The measurement of organizational performance from the Balanced Scorecard in the case of a medical biology laboratory

La mesure de la performance organisationnelle à partir du tableau de bord prospectif cas d'un laboratoire de Biologie médicale

HAFIDA NIA

Professor at the Faculty of Law, Economics and Social Sciences in Mohammedia, Hassan 2nd University, Laboratory of Entrepreneurship and Environmental Management for SMEs. Casablanca, Morocco.

MOHAMED OMARI

PhD student at the Faculty of Law, Economics and Social Sciences in Mohammedia, Hassan 2nd University, Laboratory of Entrepreneurship and Environmental Management for SMEs. Casablanca, Morocco.

NABIHA KAMAL

Head of Department of the Biochemistry Laboratory, Professor at the Faculty of Medicine and Pharmacy, Hassan 2nd University, Casablanca, Morocco.
Address: Hassan 2nd Avenue -post office box 150, 150, Mohammedia, Morocco

omarimohamede@gmail.com

Abstract:

The Ibn Rochd university hospital in Casablanca is a specialized organization with a pavilion structure that provides tertiary level care. This organization is managed autonomously under the supervision of the Ministry of Health.

The Casablanca University Hospital measures its performance by a set of indicators grouped in its activity report, following a quasi-standard process.

The Biochemistry Laboratory is a pivotal service of the University Hospital which provides a public service to users, performing almost all biochemistry analyses and serving the population of the Casablanca Settat region.

The objective of this paper is to try to measure the performance of this laboratory, based on the four main axes of the Kaplan and Norton Balanced Scorecard.

To meet this objective, we first conducted interviews to define the indicators in the dashboard, and then tried to measure these indicators either through the laboratory's information system or through sent questionnaires to staff.

The results obtained enabled us to detect malfunctions and propose recommendations.

Keywords: performance measurement; medical analysis laboratory; indicators; hospitals; university hospital.

Résumé:

Le centre hospitalo-universitaire Ibn Rochd de Casablanca est une organisation spécialisée de structure pavillonnaire qui prodigue une offre de soins de niveau tertiaire. Cette organisation est gérée d'une façon autonome sous tutelle du ministère de la santé.

Le CHU de Casablanca mesure sa performance par des indicateurs regroupés dans son bilan d'activités, en suivant un processus quasi standard.

Le laboratoire de Biochimie est un service pivot du CHU qui fournit un service public aux usagers, en réalisant presque toutes les analyses de Biochimie et en desservant la population de la région du Grand Casablanca.

L'objectif de ce papier est d'essayer de mesurer la performance de ce laboratoire en se basant sur les quatre axes du tableau de bord prospectif de Kaplan et Norton.

Pour répondre à cet objectif, nous avons en premier lieu mené des entretiens pour définir les indicateurs du tableau bord, puis nous avons essayé de mesurer ces indicateurs soit en puisant dans le système d'information du laboratoire ou par des questionnaires adressés au personnel.

Les résultats obtenus nous ont permis de déceler des dysfonctionnements et de proposer des recommandations.

Mots clés : mesure de la performance ; laboratoire des analyses médicales ; indicateurs ; hôpitaux ; CHU.

Introduction:

Organizational performance is a multidimensional construct, difficult to define (Venkatraman, 1989) measuring the efficiency and effectiveness of actions that contribute to the achievement of organizational objectives (Kaplan and Norton, 1992; Neely, 2005).

Performance measurement is a continuous collection of data from specific functional areas. It consists of continuously monitoring and tracking the activities of organizations and reporting on an ongoing basis to progress towards the achievement of assigned objectives. It is based on a system for collecting, aggregating and communicating workflows, outputs, and results.

Performance measurement contributes to decision-making and understanding of the progress made towards achieving the results defined in the **Strategic Plan and Action Plans**, which are usually accompanied by objectives. One of the most difficult tasks for managers is to identify indicators that can report to progress towards achieving the objectives. And adopting this results-based approach is not an easy task. (Audit Commission for Local Authorities and the National Health Service in England and Wales, 2000).

Historically, the performance measurement approach has gone through two main phases. The first was dominated by the financial perspective using purely quantitative financial indicators. However, this perspective has been much criticized because these indicators relate to past performance and do not measure intangible benefits. The second phase included qualitative indicators to better describe the business world characterized by fierce competition and rapid change (Hedfi-Khayati and Zouaoui, 2013). Several authors (Amir and Lev, 1996) have insisted on the complementarity between quantitative and qualitative measures, so that the perception of performance becomes more global.

Problematic: How can the performance of a medical biology laboratory are measured in a university hospital?

The objective of this paper is to measure the organizational performance of the Biochemistry Laboratory of the Ibn Rochd University Hospital Centre in Casablanca using a mixed approach, combining qualitative and quantitative indicators. To do this, we used as a reference framework the Kaplan and Norton Balanced Scorecard (Kaplan and Norton, 1992, 1996, 2007).

To answer this problematic, we will first try to review the literature on the issue of performance measurement, before looking at our case study, which is the Biochemistry Laboratory at the Ibn Rochd University Hospital in Casablanca.

1. Research Terms of Reference:

Kaplan and Norton have developed a performance measurement framework using quantitative and qualitative indicators, which is the Balanced Scorecard "BSC", which integrates four different domains: (1) financial, (2) customer, (3) internal process (4) learning and innovation (Kaplan and Norton, 1992, 1996, 2007). These areas are interdependent and reflect the organization's strategy.

This management tool attempts to answer four main questions (Quinn and Rohrbaugh, 1983):

a. Customer perspective:

How can we motivate the organization's internal and external clients?

In fact, it allows managers to focus on factors creating the added value for the customer.

b. The Financial Perspective:

This perspective provides an answer to the following question: How can we contribute to a significant improvement in results?

Indeed, this perspective includes profitability, productivity, decrease, and risk management objectives.

c. The Internal process perspective:

This perspective answers the following question: what are the processes to meet the expectations of our customers and shareholders?

Thus, from this perspective, the manager identifies the essential processes that enable him to achieve his objectives, regarding the client and shareholders (service deadlines, service quality, employee competence, productivity).

d. Innovation and learning perspective:

This perspective reflects the answer to the following question: Can we continue to learn, improve and create value for the customer?

Well besides, the evolution of the internal and external environment of organizations requires managers to improve their ability to innovate, improve and learn. Thus, once internal processes are identified, the manager must focus on the skills required, and the necessary technological capacity to develop the leadership in organizations. It must identify the means required to achieve the other three perspectives: clients, internal process and finance.

The following figure shows the dashboard of (Kaplan and Norton, 1996):

Figure 1: The Kaplan and Norton dashboard
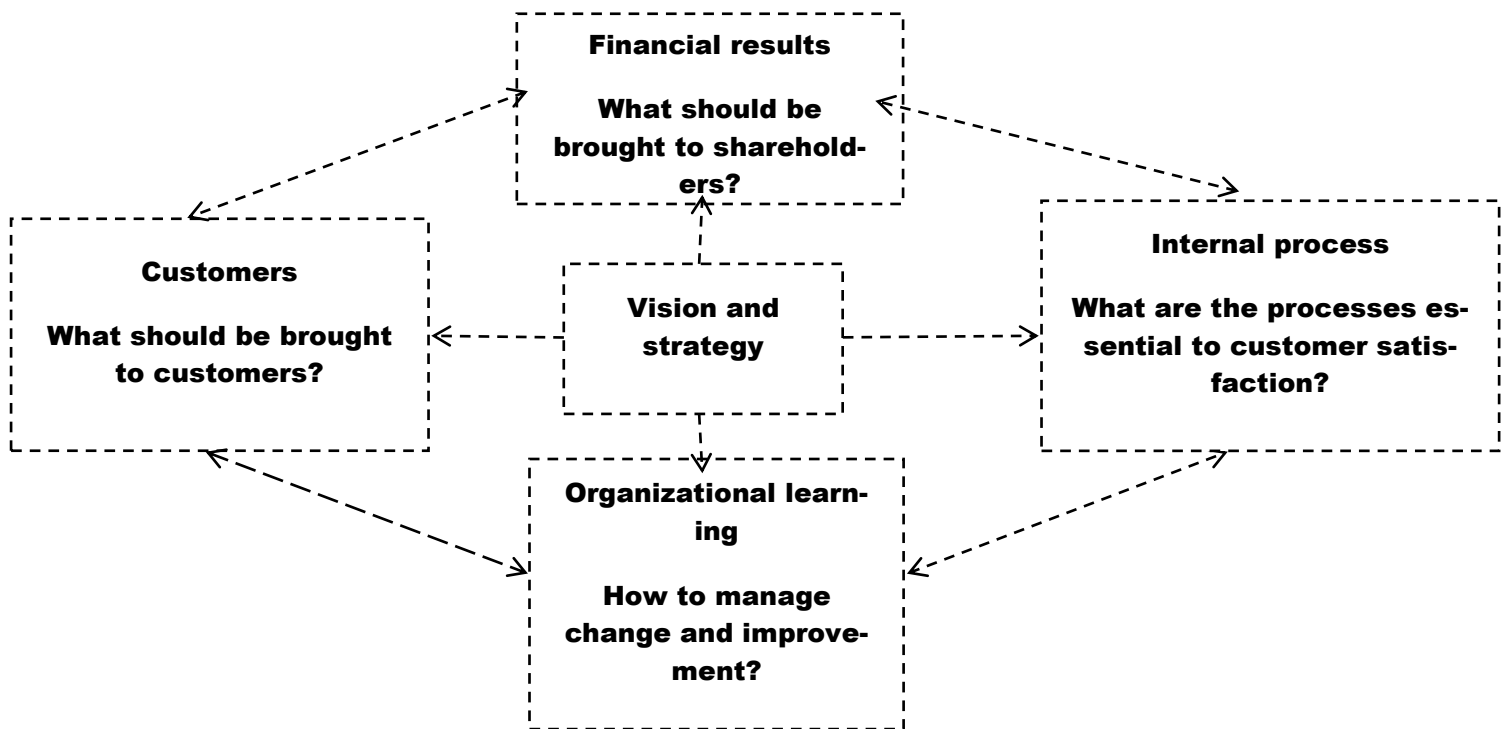
Source: Kaplan and Norton (1996)

Indeed, the BSC is a tool for maximizing the synergies of organizational structures. If we take the example of a tertiary level university hospital center: the governing board may develop its BSC based on the hospital project developed by the center's management, which describes the overall strategic orientations of the establishment. The underlying services in turn (the biochemistry laboratory in our case) should develop their BSCs based on a cascade of strategic themes selected in the Executive Dashboard. For example, if the customer axis is defined as "becoming attractive to patients", the decentralized service dashboard should include, for example, an indicator on the volume of admitted patients.

2. Research methodology

The objective of this study is to measure the performance of the Biochemistry Laboratory at the Ibn Rochd University Hospital in Casablanca, based on four axes of the BSC in Kaplan and Norton 1992, which represents the reference framework for our study.

To achieve this objective, the first step is to present the field of study and the examined population, while the second step consists of present the data collecting method.

We first solicited the participation of laboratory staff from all categories to define the different indicators to measure the laboratory's performance and used its database (the information system), which contained detailed data on all its activities.

2.1 The field of study:

The Biochemistry laboratory presents a rather particular context, especially since it represents a pivotal service in an organization with a pavilion structure, it is a laboratory that provides a public service to users, by carrying out analyses of blood and other biological fluids, and which receives on average the samples of more than 600 patients per day carrying out almost all the Biochemistry analyses, by serving the population of the Casablanca Settat region.

2.2 Target population:

The targeted population by our study is mainly composed of laboratory staff:

- The head of department (professor of higher education at the Faculty of Medicine of Casablanca).
- Two assistant professors at the Faculty of Medicine and Pharmacy of Casablanca
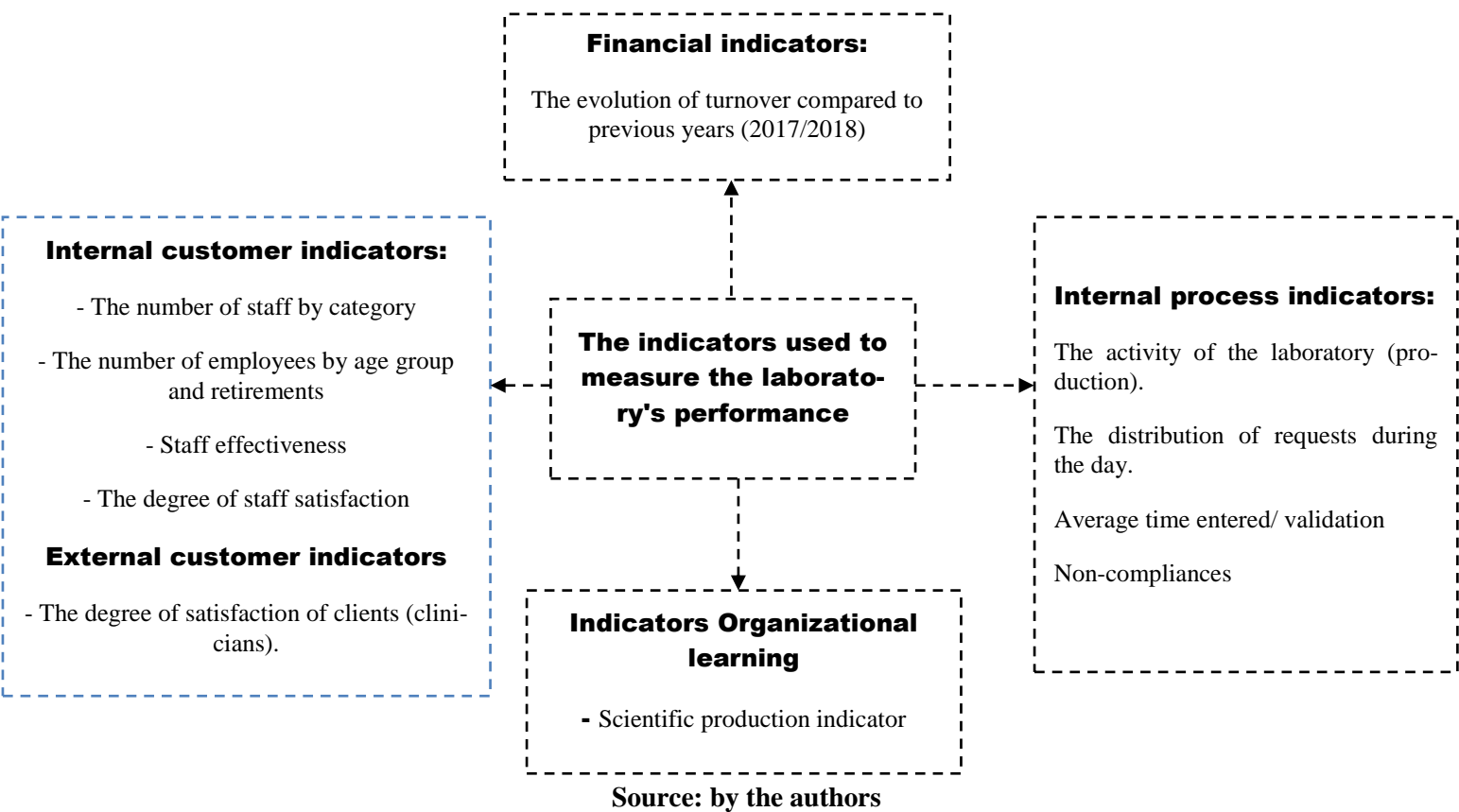
- Biologists (residents and interns).
- Biology engineers.
- Biology technicians.

Also, our study involved physicians from other clinical departments (external clients in this study) who collaborate with the laboratory, sending samples of inpatients and external patients for analysis on an ongoing basis.

2.3 The indicators used in the study:

Benchmarking and interviews with various actors involved in the laboratory performance measurement process, which enabled us eventually to identify the following indicators:

Figure 2: Indicators used in the study

Financial indicators:

The evolution of turnover compared to previous years (2017/2018)

Internal customer indicators:

- The number of staff by category

- The number of employees by age group and retirements

- Staff effectiveness

- The degree of staff satisfaction

External customer indicators

- The degree of satisfaction of clients (clinicians).

The indicators used to measure the laboratory's performance

Internal process indicators:

The activity of the laboratory (production).

The distribution of requests during the day.

Average time entered/ validation

Non-compliances

Indicators Organizational learning

- Scientific production indicator

Source: by the authors

2.4 Data collection methods:

To meet the objective of the study, two data collecting instruments were used:

- Observation (the use of LIS data).

- A questionnaire for laboratory professionals and clinicians (physicians in clinical departments).

We used the activity data of the biochemistry department and the figures concerning all the resources necessary for operation validated by the managers. Activity data are extracted from the laboratory's information system (LIS). The different indicators selected for each axis of the balanced scorecard are selected by the laboratory staff. These indicators seek to respond to the following classical general principles: relevant, precise, reproducible, reliable, communicable, quick to collect and process, synthetic, with limited perverse effects, measuring the phenomenon as early as possible, comparable, preferably indicating a trend over a relevant time horizon, and facilitating learning. They can be considered simple, measurable, accepted, realistic, temporal; that is, SMART.

For the non-found indicators in the LIS, such as internal and external client satisfaction and learning and innovation, we developed a questionnaire for laboratory staff, all categories combined, biologists, resident physicians and pharmacists, internal physicians and pharmacists, medical assistants, engineers, and technicians.

The satisfaction survey of all employees (the internal customer axis in our reference framework) covered three main points, which are:

- The laboratory's material resources and information system

- Working conditions and social climate

- The effectiveness and efficiency of the laboratory managers and particularly the major of the department.

For the laboratory's external clients, we also conducted a satisfaction survey that involved clinicians at the Ibn Rochd University Hospital in Casablanca (clinical service physicians).

For the learning and innovation axis, we have decided to measure it by means of the scientific production indicator in the laboratory (via a questionnaire survey of resident and internal doctors and pharmacists biologists).

3. Results and discussion:

Based on the four axes of the BSC, we have obtained the following results, which are as follows:

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3.1 Customer axis:

For the client axis, we distinguish between internal clients, who are the human resources working in the laboratory, and external clients, who are physicians working in clinical services, who are called clinicians.

- **Internal customer:**

For the internal customers, we have set four indicators:

3.1.1 The number of staff by category:

| Table 1: Distribution of staff by profile	
The profiles	**Number of staff**
Professors	1
Assistant Professors	2
Chief Technicians	1
Medical assistants	1
Laboratory technicians	13
Engineers	5
Service agents	1
Total	22

Source : by the authors

The Biochemistry Laboratory is composed of different profiles of different formations. The majority of them are laboratory technicians who take care of the technical part and are supervised by professors who take care of both the technical and scientific research in the laboratory.

3.1.1 The number of employees by age group and retirement:

Table 2: Distribution of staff by age group.		
Age group	**Number of people**	**Retirement from the company**
20 to 30 years old	2	
30 to 40 years old	7	
40 to 45 years old	1	
45 to 50 years old	1	
50 to 55 years old	3	From 2025 on-wards
55 to 60 years old	5	2023
60 to 63 years old	1	2020

distribution of staff by age group
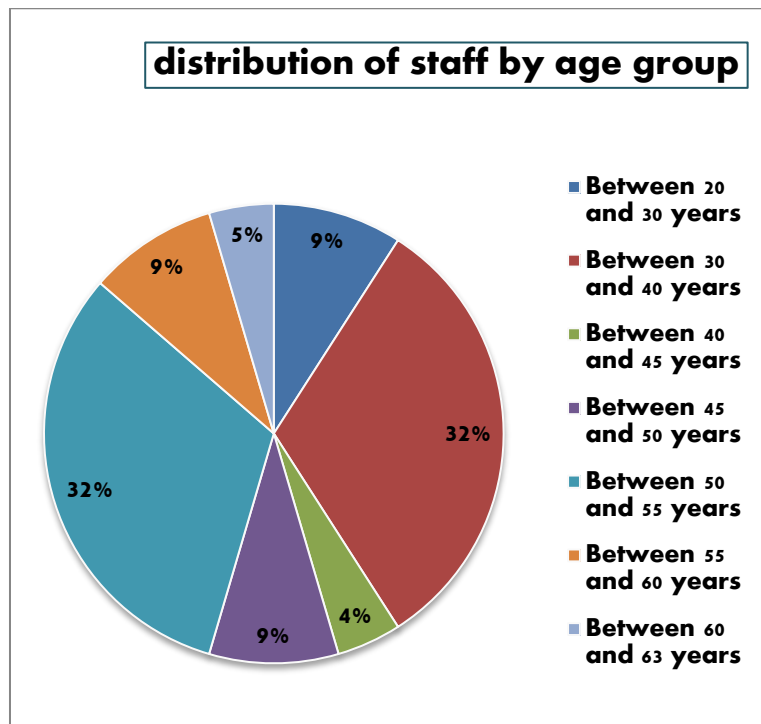
Source: by the authors

The biochemistry laboratory is composed of a heterogeneous population of human resources of different age groups with predominance of young people, but without neglecting the number of retirements by 2025, which is more than 40% of the total workforce, which represents a real headache for the laboratory's managers who must review their recruitment policies.

3.1.3 Staff effectiveness:

To measure the effectiveness of the three teams of laboratory staff (morning, afternoon and evening), we related the entered number of files into the computer system to the number of files validated by biologists by dividing the day into three slots, from 8am to 2pm, from 2pm to 7pm and also from 7pm to 8am, this study was over a 12-month period; from November 2017 to October 2018.

Table 3: Measuring staff effectiveness

| the Months	Files seized			Validated files			Efficiency rate			Deviations	
	Morning	Afternoon	Evening	Morning	afternoon	Evening	Morning %	afternoon %	Evening %	afternoon / Morning %	evening/ afternoon %
Nov. 17	9093	3372	1618	8950	3352	1615	98,43%	99,41%	99,81%	62,92%	52,02%
Dec. 17	9542	3033	1589	9510	3023	1587	99,66%	99,67%	99,87%	68,21%	47,61%
Jan. -18	9317	3843	1568	9328	3839	1565	100,12%	99,90%	99,81%	58,75%	59,20%
Feb. 18	9096	2718	1514	9055	2698	1510	99,55%	99,26%	99,74%	70,12%	44,30%
March-18	10327	3110	1683	10247	3090	1680	99,23%	99,36%	99,82%	69,88%	45,88%
Apr-18	8428	4036	1755	8403	4017	1753	99,70%	99,53%	99,89%	52,11%	56,52%
May-18	8058	4698	1948	7996	4663	1944	99,23%	99,26%	99,79%	41,70%	58,54%
June-18	8208	3507	1471	8152	3490	1468	99,32%	99,52%	99,80%	57,27%	58,06%
July-18	8397	4007	1917	8347	3986	1912	99,40%	99,48%	99,74%	52,28%	52,16%
August-18	6493	3248	2010	6451	3216	1156	99,35%	99,01%	57,51%	49,98%	38,12%
sept-18	7911	3888	2251	7843	3840	2244	99,14%	98,77%	99,69%	50,85%	42,10%
Oct-18	9868	4545	2384	9833	4517	2370	99,65%	99,38%	99,41%	53,94%	47,55%
Total	104738	44005	20090	104115	43731	20804	99,41%	99,38%	99,55%	57,99%	54,35%

The source: by the authors

The laboratory's efficiency rate was very satisfactory, since it exceeds 99% for the three teams, which means that the staff is very efficient and only leaves their position after finishing their work, given that the business process controllable in the laboratory begins with the entry of the file and ends with the biological validation of the sample. Also, we note that the work-load is concentrated on the morning, at a rate of 58% compared to the afternoon and 54% compared to the evening, which is normal in medical testing laboratories since the majority of tests are done in the morning, and on an empty stomach.
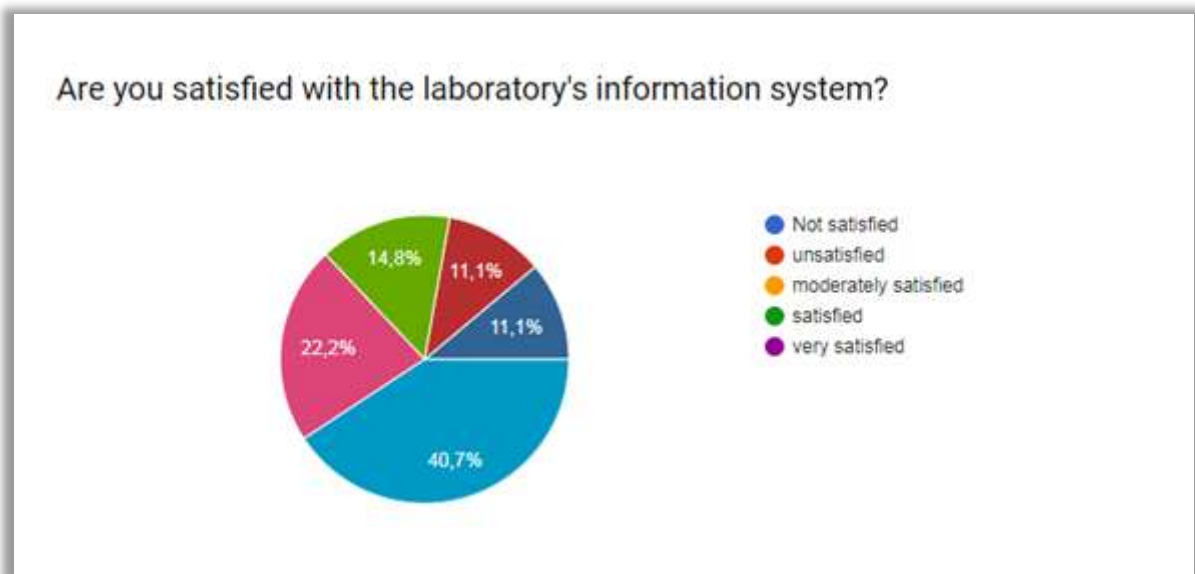
3.1.4 Staff satisfaction:

The satisfaction survey of the laboratory's internal customer (the staff), was attended by 60 people, this survey covered four essential points which are:

### 3.1.4.1 The satisfaction of material resources:
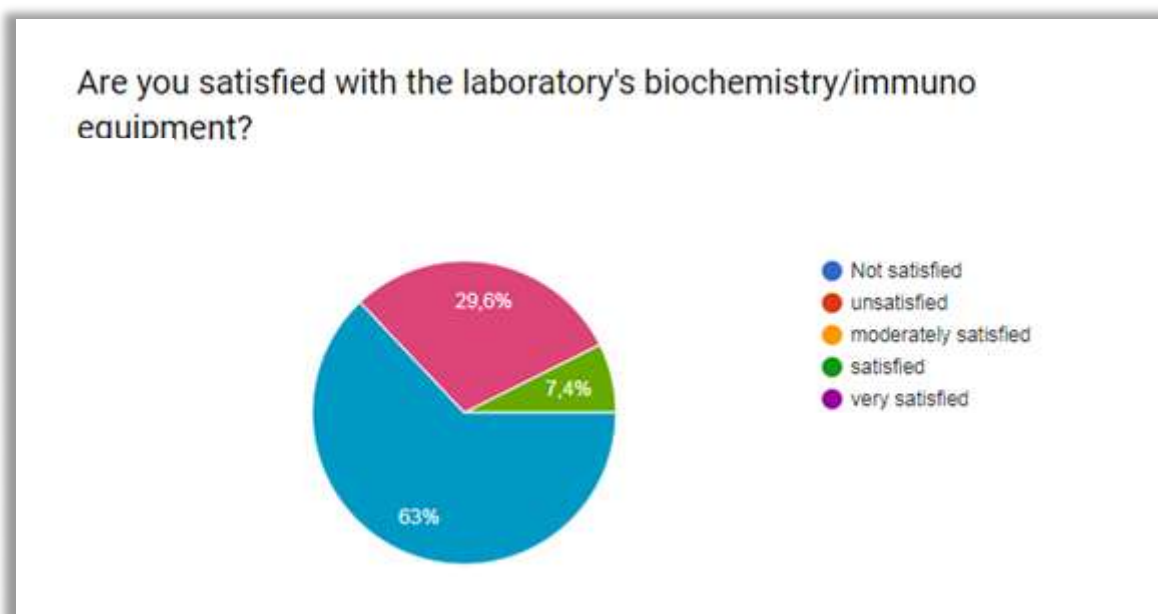
The laboratory staff is satisfied with more than 90% of the material resources, and particularly the automatons that perform biochemical and immunological analyses. Knowing that the laboratory obtains new devices every three years for public procurement purposes.

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### 3.1.4.4.2 Laboratory Information System (LIS) satisfaction:

Half of the laboratory staff are satisfied with their information system. While the other half is between moderately satisfied and dissatisfied, what makes us think about the root causes behind this heterogeneity of perception is whether it is related to the quality of computer equipment, the quality of the all-round system or the quality of the service provided by the University Hospital IT Division.

3.1.4.4.3 Satisfaction of working conditions:
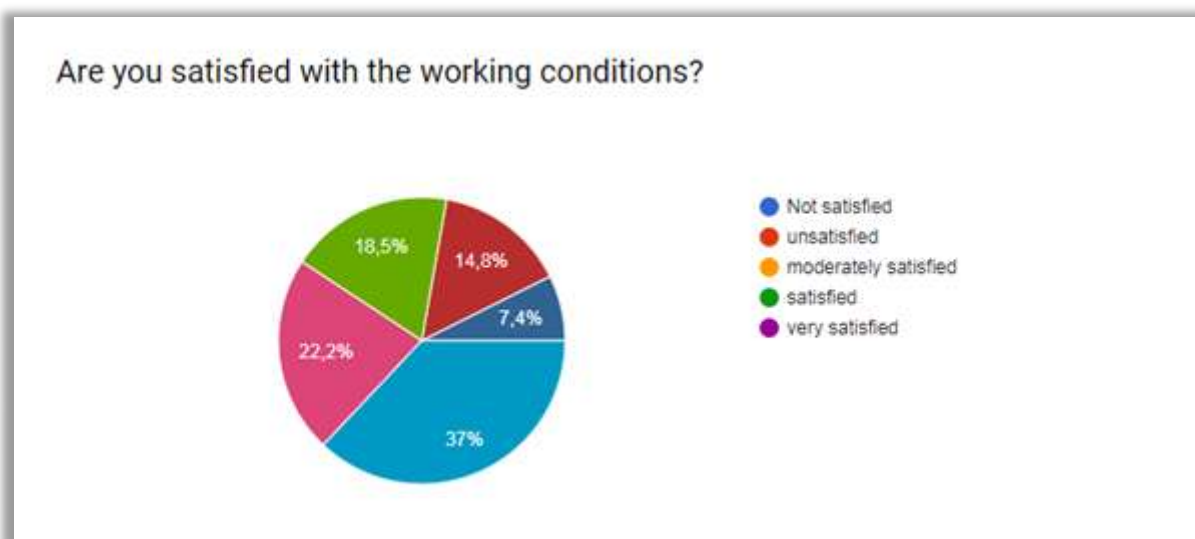
For working conditions, more than 55% of the staff are not satisfied with the quality of the social climate prevailing in the department, which is a matter for further investigation to take the necessary measures, especially since staff motivation is a central focus directly related to laboratory productivity.

3.1.4.4. The satisfaction of the performance of the laboratory manager (major of the department):
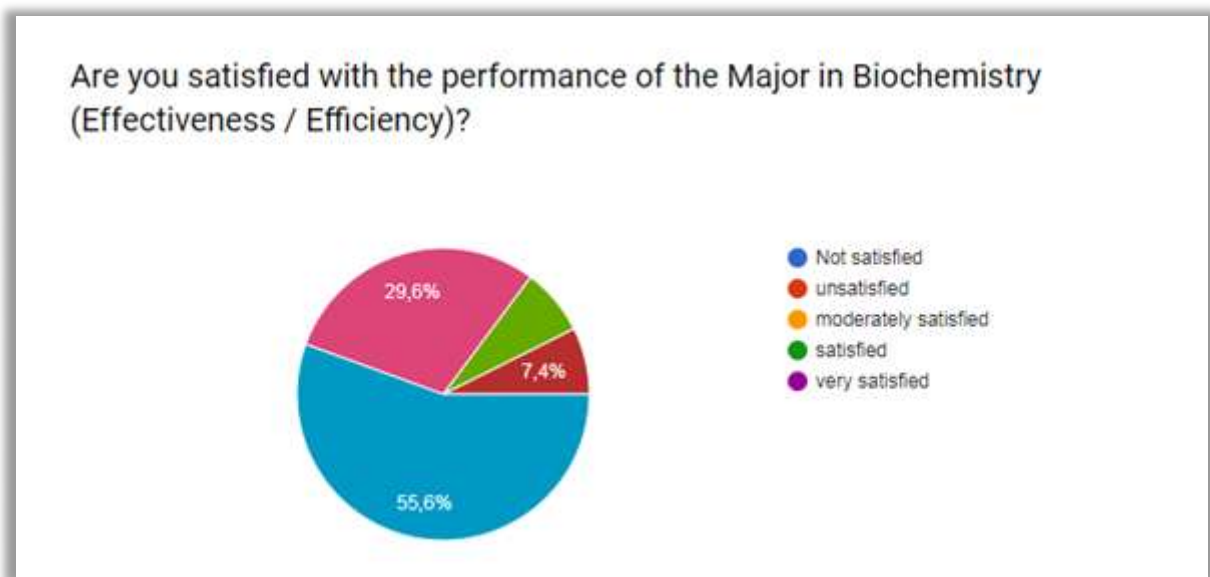
On the other hand, the staff is quite satisfied with the service provided by their manager (major of the service), regarding effectiveness and efficiency, this seems clear in the order of more than 84%, which remains very positive.

- **External customers:**

A satisfaction survey of clinical physicians working in various clinical services were conducted and are based on three key points, which are:

- The quality of the welcome

- The quality of the results

- Deadline for the submission of results.

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3.1.4.5: the quality of the welcome:

Unfortunately, only 54% of doctors are satisfied with the quality of the reception at the Bio-chemistry laboratory, a number that remains a worrying figure because the main mission of this service is to satisfy its client, who is the clinical doctor, which encourages managers to work harder to improve its product and satisfy its external clients.

3.1.4.6: The quality of the results:

Physicians are 85% satisfied with the results given to patients, which is very positive, but needs to be improved.

3.1.4.7: Delay in the delivery of results:

Physicians are very satisfied with the turnaround times for results, especially for urgent pa-tients, which do not exceed 30 minutes.

3.2 Internal process axis:

For this axis, we have defined three indicators based on:

- The activity of the laboratory (production)
- The average time entered/validation
- The non-conformities.

3.2.1: The activity of the laboratory (production):

The laboratory's activity increased regarding demand between 2017 to 2018 by around 25%. These requests are distributed during the day as follows, carried out by the three teams of the laboratory (Morning, Afternoon and evening).

Table 4: Distribution of requests by slot:

08h to 10h	10h to 12h	12h to 14h	14h to 16h	16h to 19h	19h to 00h	00h to 08h
2740	33940	50333	20261	17691	22151	7124

1,78%	22%	33%	13,13%	11,47%	14,36%	4,62%
8 people (56,78%)			**5 people (24,6%)**		**3 people (18,98%)**	

Source: by the authors

The table above shows the distribution of requests by slot, which shows the fact that 55% of the work is concentrated between 10am and 2pm, this work is done by eight people who represent 50% of the human resources available in the laboratory. While 24.6% of the work is done by the afternoon team and 18.98% by the evening team. This distribution of requests leaves room for reflection on the distribution of staff during the day to absorb the workload and respond to patient requests as quickly as possible under the best conditions.

3.2.2.2: Average time entered/ validation

Based on the LIS, we compared the average time taken to enter/validate between 2016, 2017 and 2018.

Table 5: Comparison of the average time taken to enter/validate between 2016/2017/2018

2016	**2017**	**2018**
06:13:19	04:11:24	02:44:52

Source: by the authors

For the control of the process axis, we measured the time between file entry, and biological validation, which improved significantly from 06h13min in 2016 to 04h11min in 2017 and 02h44min in 2018. This improvement is explained by the automation and control of the laboratory's business process.

3.2.3: Non-conformities:

Non-compliant samples are samples that the laboratory has not taken because they do not comply with the conditions for carrying out the analyses.

Table 6: Comparison of non-conformities between 2017 and 2018.

Months	2017	2018	Deviation %	Months	2017	2018	Deviation %
January	211	174	-17,54%	June	130	228	75.38%
February	127	184	44,88%	July	203	233	14.78%
March	123	195	58,54%	August	156	201	28.85%
April	137	158	15,33%	September	144	211	46.53%
May	360	170	-52,78%	October	192	251	30.73%
Total					1783	2005	12.45%

Source: by the authors

A comparison between 2017 to 2018 reveals a significant increase of 12.45% in the received non-compliant balances at the laboratory, which leads us to ask the following question: does the laboratory take the necessary measures via corrective actions to overcome the problems of non-compliance

3.3: The financial axis:

The Biochemistry laboratory achieved an important turnover rate of 88% between 2017 to 2018; this figure is explained by the development of the panel of services performed in the laboratory, which went from 32 analyses to 64, and the promotional effort made by the laboratory managers with other clinical services.

3.4 The learning and innovation axis:

This axis was measured by the scientific production indicator, through the measurement of the number of published articles and oral and poster communications (Posters), this was done by

a survey that reached the internal and resident doctors currently present in the laboratory and those who have already passed through. Aware that scientific production is part of their internship objectives.
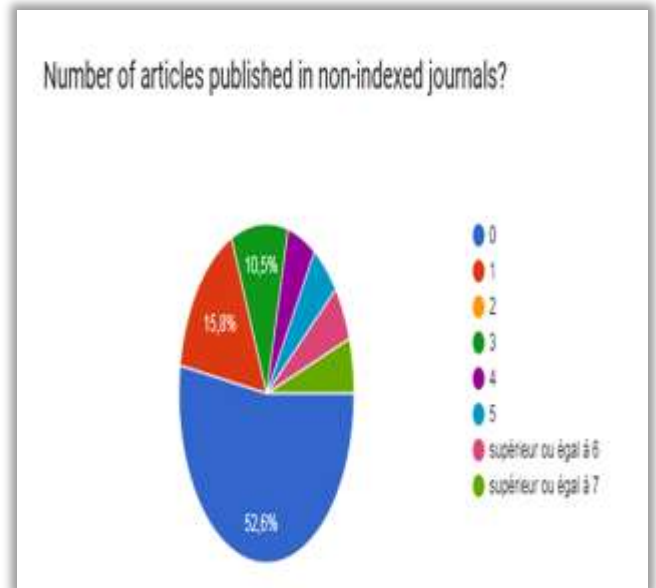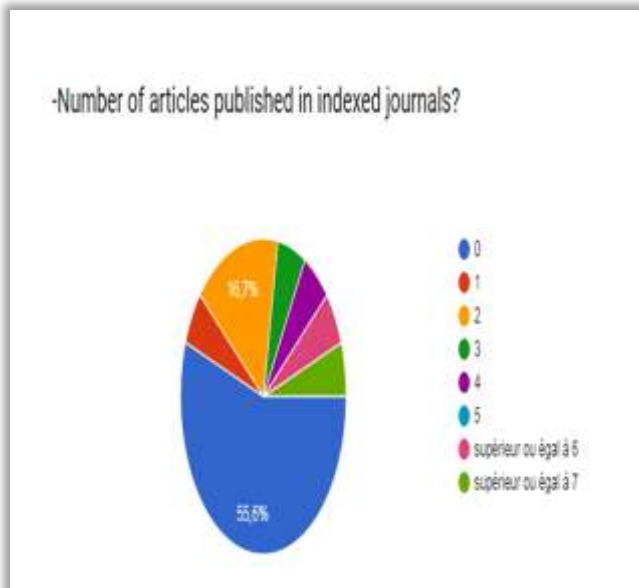
For publications in indexed journals, more than 55% have never published, and more than 52% have never been able to publish even in a non-indexed journal.
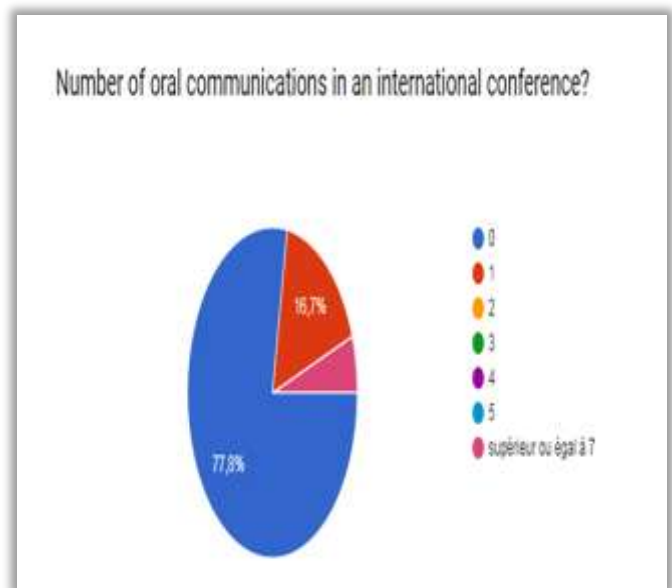
55% of the people surveyed have never participated in a national conference through oral communication. Unfortunately, still more than 77% have never communicated in an international conference.
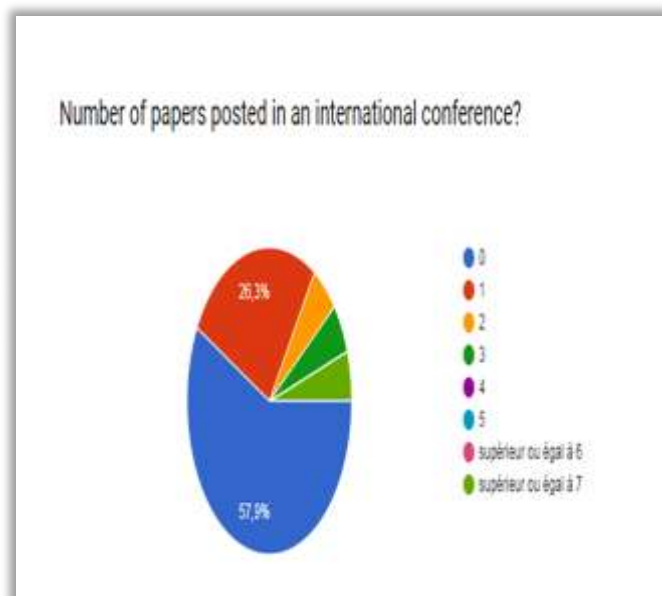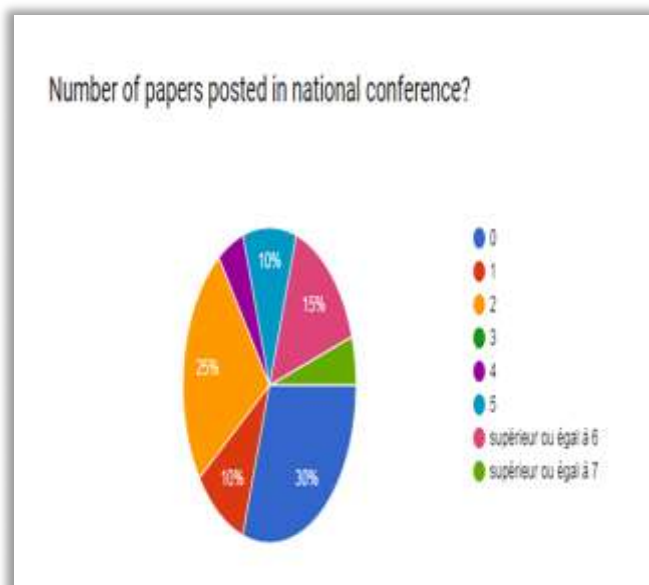
We notice there is a tendency towards participation in national conferences through poster presentations, and even in international conferences, but with a relatively low rate.

The rate of scientific production in the laboratory remains very low indeed, which has prompted us in this work to ask about the existence of conditions for the student regarding the scientific research.

Are the conditions favourable to the biochemistry laboratory for scientific production?

56,5%

43,5%

● oui
● Non
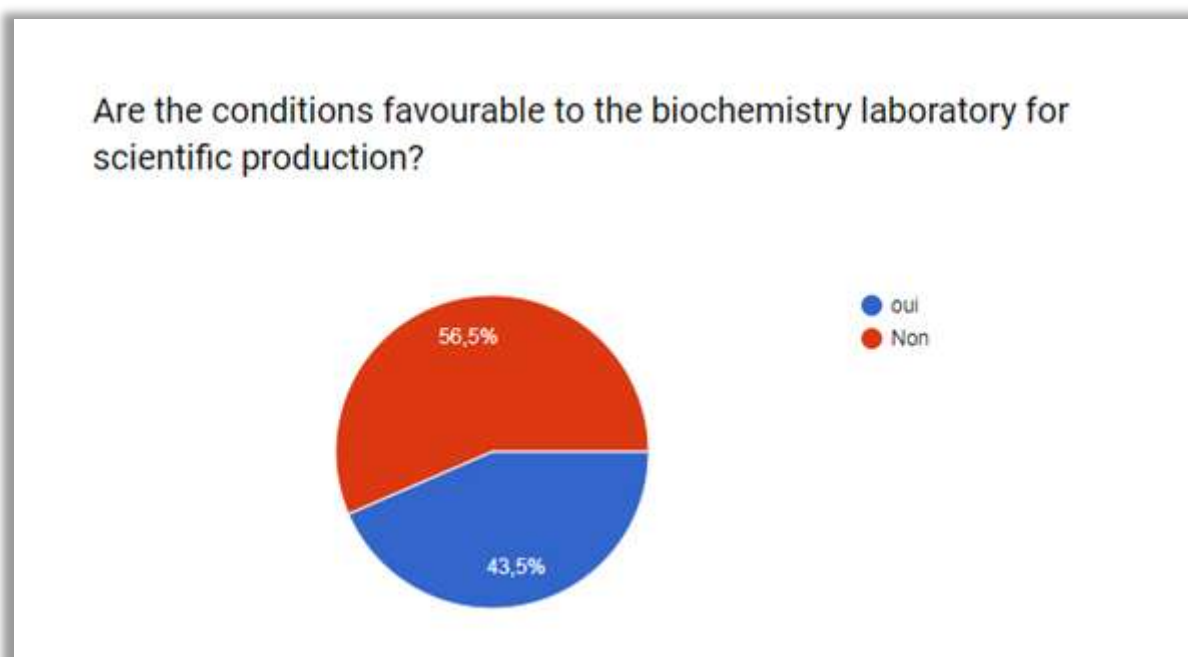
The answer to this question explained the fact that more than 56% are not satisfied with the conditions of scientific production. To overcome this problem, the laboratory's head of department recruited two assistant professors to help him supervise and monitor the scientific work of the residents and interns passing through the laboratory.

Conclusion:

Given its importance and ease of use (Ahn, 2001), many authors and professionals use the dashboard to measure organizational performance (Martinsons and Chong, 1999). However, this tool has been criticized for its simplicity and limited use of performance indicators (Hoque and James, 2000). According to the work of (Kanji and e Sá, 2010, 2002), some measures are neglected, such as those who are relating to suppliers, partners, and competitors (Wagner et al., 2011). To address this problem, Kaplan and Norton 1992 used and recommended the use of the BSC for performance measurement, which was requested as a reference framework in our study?

Indeed, achieving the balance between the four perspectives of the BSC allows managers to "control the strategy implementation process, not only to achieve short-term financial results, but also to develop long-term competitive capacities" (Papalexandris et al., 2004). This balance can be achieved between financial and non-financial indicators, between external indica-

tors (relating to clients and shareholders) and internal indicators (relating to processes and learning) or between qualitative and quantitative indicators (BENZERAFA, 2007).

This attempt to measure the performance of the Biochemistry Laboratory based on the four axes of the BSC, allowed us to come out with the following recommendations, indeed, those in the charge must:

> Understand the causes of the dissatisfaction of half of the laboratory staff of the information system laboratory, and take the necessary measures.
> Improve the quality of the reception in the laboratory.
> Work on staff motivation and the social climate indicator.
> Ensure that the conditions for scientific production are improved.

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