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# Maturity levels of management process for improving industrial performance

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## ABSTRACT

In an increasingly varied and dynamic world, staying competitive and meeting the growing demands of customers and the market has become a real challenge for any company that strives for excellence. Therefore, adopting a performance management system is an essential decision to face unexpected market changes. Thus, the quality must be projected on the approaches and the practices mainly characterized by a high degree of maturity, which gives the company the ability to achieve continuous process improvements and meet the expressed and implicit needs of customers. However, other tools can help develop a sense of strong responsibility toward performance in its global definition and at all hierarchical levels of the company. The main contribution of this work is adapting a maturity model to assess management processes in manufacturing industries inspired by the "Capability Maturity Model Integration CMMI". In this work, a survey of Moroccan industries of different sizes operating in different sectors of activity is conducted, to define their maturity levels and their relationship with different types of industrial management.

## 1. Introduction

Performance in manufacturing processes is a subject that has not yet lost its topicality, as it remains the main objective of all companies that seek customer satisfaction and continuous existence in the market [1,2]. The invasion of digital technology in different fields, especially industrial technology, has prompted quality experts to adapt and update their strategies [3,4]. One of the definitions of the term "quality" refers to the concept of values, standards, and beliefs. This definition refers to a better company to guide the performance improvement of an organism in a way to do well since the first time [5–8].

Companies contemplating certification or wishing to renew it must first position themselves and know their maturity degree concerning the processes imposed by the standards. ISO 9001:2015 certification is known to be valid three years after it is obtained, and during this period, surveillance audits are carried out once a year to reassess the conformity of the quality management system [9–11]. The concept of process can be defined as the chain of interacting activities having the same purpose. Their objective is to improve the overall performance of the organism [12]. This can lead the company and thus guide the factors of progress to the results of operations [13].

Industrial performance management is a set of strategic activities linked to different hierarchical levels based on defined objectives

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and improvement actions [14]. The management process allows steering all the activities of an company by directing its processes. It generally consists of implementing, in the long, medium and short term, guidelines implied by all hierarchical levels, which are coherent with the strategy of the company [14,15]. The significant growth of competition for higher industrial performance and the increasing demand for enhanced quality in the industry have motivated a number of industrial engineering researchers to pay careful attention to the development process [16–18]. Thus, there is a real need for effective improvements and continuous assessments in many industry processes, as these industries are required to satisfy stakeholders' and customers' needs [7,18]. In fact, the processes used by companies to develop their performance strongly contribute to the product's overall quality.

Several studies have been carried out to define the maturity levels of the quality management system [19–21]. In Morocco, these concepts are still unknown, which is why it seemed interesting to look for a relationship between levels of maturity and industrial performance in Moroccan industries. Indeed, many questions are asked in this context that concern the readiness of the industrial system to be transformed, highlighting the need for maturity models, i.e., models that could assess, as a preliminary step, the readiness of such systems to this transformation, believing that such an assessment will be the point of departure of all the potential evolution. The presented work will focus in particular on the maturity assessment of the process management of industrial systems. The suggested idea is to be inspired by a maturity model that is commonly used in software engineering, namely, the "Capability Maturity Model Integration CMMI". In this sense, after a brief recall of the quality management systems and the industrial performance management basis, the CMMI is introduced as well as its adaptation to the industrial performance management characteristics. The aim of this study is to determine the relationship between the different types of industrial performance management and the maturity levels in manufacturing processes. For that, a survey was conducted among Moroccan industries of different sizes and various sectors of activity.

The rest of the paper is organized as follows: section 2 explains the motivations of this study and presents the background of the research; section 3 addresses the research methodology followed by the present study and explains the proposed maturity model; section 4 presents the main findings of the survey; and finally, section 5 presents the conclusions and directions for potential future research.

## 2. Motivations and literature review

For the past few years, the Moroccan Ministry of Industry has shown its full commitment toward the promotion of a quality infrastructure according to international standards to support the acceleration of the Moroccan industrial market [22]. To make quality an engine of business growth and an essential component of building a competitive industrial sector, the ministry must adopt standardization, accreditation, certification, metrology, and market surveillance [23]. The companies tend to adopt a quality management system following a strategic decision expressed by the direction to improve its overall performance and ensure the sustainability of adaptive actions [9]. In the same terminology, a systematic improvement of the overall performance of the company requires planning, implementation, analysis, evaluation and improvement of the quality management system and process management [24,25]. A quality management system must be well established, implemented, maintained and continuously improved according to the requirements of the standard considered. Such a system leads to the compression of the main processes of an organism and their interactions [9]. It seems essential to identify some related field beforehand to understand the relationship between the levels of maturity and the methods of management linked to the performance.

Commonly, the principle of the ISO 9001 standard is based on the definition and updating of the process, the improvement of the company structures, and the eradication of its disruption factors. This is not only to meet the qualitative and quantitative requirements expressed by stakeholders but also to create added economic value [2,9]. However, the issue of fake certificate production has been addressed, and the reliability of ISO 9001 certification has been criticized. The counterfeit, unaccredited, paper worked, and implemented-but-not-in-use ISO 9001 certificates have all been emphasized [11]. However, having a quality certificate does not always guarantee quality, as pointed out by other authors, which asserts that the ISO standards of quality certification are respected by the same company only on paper but not in practice [6,7].

Indeed, in the ISO 9001 standard, the process approach is strongly addressed [26]. A well-established process approach allows the company to first define and comply with the imposed requirements to increase customer satisfaction; second, to take into account the value brought by the process performance control; and finally, to evaluate all kinds of information allowing continuous improvement of processes [9]. According to AFNOR, the processes must follow a plan preestablished by the company to bring added value [27]. The quality of a manufacturing process is determined by measurable factors allowing for building qualitative parameters of the product. These factors can be material or technical and are characterized by the quality of the input/output data of a process [8]. From a sustainability perspective, the evaluation and improvement of manufacturing processes is characterized by preset processes, products and unit systems [8]. A manufacturing process is the combination of different production processes, generally composed of several subprocesses represented by unit operations. The aim of these operations is to transform material and human resources into finished products ready to be consumed while improving industrial performance [8,17].

Production management is based on effective measures [28]. The management of industrial performance aims to drive from an industrial production strategy that comes mainly from the general administration in collaboration with the pilots of the production process. This production strategy is made by defining a coordinated plan of actions to gain in terms of productivity and profitability. It must be carried out not only at the general management level but also in production workshops, including all hierarchical levels [27, 28]. Industrial performance management is considered a critical element for ensuring the efficiency and effectiveness of any business, facilitating control and correction, and comparing current performance results with desired goals [29–31]. A performance management system is defined as the set of procedures and indicators for continuously measuring the performance of a company. According to [32], a performance management system is the set of structured measures used to quantify the efficiency and effectiveness of actions.

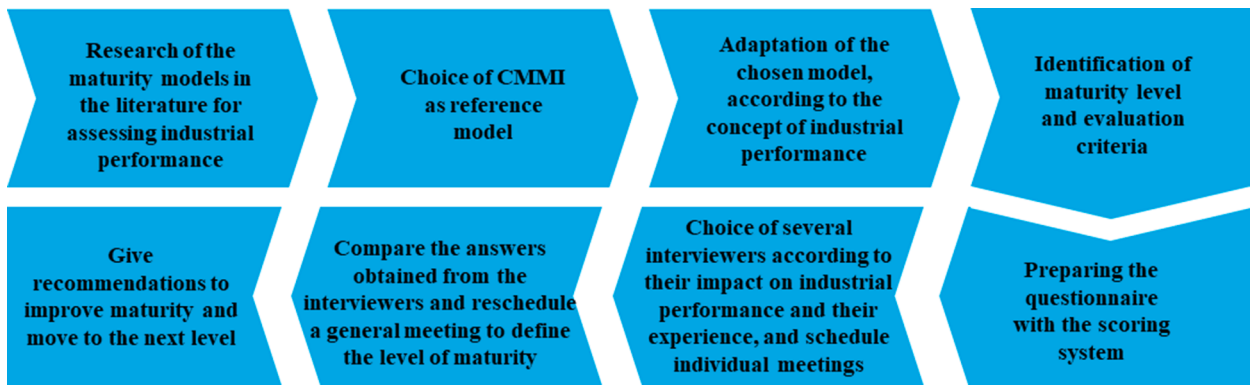


Fig. 1. Methodology used for constructing the adapted maturity model.

The work of [33,34] emphasized the integration of the performance indicator in a PMS, including all hierarchical levels.

It is useless to measure without acting; similarly, acting without having effective measures is futile. Measuring the performance of industrial systems can potentially increase the efficiency of the company by applying a strategic approach to flawless quality management [12]. Thus, the measurement system must be adapted to all hierarchical levels to increase the autonomy of employees in decision-making and individual contributions and to achieve more maturity [12,31,32].

The maturity of an organism, according to “ISO 9004”, is defined by the effectiveness and efficiency of the functioning of the organism with the aim of reaching performance [35]. Therefore, it is appropriate to consider it as a means of achieving the performance of quality management systems for manufacturing processes. It consists of acquiring management practices, following an evolutionary policy of the direction, to capture and meet the needs and the requirements of the stakeholders, while identifying the improvement areas of the productivity and the quality of the products intended for the customers [20,36].

Only a few studies have addressed the maturity levels of the quality management system in industries that consider the manufacturing process to be the main activity of the company [26,37]. The literature analysis shows that the relationship between ISO certification and the degree of maturity has been discussed from a number of perspectives [38]. Some authors have also suggested a correlation between ISO certification and product development process maturity [39]. More recently, attention has focused on the proposal of so-called 4.0 quality maturity assessment models [40]. Quality 4.0 is a term that has been used recently to introduce the alignment of the quality management process with the needs of Industry 4.0, which essentially aims at performance, efficiency, innovation, and new business models of companies [41,42]. In the literature, several authors have proposed models for evaluating the maturity of quality management processes. We can cite the work of Armani et al. [43], who proposed a framework to measure the degree of maturity in Quality 4.0. In the same vein, [44] explored the new concept of Total Quality Management 4.0 as a way to adapt quality management in Industry 4.0. Other works have addressed the Industry 4.0 maturity of industrial companies, and they have proposed a new empirically grounded model and its implementation to assess Industry 4.0 maturity [44]. Among the suggested maturity models, the “Capability Maturity Model Integration CMMI”, is commonly used in software engineering. The CMMI, as defined by the CMMI institute, is “a capability improvement model that can be adapted to solve any performance issue at any level of the company in any industry” [45–47]. Some authors have examined the adaptability of CMMI as a process improvement paradigm in the context of industrial process improvement [19,46,47], and others have used CMMI as a maturity assessment model to improve industrial performance [48]. However, no works have used the CMMI approach to evaluate industrial performance.

### 3. Methodology

Our assessment model consists of 8 sequential steps (Fig. 1). We began by conducting a literature search on maturity assessment models, specifically those used for evaluating manufacturing processes. The CMMI model was chosen due to its similarity to the processes used in product development and computer engineering, where it is used to measure the quality of services provided by software providers. We adapted the CMMI model to meet industrial needs, developing different types of performance management characteristics and maturity levels. We then created a questionnaire with a specific scoring system for each type of performance management. After obtaining consent from the companies, we scheduled meetings with managers to explain our objective in conducting the study.

Next, we selected interviewers from different hierarchical levels to provide a comprehensive perspective on the process. We considered the impact of the interviewee’s position on industrial performance and decision-making. After individual meetings with the interviewers, we remained impartial to avoid influencing their responses. The questions were designed to be clear and followed the evaluation criteria of the model. We judged the answers based on rationality and impartiality. After all the meetings, we compared the responses and prepared a report on each meeting.

At this point, a collective meeting was scheduled to compare the answers and reveal the level of maturity obtained. The objective of this meeting was to identify strengths and weaknesses to be improved through brainstorming. Finally, the responses obtained were considered, and possible areas of improvement were identified to better manage industrial performance. An action plan was then

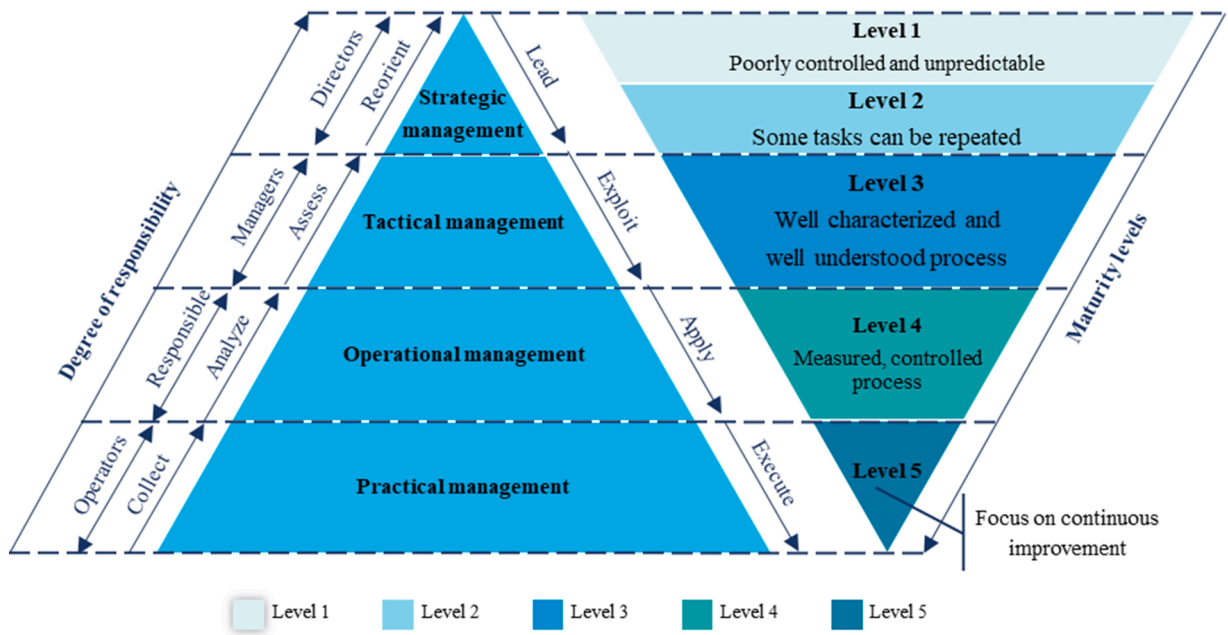


Fig. 2. The relationship between the different types of piloting and the levels of maturity of the manufacturing process.

prepared to move to the next level of maturity.

### 3.1. Adapted maturity model

In the dimension of performance management, there are generally four types: strategic or directive management, tactical management, operational management and practical management [25]. These four different types of management are associated with collaborators, also classified into four categories: directors, managers, responsible and operators, involved in the main activity of the manufacturing process. It is interesting to note that the hierarchical order of management demonstrates a certain reciprocal power between the different types of management. As it exercises vertical authority over the lower levels, strategic management may be regularly modified and adjusted using data from the tactical and operational levels. Understanding the different types of management gives meaning to the action and ensures the best possible match between strategic objectives, tactical objectives, operational objectives and the maturity level of the manufacturing process (as shown in Fig. 2).

The established maturity model makes it possible to define for each type of performance management a set of characteristics so that companies can position themselves in relation to the level of maturity. Opposite to the triangle of performance management types, we find the triangle of maturity levels, which is upside down, and we believe that the higher the level of maturity, the greater the aggregation of objectives, by moving from one type of performance management to another.

### 3.2. Performance management

#### 3.2.1. Strategic management

Strategic management can be seen as a process implemented by the production managers in collaboration with the general management that translates the evolutionary administrative policy of the company to achievable objectives and subsequently to concrete results [17]. This transition must take place according to preestablished scenarios, taking into account several variables. The proposed questions and their score for this type of management are presented in Table 1.

**Table 1**  
The proposed strategic management questions and their ratings.

| Strategic management  | Responses                                 | Scoring                         |
|---|---|---------------------------------|
| Q1-1 Do you have a manufacturing process developed, monitored, updated, by the general manager in collaboration with the production managers' according to an evolutionary strategic vision, defined by input and output data, and communicated to all levels?  | Totally<br>Partially<br>Absolutely<br>not | 5 points<br>3 points<br>1 point |
| Q1-2 <b>Is the efficiency</b> of the quality management system of the manufacturing process assumed by the general manager by defining the quality policy and objectives, and by making available all the necessary tools to achieve them?  | Totally<br>Partially<br>Absolutely<br>not | 5 points<br>3 points<br>1 point |
| Q1-3 <b>Are customer</b> needs related to production quality, anticipated, identified, and taken into account during the implementation of management strategy, translated into requirements respected during production, and meet customer expectations?<br>Are there measures to determine the satisfaction rate and the performance of the requirements? | Totally<br>Partially<br>Absolutely<br>not | 5 points<br>3 points<br>1 point |
| Q1-4 <b>Are the skills</b> of the employees necessary for the smooth running of the manufacturing process evaluated, well exploited, enriched by general management, with the aim of involving them in achieving the objectives linked to the quality of production?  | Totally<br>Partially<br>Absolutely<br>not | 5 points<br>3 points<br>1 point |
| Q1-5 Does the general management promote a favorable internal environment making it possible to involve and engage the collaborators in the achievement of the objectives established inadequacy with the company's quality policy?   | Totally<br>Partially<br>Absolutely<br>not | 5 points<br>3 points<br>1 point |

**Table 2**  
The proposed tactical management questions and their ratings.

| Tactical management  | Responses                                 | Scoring                         |
|--|---|---------------------------------|
| Q2-1 <b>Are modifications and unanticipated</b> changes analyzed? Are corrective actions planned, taking into account the impact of unplanned changes on the performance of the manufacturing process, when the production process does not proceed as planned and does not achieve the intended results? Is the effectiveness of these actions measured?  | Totally<br>Partially<br>Absolutely<br>not | 5 points<br>3 points<br>1 point |
| Q2-2 Do you suggest solutions based on research and innovation to meet customer expectations? Do you monitor the innovations and technological developments existing in the market or among competitors and define their ability to support strategies relating to production quality?<br>Do you have an ambition to be transformed into a smart factory by integrating the different technologies made available thanks to industry 4.0?<br>Do you use any smart technologies to assess the quality of your products and operations, as well as to improve your industrial performance? | Totally<br>Partially<br>Absolutely<br>not | 5 points<br>3 points<br>1 point |
| Q2-3 <b>Is the interaction</b> with all of the company's departments, external or internal suppliers and service providers systematically defined so that the input and output elements are designed to foster the internal and external environment and maintain the company's performance?   | Totally<br>Partially<br>Absolutely<br>not | 5 points<br>3 points<br>1 point |
| Q2-4 <b>Are quality objectives</b> based on the needs of customers, and process performers translated into quantitative and measurable objectives, represented by relevant indicators to assess and monitor the performance of the manufacturing process?  | Totally<br>Partially<br>Absolutely<br>not | 5 points<br>3 points<br>1 point |
| Q2-5 <b>Proposals for evaluations</b> , management, and improvements to allow the company to achieve its objectives of quality and performance of the manufacturing process on a risk/opportunity analysis basis and investment funds are they submitted? Do you identify measures to detect anomalies that could affect the body's ability to achieve sustainable performance?  | Totally<br>Partially<br>Absolutely<br>not | 5 points<br>3 points<br>1 point |

**Table 3**

The proposed operational management questions and their ratings.

| Operational management   | Responses      | Scoring  |
|--|----------------|----------|
| Q3-1 Do you participate in the evaluation of the gaps identified between the objectives to be achieved and the results obtained, as well as in the preparation of action plans to remedy the causes of these gaps to avoid that they do not recur in the future?   | Totally        | 5 points |
|  | Partially      | 3 points |
|  | Absolutely not | 1 point  |
| Q3-2 Are <b>quantitative and statistical management techniques</b> used to detect, analyze, and eradicate anomalies and malfunctions related to the manufacturing process, thereby enabling performance to be controlled and improved? Do they ensure the effectiveness and relevance of measures and practices in order to contribute to the overall company's performance? | Totally        | 5 points |
|  | Partially      | 3 points |
|  | Absolutely not | 1 point  |
| Q3-3 Is the understanding of the context, internal and external issues, strategic orientation, quality policy, objectives, and productive actions of the company, guaranteed in such a way that the quality management system of the manufacturing process be efficient and in conformity with the imposed requirements?   | Totally        | 5 points |
|  | Partially      | 3 points |
|  | Absolutely not | 1 point  |
| Q3-4 Do <b>devices</b> exist to assess, respect, and preserve the conformity of the production tool and its relevance in achieving objectives related to production quality? Do these devices help you to evaluate performance and make effective decisions?   | Totally        | 5 points |
|  | Partially      | 3 points |
|  | Absolutely not | 1 point  |
| Q3-5 Are there evaluation programs in place to ensure that those involved in the production, quality assurance, and development have the necessary knowledge and skills to fulfill their assigned roles? In case of lack, do you provide initial and professional training to fill it?   | Totally        | 5 points |
|  | Partially      | 3 points |
|  | Absolutely not | 1 point  |

### 3.2.2. Tactical management

The objective of tactical management is to transpose strategic objectives to unitary objectives and to control the progress and quality of production [32]. It enables the optimization of the value chain by identifying the parameters that have an impact in terms of cost and quality on production and can lead to a competitive advantage. The proposed tactical management questions and their ratings are shown in Table 2.

### 3.2.3. Operational management

Operational management focuses on implementing activities in accordance with what has been defined at the tactical steering level [32]. It provides adaptation modes to delicate situations according to an experimental plan of operations, with the aim of improving the manufacturing process. The proposed questions and their score for this type of management are displayed in Table 3.

### 3.2.4. Practical management

In the stage of practical management, the operators take charge of production; they are responsible for maintaining control and adjustment of the production supports, as well as assuming the correctness of the production tools [32]. Therefore, the manufactured product meets the quality and performance requirements imposed by the higher levels of management. The proposed tactical management questions and their ratings are presented in Tables 4, and 5 provides a brief overview of four types of management and the function of collaborators according to each category.

**Table 4**

The proposed practical management questions and their ratings.

| Practical management  | Responses      | Scoring  |
|---|----------------|----------|
| Q4-1 Are the needs and requirements of customers and interested parties relating to the production process taken into account and reviewed during the production phase so that the performance of the production tool is improved and sustained? Is a common understanding of quality objectives and values assumed?  | Totally        | 5 points |
|   | Partially      | 3 points |
|   | Absolutely not | 1 point  |
| Q4-2 Do you ensure that the management's strategic direction and policy are consistent with its vision, mission, principles, and culture to achieve quality objectives effectively and efficiently? Do you assess the relevance of the improvement and industrial performance management processes and whether they are in line with the strategy and objectives defined by the management? | Totally        | 5 points |
|   | Partially      | 3 points |
|   | Absolutely not | 1 point  |
| Q4-3 Does the collaboration and integration of all the actors responsible of production ensure incremental progress in industrial performance?  | Totally        | 5 points |
|   | Partially      | 3 points |
|   | Absolutely not | 1 point  |
| Q4-4 Does senior management promote the conditions of autonomy, productivity and creativity of the staff, encourage, recognize and reward their application?  | Totally        | 5 points |
|   | Partially      | 3 points |
|   | Absolutely not | 1 point  |
| Q4-5 Do you define a systematic approach for collecting and analyzing input and output data from the production process, presented in the form of indicators, , needs, and risks, in order to contribute to the deployment of guidelines allowing the improvement of its functioning?   | Totally        | 5 points |
|   | Partially      | 3 points |
|   | Absolutely not | 1 point  |



**Table 5**

The overview of four types of management and the function of collaborators according to each category.

| Types of management    | Collaborators                         | Characteristics   | Functions   |
|------------------------|---------------------------------------|---|---|
| Strategic management   | The general direction, Plant managers | Strategic vision, in the medium or long term, imposed by the decision makers of the company to increase the profitability of the activity | <ul style="list-style-type: none"> <li>- Translating a strategic vision into overall performance</li> <li>- Decompose performance objectives into activity objectives</li> <li>- Build relevant indicators</li> <li>- Anticipate, analyze and evaluate results</li> </ul> |
| Tactical management    | Production managers                   | Transforming strategies into objectives by service and control the progress and quality of production.                                    | <ul style="list-style-type: none"> <li>- Making the best use of resources according to their capacities</li> <li>- Minimize material assets</li> <li>- Plan production in the best possible time</li> </ul>   |
| Operational management | Responsible and Engineers             | Put in place organizational tools   | <ul style="list-style-type: none"> <li>- Modeling the tactical plan and declining the strategy to operational plans</li> </ul>  |
| Practical management   | Technicians and operators             | Real time and event monitoring of the manufacturing process activity  | <ul style="list-style-type: none"> <li>- Prepares production and makes the necessary adjustments</li> <li>- Carries out production operations</li> <li>- Provide technical support to production</li> </ul>   |

### 3.3. Maturity levels

The maturity levels of the manufacturing process give a global vision on performance and show the priorities and the center of interest of the company. Each level of maturity is defined by characteristics and specific limits, which allows the company to position itself and implement an action plan to move to a higher level of maturity.

In our study, five levels of maturity are considered, inspired by the CMMI model [45], and each constitutes an initiative to improve the company according to the capability of the process.

Table 6 presents the different characteristics of the process production maturity levels from 1 to 5:

**Table 6**

Characteristics of the process production maturity levels.

| Levels  | Definition                                     | Characteristics   |
|---------|--|---|
| Level 1 | Poorly controlled and unpredictable            | <ul style="list-style-type: none"> <li>- The direction develops the manufacturing process in collaboration with production managers' according to a strategic vision, but it is rarely monitored and updated;</li> <li>- The production process follows a disorderly operation;</li> <li>- The efficiency of the process is not measurable;</li> <li>- Quality objectives are nonspecific and do not represent the strategic vision;</li> <li>- Ability to adapt to unforeseen changes is low;</li> <li>- Skills management is poorly done.</li> </ul>  |
| Level 2 | Some tasks can be repeated                     | <ul style="list-style-type: none"> <li>- The functioning of the manufacturing process is defined in a formalized manner;</li> <li>- The quality management system is defined by production managers based on the needs of customers and demonstrates a certain efficiency;</li> <li>- The quality and performance objectives are consistent with the aims of the company;</li> <li>- Management techniques are often implemented and drive the process;</li> <li>- Problem-solving is by experience and without method;</li> <li>- The profile of the employees is in line with the responsibilities entrusted.</li> </ul>  |
| Level 3 | Well characterized and well-understood process | <ul style="list-style-type: none"> <li>- The production process is well applied by all process collaborators and achieves the objectives in accordance with expectations;</li> <li>- Customer's needs and requirements are taken into account and reviewed during the production phase so that the performance of the production tool is improved and sustained;</li> <li>- The used management techniques demonstrate repetitive success and can be reused;</li> <li>- Measurements are made to detect anomalies that could affect the process's ability</li> </ul>  |
| Level 4 | A measured, controlled process                 | <ul style="list-style-type: none"> <li>- The operation of the process is optimized and reviewed regularly;</li> <li>- Quantitative techniques monitor the manufacturing process;</li> <li>- The quality and performance of the manufacturing process are analyzed statistically;</li> <li>- Goals for quality and performance in manufacturing processes exceeded;</li> <li>- Focus on continuous improvement.</li> </ul>   |
| Level 5 | Focus on continuous improvement                | <ul style="list-style-type: none"> <li>- All process employees, from all hierarchical levels, are involved and integrated into performance management;</li> <li>- Modifications and unplanned changes are regularly analyzed by senior management;</li> <li>- Corrective actions for anomalies are planned, taking into account the impact of unforeseen changes on the performance and efficiency measures are carried out.</li> <li>- The company is particularly interested in solutions based on research and innovation to anticipate customer expectations, it monitors existing technological innovations and developments in the market or among competitors and defines their ability to support strategies relating to production quality;</li> <li>- Integration of advanced technologies in the majority of operations</li> <li>- Ability to take on the digital transformation and become a smart factory</li> </ul> |



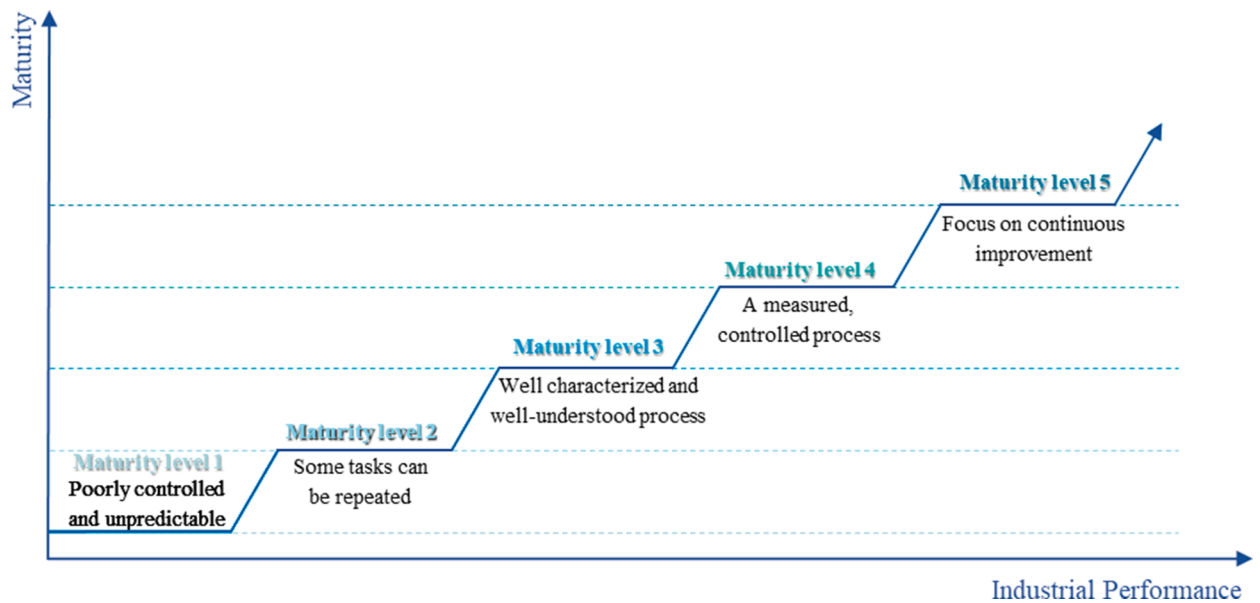


Fig. 3. The different levels of maturity of the manufacturing process.

- Maturity level 1: Poorly controlled and unpredictable
- Maturity level 2: Some tasks can be repeated
- Maturity level 3: Well characterized and well-understood process
- Maturity level 4: A measured, controlled process
- Maturity level 5: Focus on continuous improvement

The increase in the maturity levels can be achieved by relying on self-assessments of industrial performance management systems (Fig. 3). The improvement of the production process is mainly made by exploiting quantitative and qualitative data, which promises mature decision-making.

### 3.3.1. Maturity level 1

Level 1 of maturity is characterized by a manufacturing process that is poorly developed by general management and that does not respect its strategic vision. This type of process generally results in disorderly functioning. However, it manages to accomplish the essential tasks to generate products that are possibly acceptable but that may be noncompliant and do not essentially meet the needs of the targeted customers.

The effectiveness of the quality management system is not measurable. The company does not promote a favorable environment allowing the involvement and engagement of process collaborators in the achievement of production quality objectives. Furthermore, the skills of the collaborators are underestimated and not evaluated. Maturity level 1 companies generally tend to abandon their processes in times of crisis and to be incapable of achieving repetitive successes, which depend on experience and the willingness of its employees and not the application of preestablished production processes.

### 3.3.2. Maturity level 2

At maturity level 2, the manufacturing process is applied in accordance with the requirements and taking into account the needs of customers; this allows the minority of expected results to be obtained. The company must have a formal description of the quality management system for the manufacturing process in standards, procedures, and management methods, which can be used as a reference if necessary. The efficiency of the quality management system of the manufacturing process must be assumed by general management by defining the quality policy and objectives and by making available all the necessary tools to achieve them. Understanding the context and internal and external issues is partially guaranteed in such a way that the quality management system of the manufacturing process approaches efficiency and compliance with the requirements imposed by customers. This description of the manufacturing process makes it possible to clearly define the input and output data, as well as the main activity of the process, the associated responsibilities, and the implemented control methods.

### 3.3.3. Maturity level 3

A process classified in maturity level 3 is defined by input and output data, formalized, and respects the rules imposed by general management during the execution of the main activity of the company. This leads to controlled products meeting the requirements. The progress of the process is regularly monitored according to practices preestablished by production managers, taking into account interactions with the various processes. The company must ensure that these existing practices are maintained during times of crisis. In

**Table 7**  
The rating of the maturity levels of the type of management considered.

| Maturity level of the performance management | Scoring          |
|--|------------------|
| Maturity level 1                             | Points = 5       |
| Maturity level 2                             | 5 < points ≤ 10  |
| Maturity level 3                             | 10 < points ≤ 15 |
| Maturity level 4                             | 15 < points ≤ 20 |
| Maturity level 5                             | 20 < points ≤ 25 |

**Table 8**  
The rating of the overall maturity levels of the manufacturing process.

| Maturity level of the manufacturing process | Scoring           |
|---|-------------------|
| Maturity level 1                            | Points = 20       |
| Maturity level 2                            | 20 < points ≤ 40  |
| Maturity level 3                            | 40 < points ≤ 60  |
| Maturity level 4                            | 60 < points ≤ 80  |
| Maturity level 5                            | 80 < points ≤ 100 |

addition, quality objectives are based on customer needs and translated into quantifiable and measurable objectives. At this level, the pilots and collaborators of the process must make proposals for evaluations and improvements, as well as show their involvement to achieve the best performance. The production process is managed proactively at this level thanks to the monitoring, evaluation, and skills management system for employees.

#### 3.3.4. Maturity level 4

Maturity level 4 is defined by the performance of the manufacturing process quality management system; statistical measurements are systematically made to preserve the improvement. Production process managers set quantitative quality and performance targets and conduct regular benchmarking and self-assessments to identify opportunities for improvement and development, as well as any need to update the strategic vision of the organism. The quality objectives are based on the needs of customers and those involved in the process. These objectives are represented by indicators that make it possible to assess the performance of the manufacturing process for effective management. Predictability of performance and early detection of the causes of variations allow in some instances to exceed targets and focus on continuous improvement.

#### 3.3.5. Maturity level 5

At maturity level 5, the quality management system is continuously improved and reviewed to promote the functioning of the manufacturing process based on a causal analysis to understand the variations linked to the performance of the process. The company gives immense priority to research and development to distinguish itself in the market and considers innovation as the central pillar of continuous improvement in the performance of the manufacturing process. The strategic direction and the policy of the management are in line with its vision that makes it possible to achieve the quality objectives efficiently. The quality and performance objectives are continuously adapted to the vision of the company and used as a benchmark of organizational performance.

The company is particularly interested in overall performance, especially industrial performance, by exploiting all data likely to affect performance management. These data are presented in the form of indicators to contribute to the deployment of the guidelines, allowing the improvement of process functioning. Thus, data processing makes it possible to assess the gaps identified between the objectives to be achieved and the obtained results, as well as to prepare action plans to overcome the causes of these discrepancies to prevent them from recurring in the future.

The skills of the employees, necessary for the smooth running of the manufacturing process, are well exploited and enriched by general management to involve them in achieving the objectives linked to production quality. The company promotes the conditions of autonomy, productivity, and creativity of the staff; it encourages and recognizes their application in the quality approach, which ensures incremental progress in industrial performance. Table 7 summarizes the maturity levels of the manufacturing process from 1 to 5 and their characteristics.

### 3.4. Scoring system

A survey was carried out to assess the maturity levels of the quality management systems in the manufacturing processes and their

**Table 9**  
Classification of enterprises according to their size and sales figures.

| Type of company                         | Permanent employees | Sales figures    |
|---|---------------------|------------------|
| Large enterprise (LE)                   | ≥ 500 employees     | ≥ 75 million MAD |
| Small and medium-sized enterprise (SME) | < 500 employees     | < 75 million MAD |

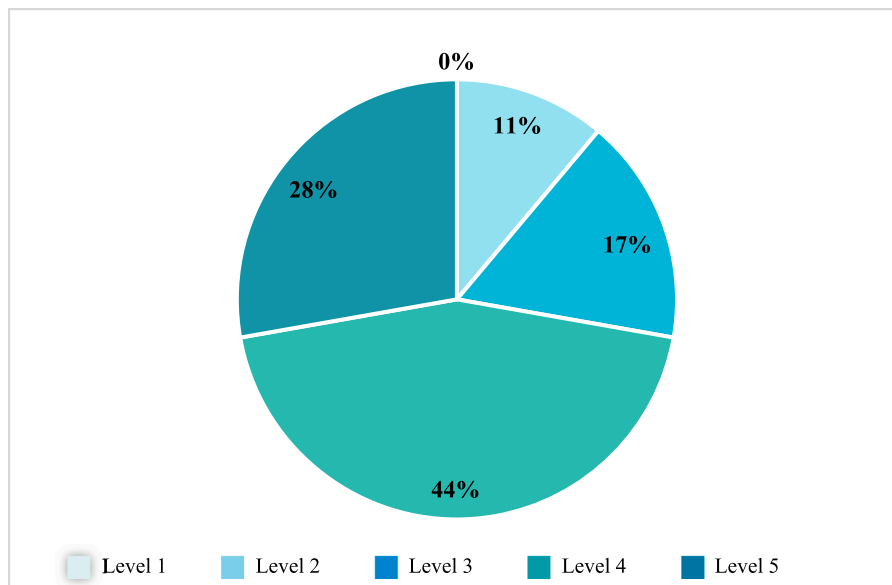


Fig. 4. Maturity levels of companies surveyed in%.

relationship with the different types of industrial performance management. The questionnaire is based on multiple-choice questions with very precise specifications; it is composed of twenty questions. For each type of management, five questions are assigned. The grading system gives marks from one to five for each chosen answer: five points for the response "totally", three points for the response "partially" and one point for the response "absolutely not". The sum of the points of each type of management defines its level of maturity compared to the following type of management: the minimum score of a management type is five, and the maximum score is twenty-five (Table 7). Furthermore, the total sum of points for all types of management defines the overall level of maturity of the manufacturing process; the minimum general score that the manufacturing process can have is twenty, and the maximum is one hundred (Table 8).

#### 4. Results and discussion

The total number of companies surveyed is 18 industries, of which 11 companies (C2, C3, C4, C5, C6, C7, C11, C13, C14, C16 and C17) work in the Machinery and equipment/Automotive/Aeronautics sector, 2 companies (C1 and C12) work in the Chemistry/parachemistry sector, 2 companies (C10, C18) in the Metallurgy/Mining sector, 1 company (C15) works in the electronics/electricity sector, 1 company (C8) works in the pharmaceutical industry and the last company (C9) works in the food industry (as shown in Appendix 1).

The classification criteria of companies, according to their size and sales figures, are fixed according to Moroccan law N° 53-00 forming the "Charter of the SME" published in the official bulletin N° 5036 [49] (Table 9).

Companies C2, C3, C4, C5, C6, C7, C9, C10, C12, C13, C15, C16, and C18 are considered large companies with an employee workforce exceeding 1000 people, and companies C1, C8, C11, C14, and C17 are classified in the small and medium-sized enterprise type (C11) with fewer than 250 employees.

##### 4.1. Overall maturity level

The answers to the questionnaire for each company and for each type of management are displayed in a scoring table in Appendix 2. The results of the survey (Fig. 4) show the following:

- 1) Twenty-eight percent of the surveyed companies reach level 5 of overall maturity. These industries have at least 60 years of existence in the market and are generally large enterprise LE types. Quality certifications have been adopted by these companies for at least 10 years, and there is a transition between the different versions of the standard. It is also noticed that the level of practical management maturity is level 5 for all these industries, which approves the total involvement of all employees in the different hierarchical levels concerning the performance of the manufacturing process.
- 2) Performance management is done proactively, seeking to preserve the improvements and efficiency of the process management system and remain focused on operational excellence.
- 3) Forty-four percent of the surveyed companies manage the performance of the manufacturing process with level 4 overall maturity. They are generally LE type with an age of existence that exceeds 30 years and an employee workforce between 500 and 999 people. The transition between versions of the standard is not always ensured, except for companies (C2, C7, C15, C16). These industries

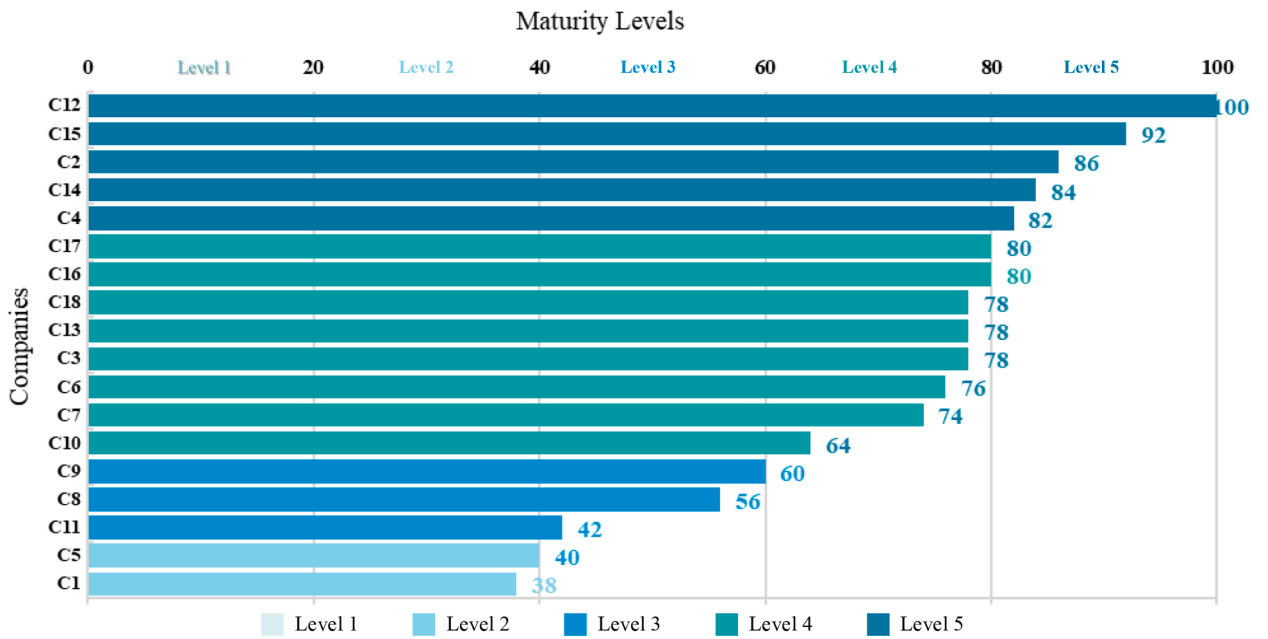


Fig. 5. Overall Maturity level of performance management.

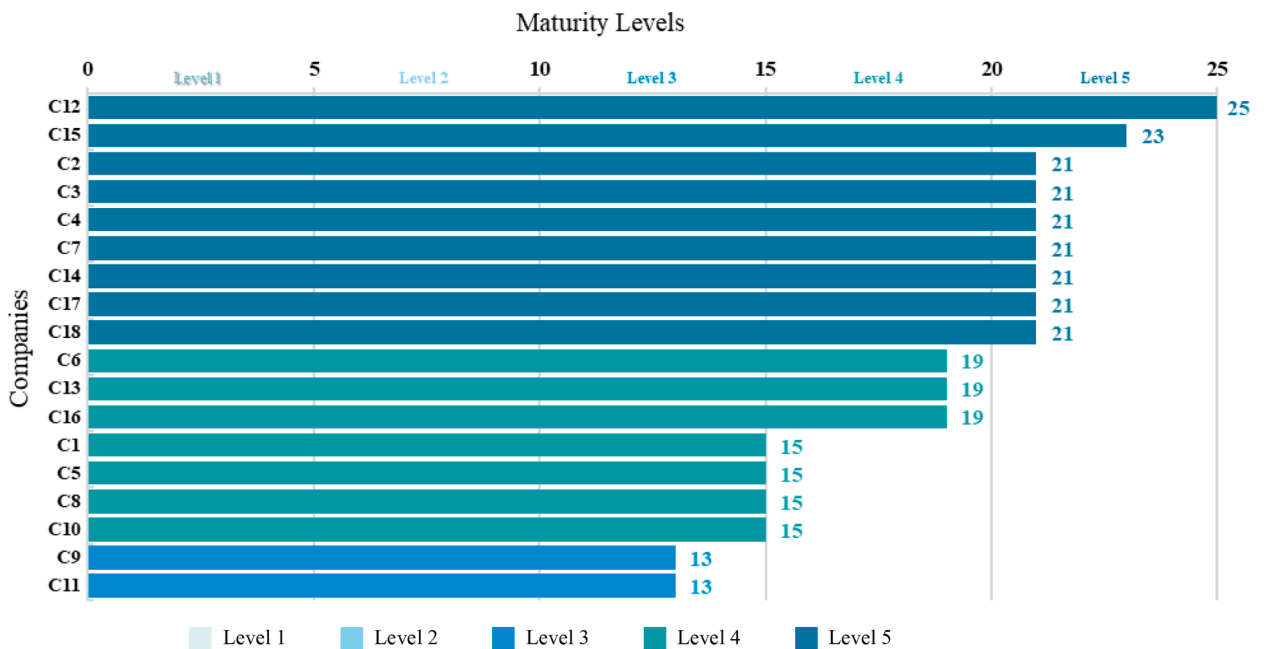


Fig. 6. Maturity level of the strategic management.

excel in operational management with a level of maturity of 5. At this level, industries are aware of the value brought by the quality management system and demonstrate their complete will to achieve higher levels of operational excellence.

- 4) Seventeen percent of the companies reach level 3 of overall maturity, and these companies are of the SME and LE types with 15 years of existence in the market. Quality certification has recently been adopted and limited only to ISO 9001: 2015) for most companies, except (C9), which has triple certification but older versions (ISO 9001: 2008, ISO14001: 2015 and OHSAS 18001: 2007). Tactical management is the main pillar of this type of industry, with a level of maturity between 3 and 4. Companies at this level have a standardized production process management system based on the identified best practices, thus providing easy knowledge of customer needs.

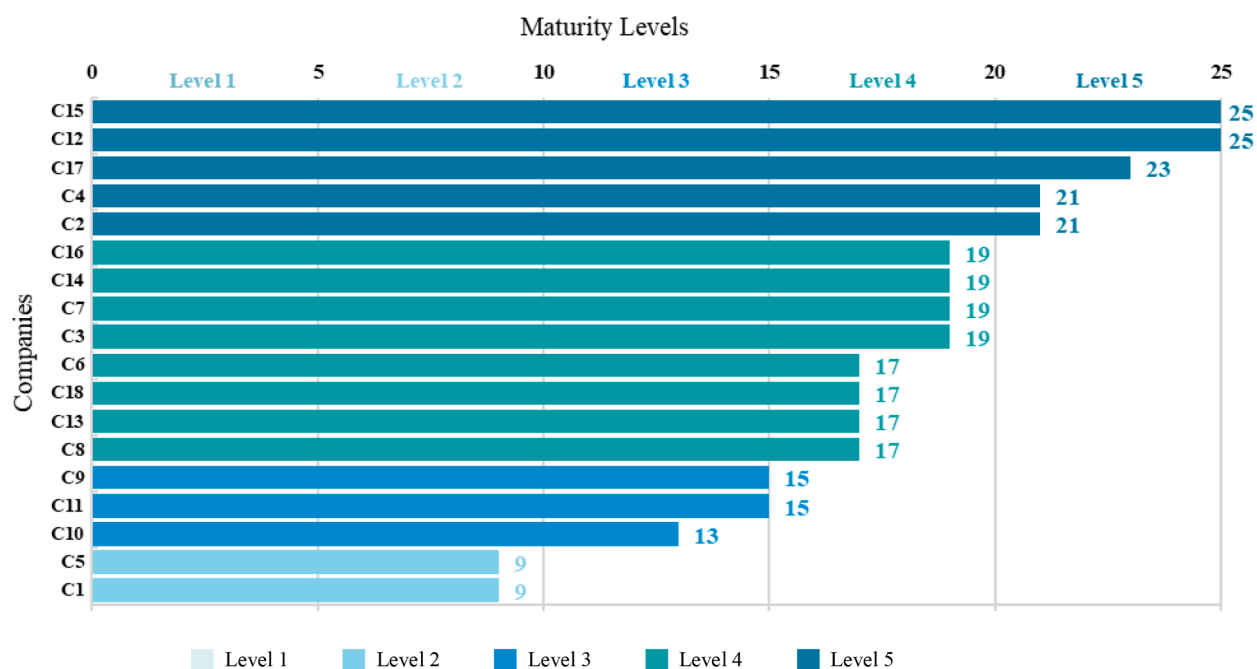


Fig. 7. Maturity level of the tactical management.

- 5) Eleven percent of companies are positioned in level 2 of overall maturity. These companies are EMS type with an employee workforce that does not exceed 250 people. The majority of these industries do not adopt any certification standard, except (C1), which is certified ISO 9001: 2015 in 2019. The level of maturity of the strategic management system is between 2 and 3. The manufacturing process management system can achieve minimum product quality and reach only a minority of objectives.
- 6) No company surveyed is in level 1 of overall maturity.

#### 4.2. Types of performance management

According to the rating system of our maturity model, we found that 5 companies (C2, C4, C12, C14 and C15) are at overall maturity level 5, 8 companies (C3, C6, C7, C10, C13, C16, C17 and C18) are at global maturity level 4, 3 companies (C8, C9 and C11) have global maturity level 3, and 2 companies (C1 and C5) are at global maturity level 2.

The result of this rating for each type of performance management is presented in Fig. 5.

##### 4.2.1. Strategic management

The results of the survey considering strategic management (Fig. 6) show the following:

- Eight companies (C2, C3, C4, C7, C12, C14, C15 and C17) are in maturity level 5 of strategic management;
- Three companies (C6, C13 and C16) are in maturity level 4 of strategic management;
- Six companies (C1, C5, C8, C9, C10 and C11) are at maturity level 3 in strategic management.
- We note that the companies that belong to a level of maturity 5 are multinationals (C2, C3, C4, C7, C14, C15 and C17) installed in Morocco between 1941 and 2010 and one Moroccan company (C12), generally LE type. Their manufacturing process is well developed and follows the strategic vision of direction. The working conditions are very favorable and allow for involving employees who are competent and aware of the need to monitor performance in the smooth running of the manufacturing process.
- Companies with a level of maturity of 4 are all LE type. Their quality management system for the manufacturing process is very efficient and allows for obtaining all the quality objectives and anticipating customer needs.
- Companies with a level of maturity of 3 are of the LE type (C5, C9 and C10) and of the SME type (C1, C8 and C11) and have been in the Moroccan market for more than 10 years. The strategic vision is well established but is not in line with production requirements.

##### 4.2.2. Tactical management

The results of the survey considering tactical management (Fig. 7) show the following:

- Five companies (C17, C15, C12, C4 and C2) are at maturity level 5 of tactical management;
- Eight companies (C18, C16, C14, C13, C8, C7, C6, and C3) are at maturity level 4 in tactical management;

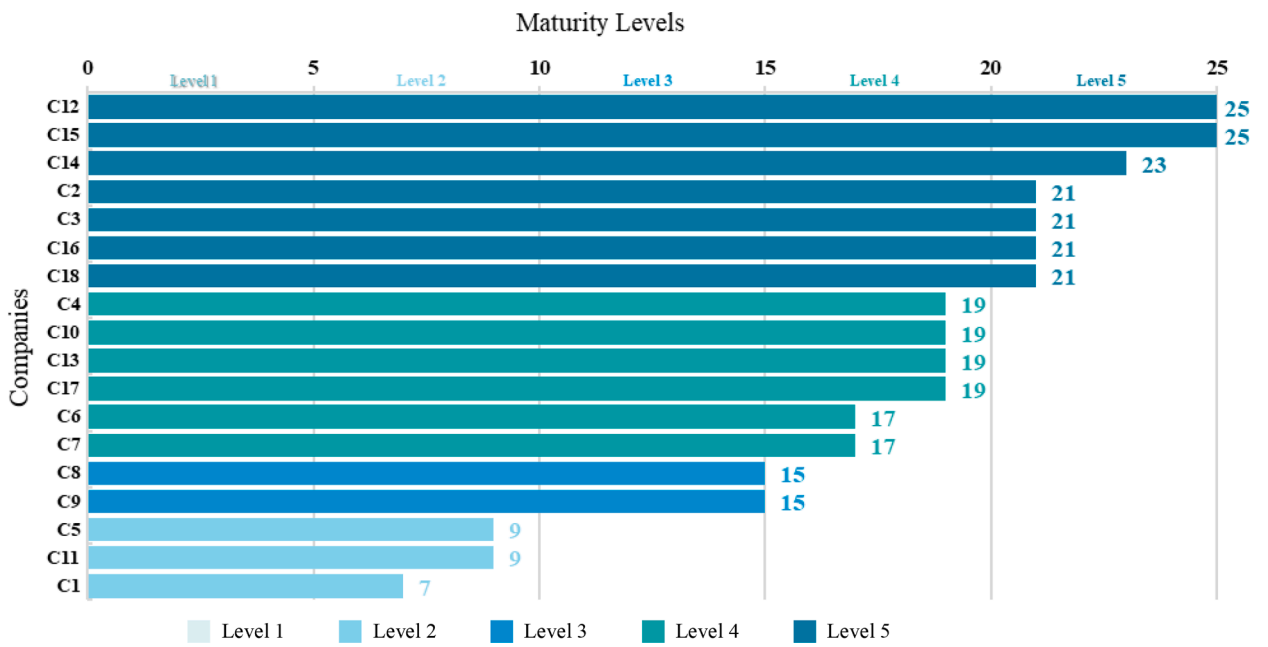


Fig. 8. Maturity level of the operational management.

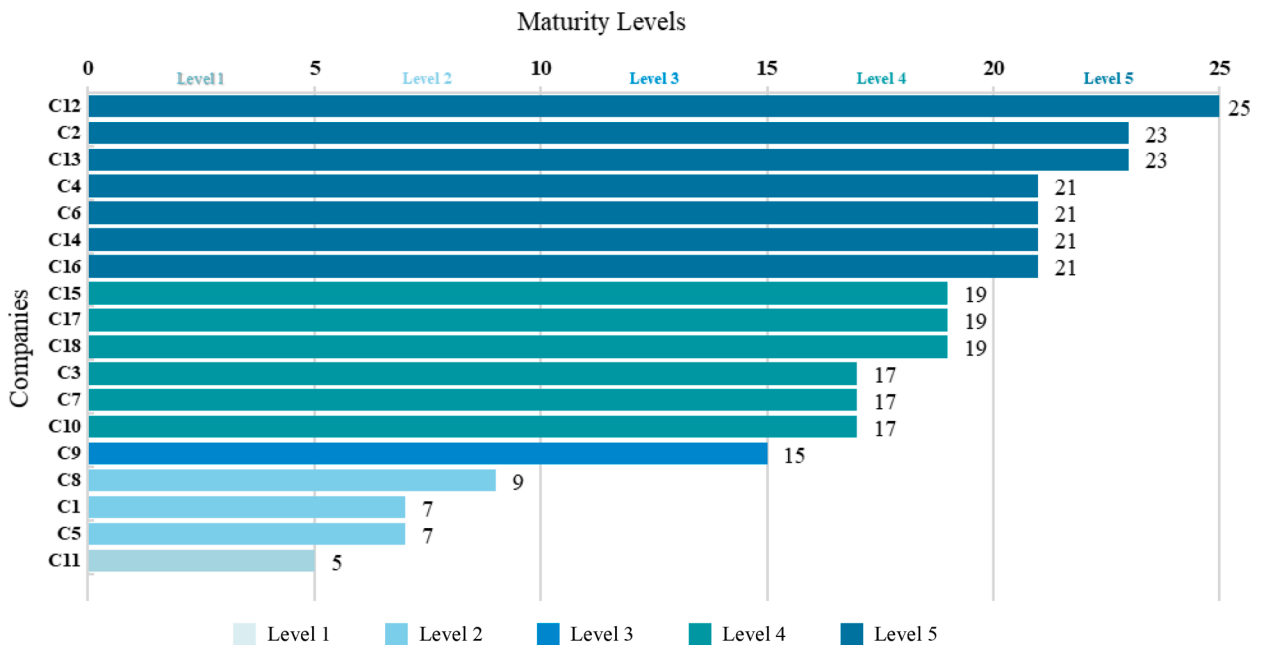


Fig. 9. Maturity level of the practical management.

- Three companies (C11, C10 and C9) adapt maturity level 3 of tactical management;
- Two companies (C1 and C5) are at maturity level 2 of tactical management.
- The companies adopting tactical management with a level of maturity of 5 are of the LE type (C2, C4, C12 and C15) and of the SME type (C17). It is noted that these companies have set up corrective action plans taking into account the impact of unforeseen changes on the performance of the manufacturing process. The effectiveness of these actions is measured and allows the company to adapt to the situation.
- The companies with a maturity level of 4 are of the LE type (C3, C6, C7, C13 and C16) and of the SME type (C8 and C14). To meet customer expectations, these companies' solutions are based on research and innovation, thus monitoring innovations and technological developments existing in the market or among competitors to support strategies relating to production quality.

- The companies at maturity levels 3 and 2 are an SME-type Moroccan company (C11) and LE-type multinational companies (C1, C5, C9 and C10). It can be observed that the interaction of the manufacturing process with all the processes of all these companies is well defined, so that the input and output elements are designed to favor the internal and external environment. The quality objectives are represented by relevant indicators enabling the performance of the production process to be assessed and monitored.

#### 4.2.3. Results of operational management

The results of the survey considering operational management (Fig. 8) show the following:

- Seven companies (C2, C3, C12, C14, C15, C16 and C18) have a level of maturity 5 of operational management;
- Six companies (C4, C6, C7, C10, C13 and C17) are at maturity level 4 of operational management;
- Two companies (C8 and C9) have a level of maturity of 3 of operational management;
- Three companies (C1, C5 and C11) have a level of maturity of 2 in operational management.
- It can be noted that the companies with a level of maturity of 5 are of types LE (C2, C3, C12, C15 and C16) and SME (C14). These companies have evaluation programs to ensure that the collaborators involved in the manufacturing process have the necessary knowledge and skills to fulfill their roles and then achieve better operational results.
- The companies with a level of maturity 4 are all multinationals of types LE (C4, C6, C7, C10 and C17) and SME (C17). These companies set up devices to assess and preserve the conformity of the production tool and its relevance in achieving objectives related to production quality. These devices allow the company to manage the relevant performance and make effective decisions.
- Companies with a level of maturity of 3 are Moroccan companies of types LE (C9) and SME (C8). These companies insist on the understanding of the strategic orientation and the quality policy by all the collaborators so that the quality management system of the manufacturing process is efficient and complies with the requirements imposed by customers.
- Companies with a level of maturity of 2 are of types LE (C5) and SME (C1 and C11). These companies have devices for evaluating the identified gaps between the objectives to be achieved and the obtained results by using quantitative and statistical steering techniques to detect and eradicate anomalies related to the production process.

#### 4.2.4. Results of practical management

The results of the survey considering practical management (Fig. 9) show the following:

- Seven companies (C2, C4, C6, C12, C13, C14 and C16) have a level of maturity of 5 of practical management;
- Five companies (C3, C7, C10, C15, and C17) are in maturity level 4 of practical management;
- One company (C9) is in maturity level 3 of practical management;
- Three companies (C1, C5, and C8) have a level of maturity of 2 of practical management;
- One company (C11) is in maturity level 1 of practical management.
- Companies with a level of maturity of 5 are all of the LE type (C2, C4, C6, C12, C13, C14, and C16) except for one of the SME type (C14). The collaboration and integration of all the actors in these companies ensure incremental progress in industrial performance. The conditions of autonomy, productivity, and creativity of the staff are favored, and employees are encouraged to be fully applied in the quality process.
- The companies with a level of maturity 4 are all multinationals of types LE (C3, C7, C10, and C15) and SME (C17). These companies take into account the observations and the performance measurement result to identify the opportunities for improvement and the needs for updating the company's strategic vision and objectives.
- The company (C9) with a level of maturity 3 is a Moroccan company of type LE. This industry takes into account and reviews customer requirements during the production phase so that the performance of the production tool is improved.
- Companies with a level of maturity of 2 and 1 are all of the SME type (C1, C8, and C11), except (C5), which is of the LE type. Companies C1, C5, and C8 are aware of the interest in the improvement and management processes of industrial performance, but they do not consider it during the production phase. The strategic orientation of the company (C11) is partially in line with its activity and makes it possible to achieve the minimum of the quality objectives of the production process.

## 5. Conclusion

The characteristics of a company are defined by its level of maturity, with the overall performance result serving so that companies are distinguished by an overall level of maturity. Thanks to the rating system of the developed maturity model, it has been found that 5 of the surveyed companies (C2, C4, C12, C14 and C15) are in the overall maturity level 5, 8 companies (C3, C6, C7, C10, C13, C16, C17 and C18) are in the overall maturity level 4, 3 companies (C8, C9 and C11) have an overall maturity level 3 and the companies (C1 and C5) are in the overall maturity level 2. The obtained results show that the overall level of maturity of the manufacturing process is influenced by the degree of maturity of the types of performance management.

For companies with a higher degree of maturity, industrial performance is approved by their approaches and practices, which gives the company the ability to continually improve their performance and meet the expressed and implicit needs of customers. Broadly translated, the present findings indicate that quality certifications are insufficient to conclude that an company has a quality manufacturing process. The study showed that some companies own different versions of standards but have one average maturity



level.

In addition, these results provide supplementary information on the degree of autonomy of companies and its relationship with the management of industrial performance. Companies favoring the conditions of autonomy and creativity tend to develop employees' responsibility, thereby increasing their application in achieving objectives linked to the manufacturing process.

Looking ahead, we recognize that while we have covered the topic of maturity in our current study, there is still much to explore, and we intend to expand our future research. As this is a multifaceted and important topic, we aim to work closely with companies to explore additional criteria. These criteria may include exploring the level of independence and designing a methodology for implementing our model, suggesting maturity indicators, and many others.

### Compliance with ethical standards

- The authors declare that they have no conflicts of interest.
- This article does not contain any studies involving animals performed by any of the authors.
- This article does not contain any studies involving human participants performed by any of the authors.

### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Acknowledgement

We would like to highlight the support provided by all industries considered in this study while conducting this research work.

### Appendix 1: Characteristics of the companies surveyed

| Companies | Year of creation | Activity area                                  | Type | Number of employees      | Certification  |
|-----------|------------------|--|------|--------------------------|--|
| C1        | 1994             | Chemistry/para-chemistry                       | SME  | From 10 to 50 employees  | ISO 9001 :2015   |
| C2        | 1954             | Machinery and equipment/automotive/aeronautics | LE   | More than 1000 employees | ISO 9001 :2015, OHSAS 18001 :2007 and ISO 45001 :2018  |
| C3        | 1999             | Machinery and equipment/automotive/aeronautics | LE   | More than 1000 employees | ISO 9001 :2000 AND ISO 14001 :2004   |
| C4        | 1959             | Machinery and equipment/automotive/aeronautics | LE   | More than 1000 employees | ISO 45001 :2018  |
| C5        | 2001             | Machinery and equipment/automotive/aeronautics | LE   | More than 1000 employees | ISO 45001: 2018  |
| C6        | 2016             | Machinery and equipment/automotive/aeronautics | LE   | More than 1000 employees | ISO 9001 :2008   |
| C7        | 1959             | Machinery and equipment/automotive/aeronautics | LE   | More than 1000 employees | ISO 9001 :2008, ISO 9001:2015, ISO 14001:2004, ISO 14001:2015, OHSAS 18001:2007 and ISO 45001:2018   |
| C8        | 2012             | Pharmaceutical industry                        | SME  | From 20 to 50 employees  | Good Manufacturing Practices   |
| C9        | 2011             | Metallurgy/mining                              | LE   | More than 1000 employees | ISO 9001 :2008, ISO 14001: 2015 and OHSAS 18001: 2007  |
| C10       | 1957             | Food industry                                  | LE   | More than 1000 employees | ISO 9001: 2015 and ISO 14001: 2015   |
| C11       | 2009             | Machinery and equipment/automotive/aeronautics | SME  | More than 1000 employees | No certification   |
| C12       | 1920             | Chemistry/para-chemistry                       | LE   | More than 1000 employees | ISO 9001: 2000 and ISO 14001: 2004   |
| C13       | 2007             | Machinery and equipment/automotive/aeronautics | LE   | More than 1000 employees | ISO 9001: 2000 and ISO 45001: 2018   |
| C14       | 1941             | Machinery and equipment/automotive/aeronautics | SME  | From 50 to 100 employees | ISO 9001: 2008   |
| C15       | 1946             | Electronics/electricity                        | LE   | More than 500 employees  | ISO 9001: 2000, ISO 9001: 2008, ISO 9001: 2015, ISO 14001: 2004, ISO 14001: 2015 and OHSAS 18001     |
| C16       | 1987             | Machinery and equipment/automotive/aeronautics | LE   | More than 1000 employees | ISO 9001: 2000, ISO 9001: 2008, ISO 9001: 2015, ISO 14001: 2004, ISO 14001: 2015 and ISO 45001: 2018 |
| C17       | 2010             | Machinery and equipment/automotive/aeronautics | SME  | More than 200 employees  | ISO 9001: 2015, ISO 14001: 2015, ISO 45001: 2018 and IATF 16949                                      |
| C18       |                  | Metallurgy/mining                              | LE   | More than 500 employees  | ISO 9001: 2015 and ISO 14001 :2015   |

Appendix 2: Scoring table

| Companies | Strategic management |      |      |      |      |     |          | Tactical management |      |      |      |      |     |          | Operational management |      |      |      |      |     |          | Practical management |      |      |      |      |     |          | Total | Overall maturity level |
|-----------|----------------------|------|------|------|------|-----|----------|---------------------|------|------|------|------|-----|----------|------------------------|------|------|------|------|-----|----------|----------------------|------|------|------|------|-----|----------|-------|------------------------|
|           | Q1-1                 | Q1-2 | Q1-3 | Q1-4 | Q1-5 | Sum | Maturity | Q2-1                | Q2-2 | Q2-3 | Q2-4 | Q2-5 | Sum | Maturity | Q3-1                   | Q3-2 | Q3-3 | Q3-4 | Q3-5 | Sum | Maturity | Q4-1                 | Q4-2 | Q4-3 | Q4-4 | Q4-5 | Sum | Maturity |       |                        |
| C1        | 3                    | 3    | 3    | 5    | 1    | 15  | Level 3  | 3                   | 1    | 3    | 1    | 1    | 9   | Level 2  | 1                      | 3    | 1    | 1    | 1    | 7   | Level 2  | 1                    | 1    | 1    | 3    | 1    | 7   | Level 2  | 38    | Level 2                |
| C2        | 5                    | 5    | 3    | 5    | 3    | 21  | Level 5  | 5                   | 3    | 5    | 5    | 3    | 21  | Level 5  | 5                      | 3    | 3    | 5    | 5    | 21  | Level 5  | 5                    | 5    | 5    | 5    | 3    | 23  | Level 5  | 86    | Level 5                |
| C3        | 5                    | 3    | 5    | 3    | 5    | 21  | Level 5  | 3                   | 5    | 3    | 3    | 5    | 19  | Level 4  | 3                      | 5    | 5    | 3    | 5    | 21  | Level 5  | 3                    | 5    | 3    | 5    | 1    | 17  | Level 4  | 78    | Level 4                |
| C4        | 3                    | 5    | 5    | 3    | 5    | 21  | Level 5  | 3                   | 5    | 3    | 5    | 5    | 21  | Level 5  | 3                      | 5    | 3    | 3    | 5    | 19  | Level 4  | 5                    | 5    | 5    | 3    | 3    | 21  | Level 5  | 82    | Level 5                |
| C5        | 1                    | 3    | 5    | 3    | 3    | 15  | Level 3  | 1                   | 1    | 3    | 1    | 3    | 9   | Level 2  | 1                      | 3    | 1    | 3    | 1    | 9   | Level 2  | 1                    | 3    | 1    | 1    | 1    | 7   | Level 2  | 40    | Level 2                |
| C6        | 5                    | 5    | 3    | 3    | 3    | 19  | Level 4  | 3                   | 5    | 3    | 5    | 3    | 19  | Level 4  | 3                      | 5    | 3    | 5    | 1    | 17  | Level 4  | 3                    | 5    | 3    | 5    | 5    | 21  | Level 5  | 76    | Level 4                |
| C7        | 3                    | 3    | 5    | 5    | 5    | 21  | Level 5  | 5                   | 3    | 3    | 5    | 3    | 19  | Level 4  | 3                      | 5    | 3    | 3    | 3    | 17  | Level 4  | 3                    | 3    | 5    | 3    | 3    | 17  | Level 4  | 74    | Level 4                |
| C8        | 3                    | 5    | 3    | 3    | 1    | 15  | Level 3  | 5                   | 3    | 3    | 5    | 1    | 17  | Level 4  | 5                      | 3    | 3    | 3    | 1    | 15  | Level 3  | 1                    | 1    | 3    | 1    | 3    | 9   | Level 2  | 56    | Level 3                |
| C9        | 1                    | 1    | 3    | 5    | 3    | 13  | Level 3  | 3                   | 3    | 5    | 3    | 3    | 17  | Level 4  | 1                      | 5    | 3    | 3    | 3    | 15  | Level 3  | 3                    | 3    | 3    | 3    | 3    | 15  | Level 3  | 60    | Level 3                |
| C10       | 5                    | 5    | 3    | 1    | 1    | 15  | Level 3  | 3                   | 3    | 1    | 5    | 1    | 13  | Level 3  | 3                      | 5    | 3    | 3    | 5    | 19  | Level 4  | 5                    | 3    | 3    | 3    | 3    | 17  | Level 4  | 64    | Level 4                |
| C11       | 1                    | 3    | 3    | 1    | 5    | 13  | Level 3  | 3                   | 1    | 3    | 3    | 5    | 15  | Level 3  | 1                      | 3    | 3    | 1    | 1    | 9   | Level 2  | 1                    | 1    | 1    | 1    | 1    | 5   | Level 1  | 42    | Level 3                |
| C12       | 5                    | 5    | 5    | 5    | 5    | 25  | Level 5  | 5                   | 5    | 5    | 5    | 5    | 25  | Level 5  | 5                      | 5    | 5    | 5    | 5    | 25  | Level 5  | 5                    | 5    | 5    | 5    | 5    | 25  | Level 5  | 100   | Level 5                |
| C13       | 5                    | 5    | 3    | 3    | 3    | 19  | Level 4  | 3                   | 3    | 5    | 3    | 3    | 17  | Level 4  | 5                      | 1    | 5    | 5    | 3    | 19  | Level 4  | 3                    | 5    | 5    | 5    | 5    | 23  | Level 5  | 78    | Level 4                |
| C14       | 5                    | 3    | 5    | 5    | 3    | 21  | Level 5  | 5                   | 3    | 5    | 3    | 3    | 19  | Level 4  | 5                      | 5    | 5    | 3    | 5    | 23  | Level 5  | 3                    | 3    | 5    | 5    | 5    | 21  | Level 5  | 84    | Level 5                |
| C15       | 5                    | 5    | 5    | 5    | 3    | 23  | Level 5  | 5                   | 5    | 5    | 5    | 5    | 25  | Level 5  | 5                      | 5    | 5    | 5    | 5    | 25  | Level 5  | 3                    | 5    | 5    | 3    | 3    | 19  | Level 4  | 92    | Level 5                |
| C16       | 5                    | 3    | 5    | 3    | 3    | 19  | Level 4  | 5                   | 3    | 5    | 3    | 3    | 19  | Level 4  | 5                      | 3    | 5    | 3    | 5    | 21  | Level 5  | 5                    | 5    | 3    | 3    | 5    | 21  | Level 5  | 80    | Level 4                |
| C17       | 5                    | 5    | 3    | 5    | 3    | 21  | Level 5  | 5                   | 5    | 3    | 5    | 3    | 21  | Level 5  | 5                      | 3    | 3    | 5    | 3    | 19  | Level 4  | 5                    | 3    | 3    | 5    | 3    | 19  | Level 4  | 80    | Level 4                |
| C18       | 5                    | 5    | 3    | 3    | 5    | 21  | Level 5  | 3                   | 3    | 5    | 3    | 3    | 17  | Level 4  | 5                      | 5    | 3    | 3    | 5    | 21  | Level 5  | 5                    | 3    | 5    | 3    | 3    | 19  | Level 4  | 78    | Level 4                |

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