse for finished products would need to increase its area by almost 50% to receive the storage of products and truck loading and unloading areas. This would require a significant layout adjustment and a substantial investment. However, it was quickly understood that this expansion was not feasible. Furthermore, the time required for the layout adjustments would be extensive. Therefore, based on this preliminary evaluation, which was conducted intuitively relying on the professional experience of those involved, the company's top management concluded that investing in the expansion was not reasonable. As a result, it was decided to explore other alternatives, leading to the option of outsourcing manufacturing, as illustrated in Figure 4.



Source: Authors (2023)

Based on the exploratory literature research, it was possible to gather several advantages and disadvantages, as shown in Table 1, and different management approaches between companies for analysis of its applicability and to decide which actions could be considered during the outsourcing planning. After discussions based on the company's internal policy, it was decided that the level of collaboration between the two companies should be operational, where both parties share basic information necessary for carrying out activities and engage in joint planning of operational tasks, such as workforce management, production, and inventory. This decision aimed to restrict the disclosure of confidential information from the company and maintain the third-party company only as an extension of production at the operational level.

Table 1: Analysis of advantage and disadvantage of outsourcing

Topic		Topic description	Applicable?	Analysis
Advantage	Concentration of efforts	It allows the company to focus on its core activities and delegate non-core activities to third parties.	No	The activity to be outsourced is not a non-core activity; but it is the main business of the company
	Streamlining	It occurs when the company transfers time-consuming activities to third parties capable of executing them more quickly	No	The activity to be outsourced does not involve bureaucratic tasks

	Quality improvement	Possibility of obtaining products or services of higher quality than those executed by the company itself	No	The company's quality standards are already good, and there is no need to hire another specialized company for that
	Productivity enhancement	Outsourcing activities can help make them more competitive	Yes	Due to the current lack of space in the company to meet market demands, it is necessary to use third-party space to remain competitive in the market
	Cost reduction	It happens when managers realize that the costs of a particular product or service are not competitive and discover that there are other companies in the market with significantly lower costs	Yes	The company has a high value-added cost to the product due to internal policies, for example, annual extra benefits. Request cost estimation from potential candidate companies
	Space release	Physical spaces previously used for process development can be utilized for other purposes after outsourcing those processes	No	All spaces in the company are well utilized, planned, and organized to meet daily necessary activities, making it easier to expand the production process to third parties
	Synergy between companies	Agreement between companies in the same business sector where one outsources part of its activities to another as a solution for increased productivity and cost reduction	Yes	This is precisely the purpose of outsourcing, to achieve productivity gains and cost reduction. Therefore, it is necessary to seek companies with similar proposals to the company looking to outsource
Disadvantage	Loss of activities control	When critical activities are outsourced, the company may lose control over these activities and become dependent on the performance of the third-party company	Yes	Monitoring must be carried out continuously by the company hiring the outsourced service, either through audits or other means. This item should be included in the action plan
	Reputation risk	The company may be negatively affected by the poor quality of services provided by the third-party company, which can harm its image and reputation in the market	Yes	If there is not proper monitoring of the third-party company, the product quality may not be maintained, and the brand's image may be harmed
	Dependency	The company may become reliant on the third-party company for the execution of critical activities, which can be risky if the third-party company is unavailable or unable to fulfill its obligations	No	The outsourcing involves electronic product manufacturing, a common activity in this industrial hub, which provides various options for outsourcing companies
	Communication difficulties	Communication between the company and the third-party company can be a problem, especially if there are cultural or language differences	Yes	The outsourcing company is from Asia, which is different from western culture. Therefore, communication between the companies should be carefully managed.
	Cost increase	Outsourcing can lead to higher costs if not well estimated, as the third-party company may charge more than the company's internal costs. Additionally, the company may need more internal resources to manage the relationship with the third-party company.	Yes	If the costs are not accurately assessed, the final product's price will be higher than that of the current factory, so attention must be paid to all elements that add value to the outsourced product
	Risk of labor disputes	Outsourcing can lead to labor disputes, especially if the third-party company fails to meet labor obligations, which can harm the reputation of the contracting company.	No	The company seeking a third-party has a specialized legal team that will draft this outsourcing contract

Source: Authors (2023)

Based on the analysis of how outsourcing activities will work, established from the conceptual research conducted, it is possible to outline the implementation of the project, thereby following the steps of action research.

Step 1: Planning

In this step, the companies interested in participate on this selection has to fill-up a form made by TF team, this is the pre-evaluation stage. This phase is eliminatory (minimum 70 accumulated points). If the applicant company meets the minimum required points, they can proceed to the evaluation step. Table 2 presents the results of this registration for further assessment. Five companies has been registered on pre-evaluation, but only three companies were approved for the evaluation phase. The selected companies were A (80 points), B (82.5 points), and C (82.5 points).

Table 2: Pre-evaluation stage

Item	Company type			Grade	Wei ght	Companies				
	Finished goods	Semi-finished good	Other			A	B	C	D	E
Product type	A) Same product B) Similar product (same area) C) Not similar products			20	A (1) B (0.5) C (0)	B	B	B	B	B
Area	A) > 500m ² B) 400~500m ² C) < 400m ²	A) > 200m ² B) 150~200m ² C) < 150m ²	A) > 50m ² B) 30~50m ² C) < 30m ²	15		A	A	B	B	C
Distance	A) < 10km B) 10~20km C) >20km			15		A	B	A	B	C
Incoming	A) > 2.5 bi B) > 2 bi C) < 2 bi	A) > 2 bi B) > 1.5 bi C) < 1.5 bi	A) > 0.5 bi B) > 0.3 bi C) < 0.3 bi	15		B	A	A	B	B
Management team experience	A) > 3 years B) > 2 years C) < 2 years			15		A	A	A	A	A
Building owner	A) Build belongs to the third-party B) Rent building C) Build is not legally operating			10		A	A	A	A	A
Organization chart	A) Production, quality and material are well established B) There is not main teams or outsourced parts C) It is not clear			5		A	A	A	B	B
General data	A) Easy to get from system or other B) Not easy to get, but it is controlled C) Not controlled or control is not clear			5		B	A	A	B	C
Score				100		-	80	82,5	82,5	62,5

Source: Authors (2023)

Next step is the evaluation based on qualitative and quantitative (cost) items. TF team has created a checklist for each department (Quality, Production, Engineering, Systems, Materials, Purchasing) raise main points needed related to the daily activities. This checklist is applied in all companies A, B and C for final decision. The Production team focused on the physical structure of the warehouses to receive the three manufacturing lines that needed expansion. The Engineering team focused on the technical staff's ability for line setup and defect repair, as well as their technical knowledge for problem-solving. The Quality team emphasized ISO9001 certification, because the company also holds such certification, along with knowledge and skills in defect detection and resolution. The Materials team concentrated on storage structure and technical knowledge of inventory management. The Purchasing team evaluated systems for material procurement management, the technical team for carrying out purchasing activities, and logistics. The Systems team assessed the server structure, systems, and information confidentiality.

Finally, the Key Performance Indicators (KPI) for the Pilot Production are defined in order to validate the process that will be implemented in the third-party company previously selected based on the qualitative and quantitative analysis conducted earlier. During the Pilot Production, 200 sets will be manufactured, and four points will be evaluated according to Table 3:

1. Process defect rate: It indicates the number of defects resulting from this production (defects/production). The maximum defect rate allowed is 2.78%, based on the company process rate for the last 3 months of Model X, which will be applied to the pilot production and multiplied by 1.5 as a reasonable value for a newly established process. If this rate exceeds 2.78%, the production must be made again;

2. Defect detectability during the production process: Four defects will be intentionally introduced during the production process to assess whether the process (machine and operator) can filter out these defects. Two of these defects will be functional simulations for machine detection, and the other two will be simulations for operator detection (1 functional and 1 cosmetic). The target is filtering out all defects; otherwise, the tager will not be achieved;

3. Production time: The production time should be equal to or less than that of the company. For this case of 200 sets, the standard production time is 64 minutes, so the target to be achieved is 1 piece every 32 seconds. If not achieved, the production must be made again until it meets the target;

4. Finished product inspection defect rate: The entire production will be inspected according to the company's inspection standards. The target is zero defect; otherwise, the produced batch will be rejected and send for rework.

Table 3: KPI for Pilot production

No	Item	Target	Jugdment
1	Process defect rate	2,78%	Approved: ≤2,78%; Rejected: >2,78%
2	Process defect detectability	100%	Approved: 100%; Rejected: <100%
3	Production time	32s/PC	Approved: ≤32s; Rejected: >32s
4	Outgoing inspection defect rate	0%	Approved: 0%; Rejected: >0%

Source: Authors (2023)

Step 2: Data gathering and analysis

The TF team scheduled visits to companies A, B, and C to assess the topics on-site through interviews, analysis of official documents presented by each company, and process observation. By using the created checklist, it was possible to evaluate each company, listing their pros and cons, and evaluating the cost presented as shown in Table 4.

Company A received an average evaluation of 68.3 points, which is under the internally established minimum average of 70 points. The critical factors contributing to the low score were as follows: the company has ISO9001 certification but requires adjustments concerning the final manufactured product (scope adjustment); lack of specialized assembly and inspection workforce for finished products; lack of engineers to coordinate repairs and technical analysis; lack of basic laboratory for defect analysis; and low security level. The advantage is that the company is approximately 7km away from the main company, which is relatively close and also contribute to logistics flow. Additionally, A company presents the best operating cost per set, which is \$1.91, representing 85% of the main company cost (\$2.24).

The average evaluation for Company B is 90.4 points, exceeding the minimum average of 70 points. This company did not have any critical points based on the checklist. The advantage observed during the evaluation of this company is that it deals with final products, one of the good is electronic panels for cars. Therefore, its employees are skiled in assembly and inspection related to finished products, even though they are not the same final product as that of the main company. Additionally, the company holds ISO 9001 certification and has a similar scope to main company. It was noted that the B company is dedicated in maintaining a high standard of quality, investing in employee training, and conducting regular internal audits. The material management system, including purchasing, logistics, and storage, follows processes similar to those of the main company. However, a disadvantage for this company is the distance of 15km and the operating cost per set, which is \$3.99, representing 178% of the main company cost (\$2.24).

Company C received an average evaluation of 81.25 points, exceeding the internally established minimum average of 70 points. The lower-rated aspects were: the company has ISO9001 certification but requires adjustments concerning the final manufactured product (scope adjustment); lack of assembly and inspection skills for finished products, as the company only deals with electronic boards manufacturing; and also needs layout adjustments. This company is located at a distance of approximately 5km from the main company, which could be an advantage for logistical workflow. The operating cost per set is \$2.54, representing 113% of the main company cost (\$2.24).

Table 4: Evaluation result of companies

Evaluation item	Maximum score	Company score		
		A	B	C
Quality evaluation				
Quality	100	62,5	92,5	67,5
Engineering	100	42,5	90	70
Materials	100	90	95	92,5
Information technology	100	95	95	95
Production	100	65	70	62,5
Purchase	100	55	100	100
Total	600	410	542,5	487,5
Avg	100	68,33	90,42	81,25
Cost analysis (US\$/PC)		1.91 (↓15% original cost)	3.99 (↑78% original cost)	2.54 (↑13% original cost)

Source: Authors (2023)

After the team meeting to discuss the cost-benefit analysis of the three companies, it was concluded that investing in Company B would be unfeasible, as its cost was above 78% of the original cost of the main company. At the same time, Company C had the advantage of being located closer to the main company, but it would still require investment in adjusting the ISO 9001 scope, training for operational skills, quality inspection, defect analysis, and repair. So the cost was still 13% higher than the original value. Therefore, the decision was to invest efforts and resources in Company A, which, despite its lower score, had a lower cost, allowing for a 15% improvement from the original cost of the main company. When considering all aspects, cost always is the most significant item in business decisions. In order to the Company A to become the outsourcing partner, an action plan would be necessary to address the critical points identified during the evaluation.

Step 3: Action plan

The action plan is focused on adjusting the differences between the processes of the main company and the third-party company. Therefore, the following points were listed for adaptation:

Quality: The group is composed by 5 parties, Incoming Quality is responsible for parts inspection and supplier management; Outgoing Quality is responsible for finished product inspection before product being sent to the customer; Field Quality is responsible for market index monitoring; Standard Quality is responsible for standardization and worker skills development, and also certifications; and Process Quality controls process statistical index and process improvements. In order to keep same organizational system in the outsourced company, it was decided to establish 2 parties inside third-party company: Outgoing Quality for goods inspection, third company is responsible for hiring inspectors, but their work and results would be monitored by the main company. And the other area is Process Quality, the current team working in the main company would redirected to outsourced company in order to handle process issues and statistical process monitoring. The remaining processes activities (Incoming, Field, and Standardization parties) will continue to be handled by the main company.

Engineering: The group consists of 3 main parties, Process Control, which involves activities such as statistical control, introduction of new models, and specification changes in the product (specifications, shape, etc.); and the Mechanical and Electrical teams, which have engineers responsible for defect analysis and the creation of work instructions (methods). It was decided to keep this team under the responsibility of the main company since they have more experience with the product. Engineers will be redirected to the new outsourced company everyday in order to monitor and work on the process. In order to make this possible, a basic analysis laboratory will be set up in the outsourced company. Other activities related to process control and work instructions are remotely made via systems. When it is a needed to apply workforce training due to a new product or changes in work instructions, the engineering team organizes and conducts the training at the outsourced company. By this way, the third-party company does not need to hire a technical team of engineers.

Purchasing: The negotiation with material suppliers will continue to be carried out by the main company, because there will be no change in the procedure, only in the quantity of materials. The materials for assembly and the finished product will be moved between the companies everyday distributed into 4 operations: In the morning, the flow is Outsourced company → Main company to deliver the finished product from the previous day's production, and immediately after that, Main company → Outsourced company for material movement to be produced. The same type of movement with the same flow would occur in the afternoon. The transportation used for this transaction is the same from main company (trucks and containers), which means there is no need for investment in transportation for either party.

Production: This group is divided into 4 parties, Operation, maintenance, administration, and innovation. The operation team, responsible for product assembly, which will be carried out by outsourced company. The maintenance team is responsible for line setup and equipment problem-solving, this part is essential for production operation, so this workforce should also be hired by the outsourced company. The administrative sector, which includes training controlling, for example, will keep to be managed by the main company. The innovation part, which involves specialized workforce such as engineers and technicians for process improvements and automation, will remain the responsibility of the main company.

Information Technology: The main company will handle all connectivity and systems installation in the outsourced company, and since the outsourced company has its own IT team, the main company will conduct training according to their protocols and systems. Main company will provide support as needed, there is no reason to hire IT team for outsourced company once issues related to this area are not common, or are simple to solve,

usually by remote assistance. Therefore, whenever there is a demand, full support will be provided either on-site or remotely.

Stage 4: Method application

Based on action plan related to the improvement points to be applied in new outsourced company, a schedule of activities was defined with the responsible departments to proceed with the installation of all processes for the execution of the pilot production to evaluate the pre-defined items in Table 3.

Table 5: Schedule for outsourced company implementation

No	Macro activity	Description	In charge	M1	M2	M3	M4	M5	M6
1	Third company selection	- Evaluation of companies according to the checklist - Cost evaluation (negotiation) - Definition of the action plan	Task force team	X					
2	ISO9001 certification	- Addition of product to the scope of third-party company	3 rd company		X	X	X	X	
3	Strategic level training	- Departments: Production, Quality, Materials, Operations - Performance indicators - Activity and operation workflow	Task force team		X				
4	Layout	- Infrastructure construction (civil, electrical, and hydraulic) - Moving of production line structures - Moving of equipment/machines/jigs - Moving of associated areas (office, materials)	Production		X	X	X		
5	Third-part workforce	- Hiring of operators, inspectors, and associates	3 rd company		X				
6	Operational training (theory)	- Understanding the process (flow, work instructions) - Production operators - Quality inspectors - Repair technicians (analysis and repair)	Production Quality Engineering			X			
7	Operational training (on job practicing)	- On-site training at the contracted factory - Production operators (production practice) - Quality inspectors (inspection practice) - Repair technicians (repair practice)	Production Quality Engineering				X	X	X
8	Systems	- Configuration of internal systems - IT team training	IT				X	X	
9	Quality training	- Statistical process control - Defect analysis and countermeasures - Process audits	Quality				X	X	
10	Test production	- Production of 50 pieces - Analysis and correction of production time - Analysis and correction of defect detection capability - Analysis and correction of process flow	3 rd company Production Engineering						X
11	Pilot production	- Production of 200 pieces - Evaluation of process defect rate ($\leq 2.78\%$) - Evaluation of defect detectability (=100%) - Evaluation of production time ($\leq 32s/PC$) - Evaluation of quality inspection (defect = 0)	3 rd company Production Quality Engineering						X

Source: Authors (2023)

Once schedule is denifined and Pilot Production has been made, it was possible to check all KPI has been achieved according to the Figure 5.

Figure 5: Result of Pilot production



Source: Authors (2023)

Step 5: Monitoring

Once the pilot production is completed, a final meeting for the outsourcing project was scheduled to discuss and shows up the outcomes. This meeting resulted in a plan for mass production monitoring with intensive support from the main company during the first 6 months, focusing on the critical points raised during the project implementation in order to keep same process quality. For this monitoring phase, there is no specific target to be achieved or an approval or rejection evaluation of the company. The goal is to identify and address any difficulties the process may find. Table 6 outlines the activities that will be undertaken to stabilize the new process.

Table 6: Process stabilization plan

No	Main activity	Part in charge	M7	M8	M9	M10	M11	M12
1	Quality inspection of finished products - Intensive inspection - Inspect 100% of the first production of lot issued	Quality	X	X	X			
2	Process audit - Work instruction: Once/week/part (Production, Quality, Materials, Repair) - ESD/EOS: Once/week	Quality	X	X	X	X	X	X
3	Process monitoring - apply same statistical control from main company to the 3rd-party company (Quality, Production) - Report and feedback meeting: once/week	Quality Production	X	X	X	X	X	X
4	Continuous improvement - Guide quality process improvement team, auditors, and repair team to identify issues and generate solutions: once/two weeks - Quality awareness campaigns as needed	Quality Engineering	X	X	X	X	X	X

Source: Authors (2023)

IV. Discussion

This study proposed an empirical model for introducing manufacturing outsourcing as a strategy to increase production capacity and reduce production costs in an industry for electro electronics devices. The production capacity increased by 14% with a 15% reduction in production cost per unit compared to the main company cost. When deciding to use outsourcing, the main company considered the potential impacts that outsourcing could have on the company's reconfiguration workflow due to this change, as it involved the partial outsourcing of a core activity.

This change caused direct impacts on its processes, such as the modification of the core manufacturing activity, which is transferring production lines to another production plant; logistics related to material management, from raw material delivery to shipping the finished product to the customer; and quality control, which needed to be monitored by the quality, production, and engineering teams to stabilize the outsourced process while maintaining the standards of the main company. At the same time, these changes had indirect impacts, such as training for the outsourced company. This training ranged from top management understanding the philosophy and working methods of the main company to floor workers executing processes correctly and following the headquarters' procedures. New responsibilities were assigned to the main company to continuously monitor the outsourced company through activities like audits, regular reports, etc.

V. Conclusion

This study serves as a model for companies that intend to apply outsourcing not only in peripheral areas but also in core activities. It represents a successful case where outsourcing was implemented and yielded satisfactory results, even including a subsequent plan for transferring additional production lines to the contracted company.

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