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Investigating the Implementation Levels of Perfect Quality Tools in Moroccan Industries using the IEMSE Method

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Abstract. This study investigates the adoption of perfect quality tools in Moroccan companies using the IEMSE (Inexistent, Existing, Method, Systematic, and Exemplary) method. A questionnaire was distributed to 40 companies to assess the implementation levels of seven perfect quality tools: TPM, Jidoka, Poka-Yoke, 8D, FMEA, 5S, and Standardized Work. The data were analyzed using descriptive statistics, principal component analysis (PCA), and the IEMSE scoring system. The results indicate that most Moroccan companies have reached the "Method" level of adoption for the perfect quality tools, suggesting a clear and precise implementation approach. However, further improvements are needed to reach the "Systematic" and "Exemplary" levels. The PCA results reveal that the seven quality tools can be reduced to a single component, simplifying the characterization of Moroccan firms' perfect quality systems. The study contributes to the understanding of perfect quality tools adoption in the Moroccan context and offers recommendations for companies to enhance their implementation efforts and overcome potential obstacles.

Keywords: Perfect quality, implementation, IEMSE.

1. Introduction

Nowadays, the term quality is becoming a necessity for every industrial firm wishing to excel and dominate market share. Ruthless competition exists between any firm wishing to possess the right and best tools to enhance the value of its products or services, and lead the way to production perfection. The question is always whether such a quality tool will lead to the desired result in the short, medium and long term. The clear and honest answer to this question is yes, because every well-mastered tool has a clear impact on the company's performance and on the entire production chain of any industrial firm operating in a given sector. We can even dominate market share if we rigorously apply the right and best production quality tools. We always try to find these tools and good means and perfect performance based on the implementation of these quality tools throughout the production chain of such an industrial firm operating in a given sector. Of course, details of the right tools for perfect quality will be given later, but the aim remains to show some interest in the term quality, given its fundamental role in the perfection of a given product or service. Business leaders in Morocco might be more interested in quality tools if they saw their added value within any given firm. There may well be obstacles to integrating perfect quality tools. We can be sure that a lack of employee training on how to implement perfect quality tools could ruin things. The high level of maturity of perfect quality tools may not even be reached if top management does not attach the utmost importance to these tools. It's worth pointing out that sometimes company managers in Morocco don't attach the utmost importance to perfect quality measurement methods or other tools. This can make any attempt to improve perfect quality tools more difficult. This can slow down the improvement of company performance in the short, medium or even long term. It's also worth mentioning that sometimes, companies designing any kind of product or service can generally implement tools other than perfect quality, without bothering to measure the true average maturity level. This research article corrects this shortcoming of showing no interest in the maturity level of perfect quality tools by developing the IEMSE method, which will give us a general idea of many things. We are interested in measuring the level of maturity of these tools, which reflects the degree of interest shown by managers in these tools, which can probably be improved in the future, thanks to the IEMSE method. Many authors have argued that implementing quality tools can come up against certain obstacles. These obstacles are related to financial resources, according to *(Sabra and al., 2020)*. After *(Shibani and al., 2012)*, some main barriers are preventing implementation of TQM in Libyan organisations. Those obstacles related to lack of skilled labour, lack of management, commitment, employees resistance and so more. According to *(AL-Hazmi and Alkhateeb, 2020)*, a list of administrative, organizational, leadership, competitive, technological, and social and culture obstacles could be opposed if we wanted to implant total quality management in Saudi Arabian marketing tourism services. We then demonstrate its role and true value as a fundamental pillar in a specific production chain. We always know that a quality tool well mastered from the outset and well implemented within a production unit always gives us the expected results and leads us towards the desired results, by obviously working out the right means of integrating these tools. There are also some practical benefits of implementing a quality system. Implementing quality tools can reduce scrap and non-quality in production. Strict compliance with quality standards can optimize this criterion to the maximum, and bring cost savings to the company. From all the above, we can confirm with certainty that quality remains an essential criterion and a requirement to be respected and taken into account when designing such a product or service. We need to be clear about the real purpose of such an industrial firm before embarking on the production of a given product or the provision of a given service. It should be clear from the outset that quality is only one of a number of criteria enabling such an industrial firm to improve in the broadest sense of the term. It's also clear that the means of production change as the product or service itself changes, but the essential thing is to set clear standards to be followed and respected, including the quality standards that are the subject of our study. To sum up, the aim of this research article is to clarify and verify whether quality tools are strictly implemented. The aim is still to specify the true level of maturity of these quality tools through the IEMSE method. The following question is posed in advance: What level of maturity of perfect quality tools will we achieve if we apply the IEMSE method?

2. Review of the terms

2.1. Review of the term Quality

According to (Anderson, 2014), Customer satisfaction with the product or service must always be demonstrated, because poor product quality leads to poor customer satisfaction. According to the same author, we must always think about finding and repairing quality defects, as this will make it easy to master the tools that enable us to achieve quality. We think about quality defects and how to remove them from the runway. Generally speaking, if we want to produce a product with zero quality defects, we have to remember to comply with universally recognized quality standards. And, according to the author (Chiarini, 2012), we're always interested in studying the CPQ (cost of poor quality), to minimize it, we must always think about reducing DPMO (defects per million opportunities). The same author has noticed that we should always have a higher quality culture and a clear quality vision.

The author (Allen, 2019) has given us the formula for quality (Q) which is equal to :

Q = P / E, with: P is the performance level and E is the expectations.

This relationship can be interpreted as follows: if we want to improve the quality of any product, its performance will systematically increase. To generalise, a product that meets the quality criterion must contain no defects that could cause it to fall off the market. Also, according to the author (Oppenheim and Felbur, 2014), we can achieve a high level of quality with a better implementation of Lean Manufacturing in a very short time. Productivity, cost and quality are really optimized when implementing Lean tools, according to the same author. According to (Farooq and al., 2017), we present a 10-step systems engineering methodology for quality improvement of manufacturing systems. Furthermore, Lean always reduces all forms of waste and improves the quality of a specific product on an ongoing basis. (Collins and Mannon, 2015) has well-cited tools that clearly help to improve the quality of a given product or service. Each individual within a given organization is expected to know his or her assigned role in order to improve product quality. A non-compliant or poor-quality product can always lead to additional costs.

The author (Mahmood and al., 2014) has provided us with the formula for calculating the cost of poor quality (COPQ), which is as follows:

- $COPQ = \sum RMT * MQ + \sum RMH * MHQ + \sum RMC * MCQ + \sum RT * TQ$

With:

RMT is the unit rate of material,

MQ is the quantity of lost material,

RMH is the rate of man hours,

MHQ is the quantity of lost man hours,

RMC is the rate for machinery hours,

MCQ is the quantity of lost machinery hours,

RT is the rates of overheads per day,

TQ is the number of days lost in any activity on critical path.

The author (Philip, 2018) has in fact given the formula that includes the term quality reject rate :

- OEE = Machine Availability × Performance Rate × Quality Reject Rate

With: OEE is the Overall Effectiveness of equipment;

2.2. Review of the term Perfect Quality tools

So, we're interested in shedding some light on the sub-dimensions of the widely-known tools of perfect quality, the table below gives an overview of this point:

Table 1. Tools of Perfect Quality

Dimension	Tools
Perfect Quality	• TPM • JIDOKA • POKA-YOKE • 8D • FMEA • 5S • STANDARDISED WORK

- TPM : According to (McCarthy, 2015), some guiding principles of TPM are as follows : Operator asset care, Maintainer asset care, continuous skill development, early equipment management, quality maintenance and continuous improvement.
- JIDOKA: It allows us to ensure that any piece of equipment is working properly without human intervention (Hirano, 2009).
- 8D: Stands for eight discipline problem-solving methodology (Jensen and Breneman, 2015).
- 5S: According to (Ortiz, 2015), there are five steps; Remove the unnecessary, situate things, sparkle, standardize the rules and finally follow and progress.
- STANDARDIZED WORK: It allows people to solve problems and improve, it allows to sustain improvements across all shifts (Patchong, 2012).
- FMEA: The aim of this tool is to eliminate any failures or anomalies that may have some undesired effect on the entire production or manufacturing process before reaching the customer. (Stamatis, 2019).
- POKA YOKE : It's generally used to prevent the causes of errors (Dudek-Burlikowska and Szewieczek, 2009).

We have classified 40 authors who have discussed the perfect quality tools and their implementation in different industrial firms belonging to different sectors.

Table 2. Perfect Quality Tools mentioned by 40 Authors

Author / Tools	TPM	Jidoka	8D	5s	STANDARDIZED WORK	FMEA	POKA YOKE
(Agrahari and al., 2015)				*			
(Attri and al., 2013)	*						
(Attri and al., 2013b)	*						
(Arabian-Hoseynabadi and al., 2010)						*	
(Bewoor and al., 2021)			*				
(Bakri and al., 2012)	*						
(Baluch and al., 2012)	*						
(Bahrami and al., 2012)						*	
(Berk and Toy, 2009)		*					
(Chlebus and al., 2015)	*						
(Chin and al., 2008)						*	
(Deuse and al., 2020)		*					
(Dev Sharma and Srivastava, 2018)						*	
(Danovaro and al., 2008)		*					
(Fin and al., 2017)					*		
(Gupta and Garg, 2012)	*						
(Jugraj, 2017)				*			
(Jiménez and al., 2015)				*			
(Jain and al., 2014)	*						
(Johansson and al., 2013)					*		
(Lipol and Haq, 2011)						*	
(Mariz and al., 2012)					*		
(Michalska and Szewieczek, 2007)				*			
(Omogbai and Salonitis, 2017)				*			

Author / Tools	TPM	Jidoka	8D	5s	STANDARDIZED WORK	FMEA	POKA YOKE
(Pinto and al., 2020)	*						
(Pereira and al., 2016)					*		
(Romero and al., 2019)		*					
(Rajput and Jayaswal, 2012)	*						
(Rahman, 2010)				*			
(Rodrigues and Hatakeyama, 2006)	*						
(Singh and al., 2018)	*						
(Shen, 2015)	*						
(Schmittner and al., 2014)						*	
(Singh and al., 2014)				*			
(Singh and al., 2013)	*						
(Saurin and al., 2012)							*
(Sharma, 2012)	*						
(Uslu Divanoğlu and Taş, 2022)			*				
(Veres (Harea) and al., 2018)				*			
(Widjajanto and al., 2020)							*

Through a case study, the author (Agrahari and al., 2015) looks at the implementation of 5s in a small scale industry. According to the author (Attri and al., 2013), improving the performance of maintenance activities requires a clear maintenance strategy from the outset. The author (Attri and al., 2013b) provides an analysis of the barriers to total productive maintenance. The author has also developed an interpretive structural modeling to identify the implication of some key enablers in the implementation of TPM. The author (Arabian-Hoseynabadi and al., 2010) takes a look at Failure Modes and Effects Analysis (FMEA) for Wind Turbines. Based on a case study, the author (Bewoor and al., 2021) conceives a Mapping Lean Six Sigma with 8D problem solving methodology to improve productivity and safety. According to the author (Bakri and al., 2012), a real gap was found and an integration was needed between the two methodologies Lean Production and TPM. The author (Baluch and al., 2012) has clarified that to deliver productivity without waste; we should combine Lean Maintenance with other tools, such as TPM. After the author (Bahrami and al., 2012), the technique FMEA allow us to improve different stages of project implementation and reduce project costs. The author (Chlebus and al., 2015) gives us a new approach to implement TPM in a mining industry conditions. The author (Chin and al., 2008) has developed a framework of a fuzzy FMEA (failure modes and effects analysis) based product design system. Also, the author (Deuse and al., 2020) has provided a systematic combination of Lean Management with digitalization to improve production systems on the example of Jidoka 4.0. The author (Dev Sharma and Srivastava, 2018) has shown a literature review of FMEA considered as a method of identifying and preventing systems problems before they occur. The aim of the paper (Danovaro and al., 2008) was to insert JIDOKA in software production. As a case study of a company of south Brazil (Fin and al., 2017), the implementation of standardized work has shown a result of 36 minutes reduction in terms of assembly time and 200 meters reduction in terms of operators' movement on average. A case study of an automobile manufacturing organization has shown us that the implementation of TPM increases the efficiency and productivity of machines in terms of Overall Equipment Effectiveness (OEE) (Gupta and Garg, 2012). From a literature review of 5s, the author (Jugraj, 2017) highlights the benefits of 5s implementation on the sustainable performance of the organization. Furthermore, the author (Jiménez and al., 2015) has implemented 5s in the laboratories of an industrial engineering university school. A literature review of TPM and the evaluation of this practice in SMes is demonstrated after (Jain and al., 2014). The author (Johansson and al., 2013) has given us the current situation of standardized work in automotive industry in Sweden. The author (Lipol and Haq, 2011) provides a FMEA risk analysis method in industries. It's shown by the author (Michalska and Szewieczek, 2007) that 5s methodology allows as a tool to improve all processes inside the company. Furthermore, the author (Omogbai and Salonitis, 2017) has implemented 5s using system dynamics approach. The author (Pinto and al., 2020) put a strategic plan for maintenance and has implemented TPM approach. The integration of standardized work was helping co-workers training and reduced variability and irregularity (Pereira and al., 2016). The author (Romero and al., 2019) considered Jidoka as a main principle allowing to SMEs digital transformation. The author (Rajput and Jayaswal, 2012) provided a TPM approach to improve overall equipment efficiency. Two companies were implementing 5s practice and as a result the technique has improved environment performance and both health and safety standards (Rahman, 2010). The author (Rodrigues and Hatakeyama, 2006) analysed the fall of TPM in companies. The author (Singh and al., 2018) provided a success of TPM concept through a case study. Furthermore, the author (Singh and al., 2014) provides a review of the implementation of 5s tool. The author (Shen, 2015) discussed the key successful factor of TPM in companies. The author (Singh and al., 2013) introduces a study of the implementation of TPM in a machine shop. Also, the study of (Saurin and al., 2012) provides a framework for assessing poka-yoke devices. To improve manufacturing performance, we follow a TPM rules. The implementation of this latter allows achieving the desired production output (Sharma, 2012). After the author (Uslu Divanoğlu and Taş, 2022), the application of 8D methodology can reduce failures in automotive industry. Implementing 5s has a positive impact on overall performance in an automotive company (Veres (Harea) and al., 2018). The article (Widjajanto and al., 2020) discussed Poka-yoke approach related to the industry 4.0 by reviewing articles published within 2015-2020.

The figure below shows us the number of appearances of each perfect quality tool cited by the authors previously mentioned in the table above.

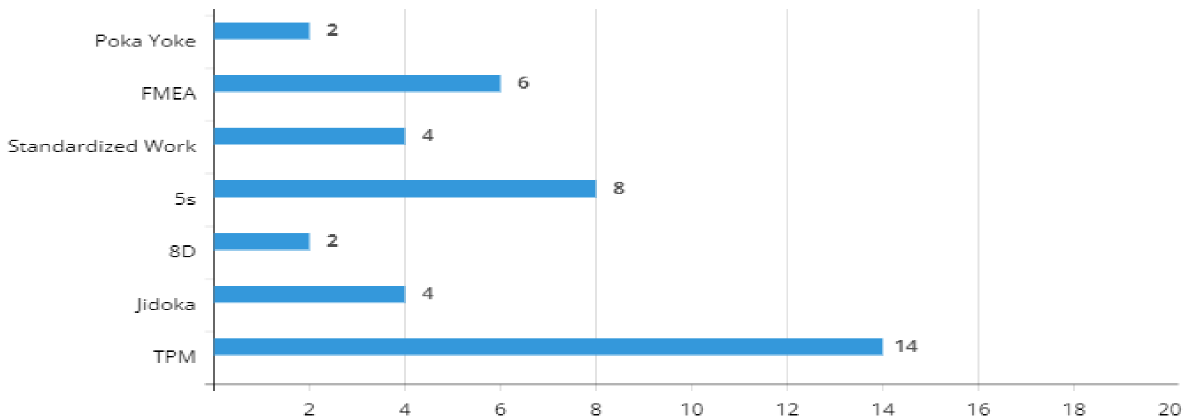

Fig. 1: The number of appearances of each Perfect Quality Tool

All the studies by the previous 40 authors focused on specific tools for perfect quality, but neglected methods for measuring the maturity of these quality tools. Through this article, we correct this research gap and remedy what these authors of previous studies have neglected, and introduce the maturity measurement method for these tools, which is IEMSE. So, after clarifying the term quality and the term tools for perfect quality through a review of these two terms. It's now time to turn the spotlight on the IEMSE method. This method for measuring the maturity level of any given tool is made up of five levels. The aim of this study is to measure the maturity level of perfect quality tools using the IEMSE method. In the research methodology, we are also interested in specifying these five levels of the IEMSE method.

3. Methodology

To collect our data, we choose random sampling technique. After (Omair, 2014), simple random sampling is as simple as picking up chits from the box. Every person in the study population must have an equal or known probability of being included in the simple. Furthermore, four major modes of data administration are often used:

- Administration by post;
- Administration via the internet;
- Face to face;
- Administration by phone.

In this context, it was decided to administer the data via the Internet using the well-known social network LinkedIn, given its multiple advantages, which will be clarified later. The formula for calculating the sample size n, based on (Yamane, 1973), is:

n = N / (1+ N (e2));

Where:

N : Population size;

Assuming a confidence level of 85%, we have:

e : Precision level;

Considering N = 90000 and e = 0.15;

n = 90000 / (1 + 90000 (0.15)2) = 44. In our case, we took n = 40.

The aim of this research is to reveal the level of maturity of perfect quality tools within Moroccan companies, using the IEMSE method. For this purpose, we designed a form containing the perfect quality tools. We collected data from some forty companies, all operating in Morocco. A descriptive statistical analysis and an exploratory data analysis were developed.

To evaluate this part of the questionnaire, the IEMSE method is an abbreviation of 5 different levels of response (Duret and Pillet, 2009) :

- I: Inexistent - This item is totally absent from the company;
- E: Existing - The company takes this point into account;
- M: Method - The aim is to generalize this practice by following a clear and precise method;
- S: Systematic - A systematic method of implementation;
- E: Exemplary - A strict, rigorous practice with remarkable results.

In addition, the score associated with the IEMSE method is as follows:

Table 3. The score associated with the IEMSE method

IEMSE Method	Score
Inexistent	[0 ; 1,5]
Existing	[1,5 ; 2,5]
Method	[2,5 ; 3,5]
Systematic	[3,5 ; 4,5]
Exemplary	[4,5 ; 5]

As mentioned above, the aim of the study is to measure the level of maturity of perfect quality tools, using an appropriate scale of measurement. At the outset, we were spoilt for choice. To simplify the task and give each level of measurement an appropriate definition and meaning, we chose the IEMSE measurement scale. Following this scale, we get a general idea of each measurement level. To reach a higher level, a strict mastery and implementation of perfect quality tools should be put in place. According to the IEMSE measurement scale, each level has a meaning, and the true maturity level is known in advance by calculating the various averages. All that remains to be done is to inform the respondent of the degree of interest shown by managers in perfect quality tools, using a form that integrates the IEMSE method and is well designed for this purpose. It should then be borne in mind that each higher level of maturity reached must be the result of a strict and rigorous implementation of perfect quality tools. The form distributed to some forty industrial firms, all operating in Morocco, is as follows:

Table 4. IEMSE method for Perfect Quality Tools

	TPM
Inexistent	• Curative maintenance is generally used when an anomaly occurs.
Existing	• New ways of preventing breakdowns are being studied
Method	• We facilitate the transition from corrective maintenance to preventive maintenance
Systematic	• Continuously improve the overall performance of the company's production resources through preventive maintenance.
Exemplary	• No anomalies detected, phenomenal performance of all the company's production resources by maintaining the system in a preventive manner
	Jidoka
Inexistent	• No such tool exists within the company
Existing	• Operators are well aware of the benefits of this tool
Method	• The emergency button is pressed for the majority of detected anomalies

Systematic	• Operators are encouraged to press the emergency button whenever an anomaly is detected.
Exemplary	• Operators are encouraged to press the emergency button whenever an anomaly is detected, and preventive actions are taken to reduce intervention time during system shutdown.
	Poka Yoke
Inexistent	• No POKA-YOKE system in place
Existing	• We try to explain the importance of using Anti-Error devices
Method	• POKA-YOKE is sometimes used
Systematic	• POKA-YOKE is often used
Exemplary	• The POKA-YOKE is in permanent use
	8D
Inexistent	• This quality method is not integrated within the company
Existing	• The 8D method is used when necessary or when there is a real need.
Method	• This method of analyzing and solving problems is integrated within the company, and we aim to perfect this method in the future.
Systematic	• This method of analyzing and solving problems is widely used within the company. We are on the way to perfecting this method through expert-led training courses.
Exemplary	• This method of analyzing and solving problems is widely used. We have mastered this method
	FMEA
Inexistent	• Total absence of a strict failure mode analysis within the company
Existing	• A good knowledge of existing failure modes, but the criticality threshold remains undetermined
Method	• A good knowledge of existing failure modes and determination of the criticality threshold
Systematic	• Strict, rigorous analysis of all failure modes within the company, and determination of both the criticality threshold and the overall criticality of failure modes.
Exemplary	• Take action to reduce overall criticality and minimize damage

	5S
Inexistent	• Total absence of space optimization rules, and staff totally unaware of the rules and the correct way to optimize space.
Existing	• Space optimization rules (5s) must be respected in the future, and staffs are beginning to be trained to be familiar with these rules.
Method	• Space optimization rules (5s) are in place. What's more, these rules are known, but little respect is shown for them as a whole.
Systematic	• Space optimization rules (5S): tidiness, cleanliness, visual identification, etc. are in place, and staffs are made aware of the importance of respecting these rules.
Exemplary	• Space optimization rules (5S): tidiness, cleanliness, visual identification, etc. are in place and strictly adhered to.
	Standardized work
Inexistent	• We work in groups and there's a mixture of tasks. We can work on any task without any constraints.
Existing	• Employees are trained in the importance of segregation of duties, so that each member of staff must perform all the tasks assigned to him or her correctly.
Method	• Some tasks are well separated, others are not. Staffs are more aware of the importance of segregation of duties.
Systematic	• The majority of tasks are clearly assigned to each operator. All tasks are performed to perfection.
Exemplary	• All tasks are separated and clearly assigned to each operator. We know what we have to do and we perform all tasks perfectly.

4. Results & Analysis

4.1. General collection of our study sample

Table 5. Size of the companies surveyed

Size	Number	Percent
Small Companies	4	10 %
Medium Companies	16	40 %
Large Companies	20	50 %

4.2. Reliability and validity of measurement scales

Table 6. Correlation Matrix of Perfect Quality Tools

		TPM	JIDOKA	POKAYOKE	@8D	FMEA	@5S	Standawork
TPM	Pearson Correlation	1	,551**	,508**	,381*	,456**	,329*	,321*
	Sig. (2-tailed)		,000	,001	,015	,003	,038	,044
	N	40	40	40	40	40	40	40
JIDOKA	Pearson Correlation	,551**	1	,569**	,428**	,483**	,450**	,502**
	Sig. (2-tailed)	,000		,000	,006	,002	,004	,001
	N	40	40	40	40	40	40	40
POKAYOKE	Pearson Correlation	,508**	,569**	1	,768**	,733**	,644**	,700**
	Sig. (2-tailed)	,001	,000		,000	,000	,000	,000
	N	40	40	40	40	40	40	40
@8D	Pearson Correlation	,381*	,428**	,768**	1	,709**	,620**	,661**
	Sig. (2-tailed)	,015	,006	,000		,000	,000	,000
	N	40	40	40	40	40	40	40
FMEA	Pearson Correlation	,456**	,483**	,733**	,709**	1	,500**	,621**
	Sig. (2-tailed)	,003	,002	,000	,000		,001	,000
	N	40	40	40	40	40	40	40
@5S	Pearson Correlation	,329*	,450**	,644**	,620**	,500**	1	,603**
	Sig. (2-tailed)	,038	,004	,000	,000	,001		,000
	N	40	40	40	40	40	40	40
Standawork	Pearson Correlation	,321*	,502**	,700**	,661**	,621**	,603**	1
	Sig. (2-tailed)	,044	,001	,000	,000	,000	,000	
	N	40	40	40	40	40	40	40
TPM	Pearson Correlation	1	,551**	,508**	,381*	,456**	,329*	,321*
	Sig. (2-tailed)		,000	,001	,015	,003	,038	,044

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 7. Reliability of measurement scales

Reliability Statistics	
Cronbach's Alpha	N of items
,896	7

The Cronbach's alpha for perfect quality tools is 0.896, which means that the measurements scale is very reliable, hence the need for further research analysis. On the convergent validity of perfect quality tools. All sub-dimensions of perfect quality are well correlated in peers. All values are above 0.3. A minimum value of 0.321 between standardized work and TPM and a maximum value of 0.768 between 8D and POKA-YOKE. We therefore accept the convergent validity of our measurement scale. We can continue our research.

4.3. Exploratory Data Analysis

We are supposed to perform exploratory data analysis using PCA. This multivariate analysis method aims to group a large number of variables into a limited number of factors in order to facilitate the analysis of these factors and detect any independent relationships between the different variables. The principle of this method is that it should be used with quantitative variables. This is appropriate for our case study. The total variance explained table shows how the variance is devided among the 7 possible factors. Note that one factor has eigenvalue greater than 1, which is a common criterion for a factor to be useful. When the eigenvalue is less than 1.0, this means that the factor explains less information than a single item would have explained. It could be concluded that this only factor extracted from the all variables is explaining about 62,055 % variance of total variance. We can always see that only one component or one single-component solution has been the subject of our study after performing the PCA factor analysis. We can then consider all the perfect quality tools as a single entity and calculate the average of the means of these tools, considering them as a single entity and thus assigning a single level of maturity to these quality tools using the IEMSE method. Of course, we can always check whether these perfect quality tools are indeed correlated, thanks to the construct validity that approves this point.

Table 8. Extraction Method: Principal Component Analysis

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	4,344	62,055	62,055	4,344	62,055	62,055
2	,883	12,612	74,667			
3	,542	7,748	82,415			
4	,446	6,376	88,791			
5	,319	4,558	93,349			
6	,261	3,735	97,084			
7	,204	2,916	100,000			

Extraction Method: Principal Component Analysis.

Considering factorial loads. We have a maximum value of 0.907 between the POKA-YOKE element and the single component. This reflects a perfect correlation between the element and the single component. In addition, a minimum value of 0.617 between TPM and the single component reflects a strong correlation between this element and the single component. Basically, all the factor loadings are greater than 0.6, which leads us to note the good correlation between variables and the single component. In general, the results obtained from the component matrix make it possible to associate the single component with the 7 quality tools. The component Matrix helps to reduce the size of data. So, we have reduced the 7 tools of perfect quality to a single principal component. This component makes it possible to characterize the various Moroccan firms by their perfect quality system in a simple and reliable way.

Table 9. Component Matrix

Component Matrix

	Component 1
TPM	,617
JIDOKA	,708
POKAYOKE	,907
@8D	,846
FMEA	,829
@5S	,758
Standawork	,814

Extraction Method : Principal Component Analysis.

a. 1 components extracted.

4.4. Descriptive Statistical Analysis

The means for all perfect quality tools are between 2.5 and 3.5. This indicates that a clear and precise method has been developed. We are supposed to analyze the results according to the third level of the IEMSE method, which is M: Method. All results have been simplified and analyzed in the form of a table calculating the mean and standard deviation of perfect quality tools, and the IEMSE measure associated with this calculation.

Table 10. The mean of perfect quality tools and the associated IEMSE measurement

Perfect quality tools	Standard Deviation	Mean	IEMSE	Meaning
TPM	1,219	3,00	Method	• We facilitate the transition from corrective maintenance to preventive maintenance
Jidoka	1,107	2,83	Method	• The emergency button is pressed for the majority of detected anomalies
Poka-yoke	1,366	3,07	Method	• POKA-YOKE is

				sometimes used
8D	1,159	3,20	Method	• This method of analyzing and solving problems is integrated within the company, and we aim to perfect this method in the future.
FMEA	1,429	3,40	Method	• A good knowledge of existing failure modes and determination of the criticality threshold
5S	1,277	3,40	Method	• Space optimization rules (5S): tidiness, cleanliness, visual identification, etc. are in place but little respected.
Standardized work	1,312	3,35	Method	• We are starting to separate certain work tasks, and operators are less confused about what their real job is.
Total	1,267	3,18	Method	• The aim is to generalize those practices by following a clear and precise method

Our in-depth analysis of the exploratory data has shown us that all seven quality tools can be reduced to a single principal component. However, the descriptive statistical analysis of the data and the different averages of the perfect quality tools show that these averages are between 2.5 and 3.5. A radar chart was developed. We can see that six quality tools are above average: TPM, POKA-YOKE, 8D, FMEA, 5s and standardized work. So, we can always think of increasing the productivity of the firms studied by rigorously implementing perfect quality tools. We still believe that these seven quality tools form a single entity capable of improving the quality of the products and services of the companies studied. The total average score of 3.18 is above average and lies between 2.5 and 3.5. This confirms with certainty that we are in the third level of the IEMSE method. It's safe to assume that we're above the average, as an interest in perfect quality tools is well expressed among these firms operating in Morocco. We can always think of better ways to implement these tools of perfect quality to achieve more optimal performance. We're starting to take an interest in these quality tools, and we're investing time and human expertise to improve production performance. Quality is one of the four criteria of excellence that we aim to constantly optimize. These criteria are: cost, quality, lead time and service. We always aim to eliminate production scrap and waste in an optimal way. The aim is to remain competitive by producing a given product or service that meets quality standards. We always realize that there are many key parameters that can impact the degree of interest in these quality tools. It's also important to train staff in the right ways to ensure that such an industrial firm excels in optimizing the four criteria mentioned above. These criteria are strongly interrelated. For, if we aim to optimize the quality of a given product or service, the cost of production, for its part, will also be impacted. We're always interested in getting rid of the extra cost of quality rejects. It is therefore essential to comply with quality standards when designing any product or service. It is well known that strict and effective implementation of perfect quality tools will change the commercial aspect of a given product or service. Increasing productivity and remaining the market leader remain the key objective of every company wishing to lead the market. Implementing these quality tools gives the companies studied in Morocco a competitive edge and leads them down the right path to industrial competitiveness. It is possible to achieve good results and added value in terms of these four criteria while focusing on quality tools. A third level of the IEMSE method has been reached. But these companies can still be pushed to do their best to better visualize the field and reach the high level of competitiveness. This can happen to any company wishing to lead the market. A certain financial profit can even be made, and a wide range of customers loyal to the given product or service can be retained. If you're aiming to be an exemplary company, you'll even have to train your workers in the right methods for implementing quality. We think of ourselves as a company that builds customer loyalty while playing with parameters that allow us to impact these quality tools. These parameters drive any industrial firm to be an excellent firm that aims to achieve the highest level of performance. This is the third level of the IEMSE method. But an exemplary company can even reach a fourth and even a fifth level of the IEMSE method, and can even be at the pinnacle of competitiveness, making remarkable progress in terms of cost, quality, lead time and service. Pushing these firms towards excellence is not such a simple matter. Quality tools push managers to invest their time and financial budget in something concrete. Reducing and minimizing quality rejects can always be done by implementing these quality tools. We realize that these tools are a single entity, thanks to exploratory data analysis. The focus is always on reducing those quality rejects that can damage products or services of any kind, and harm the working environment. In Morocco, a fourth level of quality tool maturity is not always easy to achieve. We wonder whether it is necessary to invest our time and financial budget to reach this level. Becoming an exemplary company is not such a simple matter. The best thing to do is to implement these tools as the situation demands. An above-average level of maturity reflects the fact that company managers in Morocco are already very interested in these quality tools, which of course form a single entity. The need to implement these tools is clear. A third level of IEMSE has been reached. The reasons for this can be diverse: to eliminate quality rejects, to earn extra profit, and even to stay on the right track of competitiveness by strictly adhering to quality standards.

Fig. 2: Graphic radar showing the maturity level of perfect quality tools

5. Discussion

In this research article, we began by collecting all sources of information using perfect quality tools. The IEMSE method was then clarified and, using a well-designed form, all sources of information related to perfect quality tools were collected. Some forty Moroccan companies demonstrated the degree of implementation of these quality tools. A final result also showed that a third level of the IEMSE method had been reached when implementing perfect quality tools. Thus, exploratory data analysis led us to reduce the seven quality tools to a single component. As we all know, every company's aim is to increase productivity and control the market through the various tools it has put in place. We are certain that a quality tool can play a vital role in guaranteeing a much higher quality product or service. We can always implement these tools and wait for company managers in Morocco to see the ideal way to better integrate all these practices into a given firm in Morocco. We can always expect to reach the fourth level of the IEMSE method, or even the fifth, through strict and effective implementation of the seven quality tools mentioned above. As an example and as an action plan, company managers in Morocco can focus on training their various employees in the right way to implement these tools, and even enrich their knowledge of the benefits of perfect quality tools. Mutual knowledge of the different workers will certainly enable a fourth and even a fifth level of the IEMSE method to be reached. By adopting perfect quality tools, companies in Morocco can comply with quality standards without any risk of anomalies. They may even see a direct positive impact on their overall production output. Additional costs due to any anomalies can even be minimized by integrating these tools throughout the production chain. Our study has certain limitations. It is not always possible to know the degree of interest of the various people responsible for these tools. It's true that a third level of maturity has been reached. These managers may give supreme importance to these tools, but obstacles may stand in their way. A point not made clear in the results section of this article. We can therefore recommend that company managers in Morocco show greater interest in these tools. Of course, there are always obstacles to the implementation of quality tools. These obstacles may be directly related to employees. Of course, a lack of training for workers can make implementing these tools more complex. These same obstacles can even be financial, such as a lack of financial resources to accomplish the task of implementing the various quality tools. My recommendation to these managers in Morocco is to invest more time and more human and financial resources in order to reach a higher level of maturity of perfect quality tools. The question remains:

- What do Moroccan business leaders think of these tools? And also:
- Does strict, effective implementation of the tools of perfect quality always lead to the desired results?

These quality tools are always thought to ensure optimum quality of the company's products and services. Today, quality plays a vital role in the commercial success of any company's product or service in Morocco. Also, perfect quality tools are of paramount importance within Moroccan companies. The results of our research analysis clearly demonstrate this point. These tools are valued and implemented to achieve the desired results. In all the companies studied in Morocco, there is a real interest in recognising the benefits of perfect quality tools. Introducing a certain tool, for example, guarantees higher production output and better quality, which can have a positive impact on the entire production chain. Various authors quoted in this article have clearly demonstrated the positive aspect of introducing some of these tools. Because, taken together, they can push production forward without breakdowns or anomalies in production or stock. The usefulness of these tools within the Moroccan company has been well thought through, and the results of our analysis confirm this point. In fact, a higher than normal level of maturity has been achieved. This clearly indicates that each of these quality tools plays a very important role within the Moroccan company. The TPM tool implemented within these companies in Morocco encourages the transition from corrective maintenance to preventive maintenance. The purpose of implementing TPM is to prevent work equipment from breaking down. This saves time and money, and enhances quality. So no one can deny the major role that this tool can play not only in detecting anomalies but also in preventing breakdowns, which can happen at any time to work equipment. We are also interested in implementing JIDOKA within the companies studied in Morocco. When an anomaly occurs, an emergency button is pressed. Thanks to this tool, any anomaly that has just occurred is easily detected and we can easily find out about the various breakdowns that have just occurred on any piece of work equipment. Secondly, it is in the interests of managers and company directors in Morocco to introduce POKA YOKE into the company. Because this tool prevents human error from occurring. The probability of human error is generally reduced to zero, and it is no longer possible to fall into error thanks to the implementation of this tool. This term or this tool introduced within a given company in Morocco can ensure that no human error can occur. Optimum safety is guaranteed when this tool is implemented. The 8D tool is another tool generally used to solve and analyse production problems such as surprising breakdowns. There is also the FMEA tool, which prompts us to take action when the criticality threshold is reached. The failure modes are well known and a strict analysis of these failure modes is developed. We know the criticality threshold and generally when it is reached, we act on the entire production chain to reduce work breakdowns. The managers of the companies studied are also interested in the 5s tool, given its major role in optimising the workspace. You can benefit from more space by implementing the 5s tools. The managers of the companies studied show no hesitation in implementing standardised work. The tasks are separated from the work and the operators are less confused and know perfectly well all the tasks they have to carry out all the time. So, from what we have discussed, it is clear to the eye that each quality tool has a certain importance within the different firms studied. Mastering these quality tools will make it easier to improve the quality of the products or services linked to a given company. It is easy to save time, money and quality by implementing all of these tools. We discuss all these results and confirm with certainty that a higher level of maturity has been reached. This explains the usefulness of these perfect quality tools. Together, these tools lead us to the right path of production perfection and push us forward. Most managers implement these tools and believe that the desired results can be achieved. We stand up to competition from other companies and we think we can even lead the market by implementing these tools to the letter. By implementing these tools, we are acting on a number of parameters, especially quality. We are aiming for perfection in production, and by implementing all of these tools; we are significantly reducing rejects and non-quality. We resist market changes and produce a service or product of any kind with optimum quality that satisfies the end customer. Thanks to these quality tools, we can easily reach a wide range of customers who are primarily interested in the quality of the products sold on the market. We can market a product that optimises all four major criteria: cost, quality, lead time and service. We can then ensure the positive aspect of perfect quality. A zero-defect product optimises these four criteria together and meets customer expectations. Additional profit can be made by acting on just the four criteria and implementing the tools of perfect quality. It is clear that company managers are interested in these tools. So we can argue that effective implementation of these tools reveals two major things: firstly, those managers are increasingly interested in these tools, and secondly, that the desired results are largely achieved thanks to this interest in perfect quality tools. Future researchers can show us the positive impact of implementing these perfect quality tools. They can also show us the challenges of implementing these tools. Various authors have also discussed the implementation of different perfect quality tools, based on their research articles published in different journals. Sometimes, however, company parameters such as size can lead managers or operators to neglect certain tools. In this research article, we have not taken some of these parameters into account. We leave it to the researchers to analyze the various parameters that may impact on the degree of interest in these tools.

6. Conclusion

According to our in-depth analysis of the different methods we have implemented and based on our study of the maturity level of perfect quality tools. We found that an above-average level of maturity had been achieved. We are interested in the implementation of perfect quality tools, and we insert these tools within the firms studied. We demonstrate a major interest in the implementation of perfect quality tools, and aim to perfect the final product or service when quality tools are implemented. The end result is better product quality and higher production output. The four major criteria - cost, quality, lead time and service - are optimally met. You realize the added value that these quality tools can bring together, and you come to realize that an above-average level of maturity has been reached. We always think of satisfying the end customer by playing with the various quality tools, and we always think of exceeding customer expectations by designing a final product or service with optimum quality criteria. In this article, we'll take a look at these quality tools and measure the actual level of maturity using the IEMSE method. The aim of this research article is to show what level of maturity we can achieve by rigorously applying the tools of perfect quality. There is a growing interest in quality tools, as they enable us to ensure consistent production of any product or service with fewer anomalies and fewer breakdowns. So, thanks to these tools, we can not only detect breakdowns but also anticipate anomalies before they occur. We must always think of acting according to what is dictated, and we must always aim for production perfection by acting on the four criteria mentioned above: cost, quality, lead time and service. So, to conclude, we measured the maturity level of perfect quality tools using the IEMSE method, and found that an above-average level of maturity had been achieved. We're really thinking about introducing quality tools within the firms we studied in Morocco, and we're rigorously following the implementation rules. After all, implementation is not just an act, but a way of thinking and acting. Implementing these perfect quality tools certainly requires talent, human expertise and local knowledge. When these quality tools are united together, we can ensure major production quality and push the entire production chain forward. You can produce better without any fear of breakdowns or anomalies of any kind. So, from all the above, no one can deny the benefits of perfect quality tools. A basic knowledge of these tools is an important thing. Implantation must certainly follow certain rules. We must always learn to implement the right methods, tools and techniques that always push us to optimize the four criteria: cost, quality, lead time and service. Finally, the four criteria mentioned above are of immense importance for industrial firms in Morocco. One can focus on product cost, just as one can focus on quality. But a typical company focuses on optimizing all four criteria to the maximum. The desired goal can always be achieved. This blend of the four criteria drives any industrial firm forward. The key is optimization. Certainly, the quality tools cited in this research article are aimed at optimizing the quality of the end product or service. But, in one way or another, they can have an impact on all four criteria. They can also have an impact on lead times, by eliminating delays in final product delivery due to quality rejects, for example. In one way or another, they can also have an impact on costs, due to the extra costs wasted on product non-conformance. Service quality is also affected. One way or another, we can push the company's entire production forward, and by acting on all four criteria together, we can easily lead the market and market a given product or service without any production constraints. The end product or service is guaranteed to meet quality standards. In conclusion, the work must certainly be carried out according to quality standards. The IEMSE method has revealed the hidden aspect of the maturity level of these quality tools. A third level has been reached. In this research article, we have neglected parameters such as company size, which can generally impact the results obtained from the maturity level of quality tools. Our results can be analyzed according to the change in these parameters. For, when company size changes, so does the degree of interest in quality tools. For SMe, for example, the main goal is to stay on the right track for competitiveness, and we can achieve any financial goal if we stay on the right track. For Le, on the other hand, the ultimate goal is to lead the market and become the number-one brand that can conquer the market of a certain customer range. Quality tools enable companies of all sizes to ensure good product quality by eliminating rejects and product non-quality. You can even exceed customer expectations and make extra profit while integrating the right and best quality tools. We can even think of integrating these quality tools into any industrial firm, whatever its size. We realize, however, that there are parameters other than company size that can influence the degree of interest in these tools. So, before implementing these quality tools, we need to think about modifying these parameters so that they are adequate. Acting on these quality tools can lead any industrial firm towards excellence. We always leave the way open for future researchers to discuss the right tools for excellence. Of course, there are other quality tools that can pave the way for any industrial firm to achieve excellence. It's always worth bearing in mind that key parameters can influence the degree of interest in these tools. So, from all the above, the margin for reflection is open to future researchers who wish to clarify the nature of these parameters. In this research article, we have not revealed the nature of these parameters. But what is certain is that there are key parameters other than size that can influence the degree of interest in these tools. Future researchers can always reveal the nature of these parameters and ask themselves questions like:

- Are there parameters other than size that can influence the degree of interest in quality tools?

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