



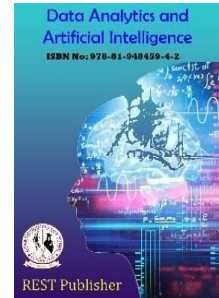
## Data Analytics and Artificial Intelligence

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# Analyzing Prognostics and Healthcare Management (PHM) Using Decision Making Tools

\*Sathishkumar Mani, Ramya Sharma, M. Ramachandran, Soniya Sriram

REST Labs, Kaveripattinam, Krishnagiri, Tamil Nadu, India

Corresponding Author Email: [sathishrestlabs11@gmail.com](mailto:sathishrestlabs11@gmail.com)

**Abstract:** Plenty of study has been accomplished on prognostics alongside healthcare management (PHM), a new topic in mechanical engineering whose services is gaining traction in industries as well as universities. More than half of these efforts happened to be focused on machinery PHM, leading in the creation of several algorithms for this specific application. The vast majority associated with these algorithms are focused on applications using conventional rotating machinery parts like bearings and gears. Comprehension of this historical work is required to provide any future research efforts; yet, there has not been a thorough analysis that summarizes previous and ongoing PHM activities. Furthermore, no systematic technique for creating and implementing one PHM system has been devised. Organizational performance assessment (OPA) is beneficial in directing improvement efforts as health care organizations seek strategies to ensure cost-effective, high-quality service delivery while still addressing patient demands. Furthermore, assessing organizational performance is critical for continuing decision-making by executives, efficient operation, and strategy creation. The functions and influence of OPA avatars on medical fields are discussed in this research, and areas of possible misuse, which involve myopia, or short tunnel vision, and gaming, are noted. Inspection of the relevancy concerning health-related research is to evaluate the study results' value, relevance, and possible effect. It pertains to vital to remember that the relevance of a study might differ based on the inquiry's topic and the target audience. Researchers who are interested anonymous reviewers, together with others with expertise in the area are frequently critical in determining the importance that live in health care management investigations. In this research we will be using Decision Making Trial and Evaluation Laboratory (DEMATEL). Equal Importance, Moderate Importance, Strong Importance, Demonstrated Importance, Extreme Importance. Equal Importance, Moderate Importance, Strong Importance, Demonstrated Importance, Extreme Importance, Sum. As per the Decision Making Trial and Evaluation Laboratory (DEMATEL) Strong Importance got more value were Equal Importance got less value. From the above results I conclude that as per the Decision Making Trial and Evaluation Laboratory (DEMATEL) Strong Importance got more value than others.

**Keywords:** Equal Importance, Moderate Importance, Strong Importance, Demonstrated Importance, Extreme Importance.

## 1. INTRODUCTION

Healthcare Management is critical for continuing decision-making by executives, efficient operation, and strategy creation. The functions and influence of OPA avatars on medical fields are discussed in this research, and areas of possible misuse, which involve myopia, or short tunnel vision, and gaming, are noted.

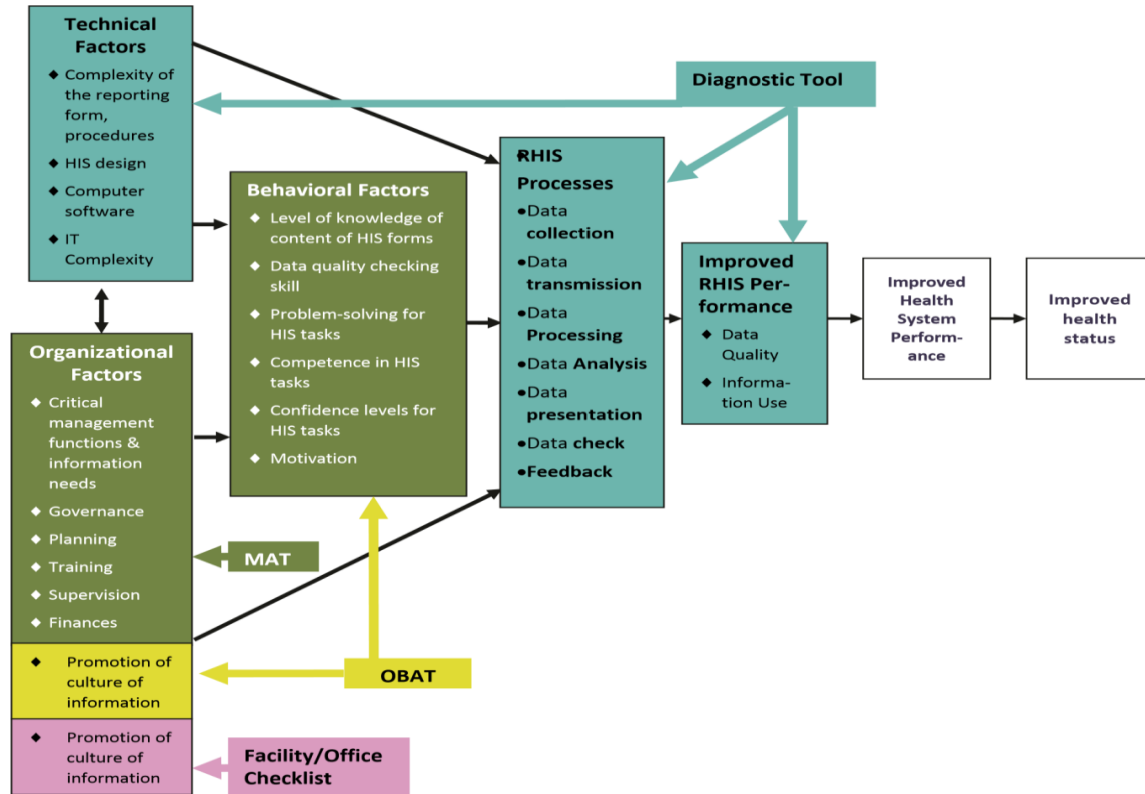


FIGURE 1. Assessment of Health Management

Diagnostic testing and prognostication originated in the medical industry. Troubleshooting and projections increasingly infiltrated all disciplines of mechanical engineering as servicing technology evolved. There is several professional equipment available today to execute machine diagnostics, including sensors, meters, controllers, in addition computational tools. [1] These devices are capable of collecting and 2organist signals generated by an apparatus or process. To detect the fundamental reasons of machine failure, more advanced diagnostics methods have been available. On the other hand, diagnostics, which is performed after a fault has already happened, is a reactive procedure for maintenance choices and is unable to prevent interruptions and associated costs from occurring. [2] Florence Nightingale, an affliction of those liable for poor medical care via the army, was a pioneer of rigorous assessment. Her withering expose related to Crimean hospitals to others as death traps was predicated on her finding that distance from hospital was a primary factor of regimental mortality. [5] The regiments combined with the least luck were those with easy access against hospital beds, considering deaths were caused less by fighting injuries and more by contracting an infection in the hospital. She eventually established her consistent method of hospital data, which included comparing death rates particularly bed 2organization by medical category. The toxin produced by botulinum toxins is the foremost toxic chemical known to man. A single kilogram me of crystalline poison, equally scattered and breathed, would kill over one million people, while technological constraints would make such spread impractical. [12] [13] Nanotechnology has the ability to assist nations of developed and developing nations alike tackle many of their challenges, from enhancing the supply of healthcare to expanding commercial possibilities. [14] Every year, the number of countries offering e-commerce solutions grows, and as a result, the number of workplaces with internet access for commercial operations grows significantly throughout the world. Table 1 shows three e-commerce projection estimations. These estimates clearly demonstrate the importance of e-commerce to the economy worldwide. [15].

## 2. MATERIALS AND METHOD

DEMATEL is a methodological technique 2rganiza in decision-making processes, notably in the fields belonging to operations research as well as management science. It seeks to examine the intricate linkages and interdependence between components or variables adhering a decision problem. [16] Prof Thomas L. Saaty created DEMATEL in the 1970s. It makes available an 2rganizat system for 2rganizat the causal links and feedback loops between various

aspects and aids in determining their influence on the entire decision-making process. To model and assess the interdependencies, the technique integrates aspects from graph theory, linear algebra, matrix algebra, before social network analysis. [17] DEMATEL has been used in a variety of fields, including administration of projects, logistics leadership, handling the environment, healthcare, while participating strategic planning. DEMATEL facilitates decision-making processes by identifying significant aspects and understanding their linkages. It also provides a systematic way to 3rganizat and evaluating complicated choice issues. [18]

**Equal Importance:** The concept of offering equal worth, significance, or respect to various elements, persons, or ideas is referred to as equal importance. It implies that all components or people concerned are equal in value and should consider it presented with converted respect and care. [19] It is critical to understand that equal priority does not translate to uniformity or deliberately a disdain for variations. Rather, it 3rganizati the principles of justice and variety while 3rganizatio the unique value throughout each component or human involved. [20]

**Moderate Importance:** Health management assessment is of modest relevance since it is critical to maintaining optimal health outcomes particularly the effective delivery of services related to healthcare. Effective health oversight necessitates a multifaceted strategy that includes preventive care, illness management, health promotion, while participating the coordination belonging to healthcare resources. [21] Finally, 3rganizat health supervision is of modest importance since it allows for amplification of areas to support improvement, assures the successful delivery throughout healthcare services, and leads to improved health outcomes for people and groups. To promote ongoing quality improvement while ensuring optimal operation of health systems, a thorough evaluation spanning many facets relating to healthcare management is required. [22]

**Strong Importance:** The evaluation of health management is critical due to the fact enables efficient 3rganizatio of assets, excellence enhancement, gauge of performance, planned spending, managing hazards, while participating evidence-based decision making. [23] Regular assessments can help healthcare 3rganizational improve the efficiency, efficacy, and long-term stability of their particular systems for delivering healthcare. [24]

**Demonstrated Importance:** For various reasons, assessing health leadership has become critical in healthcare systems. It provides for the assessment and improvement belonging to healthcare services, as well as the facilitation of methods of decision-making, the assurance of quality treatment, and the promotion of patient safety. [25] In 3rganizati form, health management evaluation is critical in healthcare systems regarding quality improvement, efficient usage of resources, supported by research evaluation of choices, confidentiality of patient information, compliance, ongoing improvement, and stakeholder involvement. By performing frequent evaluations, healthcare 3rganizational may assure the distribution of high-quality treatment, enhance patient outcomes, and 3organize healthcare 3rganist. [26]

**Extreme Importance:** People and their neighborhoods must priorities health management since it is critical to sustaining and developing holistic wellness. [27] Finally, health surveillance is critical for personal well-being, the avoidance of illnesses, long-term condition oversight, costs related to healthcare containment, while participating public health. Individuals may live better lives, lower illness burdens, and make valuable contributions to a healthy society by 3organization health management. [28]

**Sum:** Wellness management assessment entails assessing the efficacy and efficiency during many components throughout healthcare delivery in addition administration. This evaluation often includes several components, such as the 3rganizational makeup, financial management, excellence in care, together with tactical preparation. [29] Additionally, variables regardless of the circumstances, may be included in plus to these components as you enjoy the assessment concerning wellness management. Human resources administration, networking infrastructure, management of hazards, and community participation are some examples. [30]

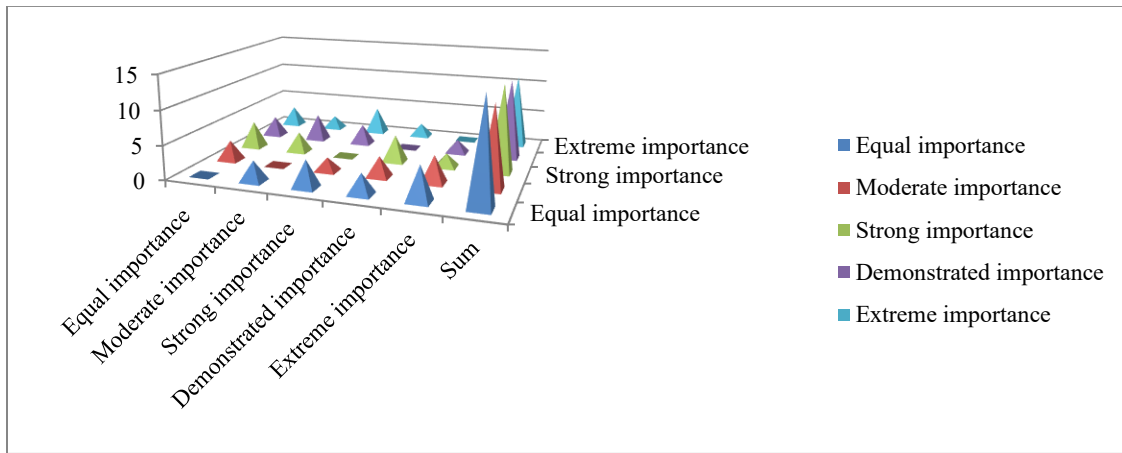
### 3. RESULT AND DISCUSSION

**TABLE 1.** Assessment of Health Management

	Equal Importance	Moderate Importance	Strong Importance	Demonstrated Importance	Extreme Importance	Sum
Equal importance	0	3	4	3	5	15
Moderate importance	3	0	2	3	4	12
Strong importance	4	3	0	4	2	13
Demonstrated importance	3	4	3	0	2	12
Extreme importance	3	2	4	2	0	11

Chart

This table shows Decision Making Trial and Evaluation Laboratory (DEMATEL). Here in this table Equal Importance, Moderate Importance, Strong Importance, Demonstrated Importance, Extreme Importance, Sum.



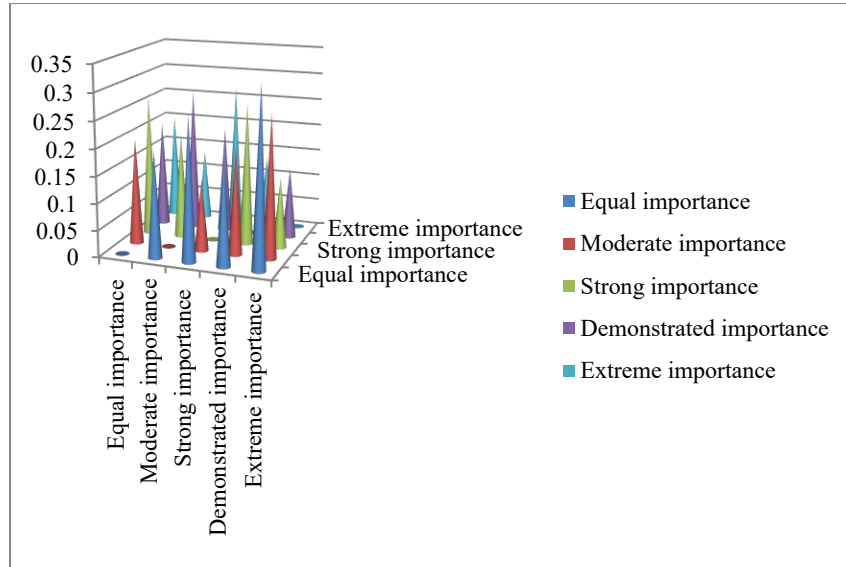
**FIGURE 1.** Assessment of Health Management

This table shows Decision Making Trial and Evaluation Laboratory (DEMATEL). Here in this table Equal Importance, Moderate Importance, Strong Importance, Demonstrated Importance, Extreme Importance, Sum.

**TABLE 2.** Normalization of Direct Relation Matrix

Normalization of Direct Relation Matrix					
	Equal importance	Moderate importance	Strong importance	Demonstrated importance	Extreme importance
Equal Importance	0	0.2	0.266666667	0.2	0.333333333
Moderate Importance	0.2	0	0.133333333	0.2	0.266666667
Strong Importance	0.266666667	0.2	0	0.266666667	0.133333333
Demonstrated Importance	0.2	0.266666667	0.2	0	0.133333333
Extreme Importance	0.2	0.133333333	0.266666667	0.133333333	0

This table shows Normalization of Direct Relation Matrix of Equal Importance, Moderate Importance, Strong Importance, Demonstrated Importance, Extreme Importance.



**FIGURE 2.** Normalization of Direct Relation Matrix

This Figure shows Normalization of Direct Relation Matrix of Equal Importance, Moderate Importance, Strong Importance, Demonstrated Importance, Extreme Importance.

**TABLE 3.** I= Identity matrix

$T = Y(I - Y)^{-1}$				
I= Identity matrix				
I				
1	0	0	0	0
0	1	0	0	0
0	0	1	0	0
0	0	0	1	0
0	0	0	0	1

Table 3 shows transformation  $T = Y(I - Y)^{-1}$  represents a matrix mapping that depends on the matrix Y and the identity matrix I. Here, I is a 5x5 identity matrix; it has ones on its main diagonal and zeros elsewhere. It acts as the neutral element for matrix multiplication. The term  $(I - Y)^{-1}$  implies that I-Y must be a non-singular and invertible matrix. This transformation effectively scales and reshapes the impact of Y by multiplying its elements according to their deviation from the identity matrix.

**TABLE 4. (I-Y)**

(I-Y)				
0	0.2	0.4	0.18	0.27
0.364	0	0.2	0.09	0.18
0.182	0.1	0	0.27	0.09
0.091	0.3	0.2	0	0.18
0.182	0.4	0.1	0.27	0

Table 4 shows matrix Y. Y is a 5 x 5 weighted interaction matrices. All diagonal elements are zero, indicating that there is no self-interaction between the components. Each off-diagonal entry represents the influence or strength of the relationship from one variable to another. The unequal values show that the interactions are directional and vary in magnitude; some relationships are strong (for example, 0.4 and 0.364) while others are weak. The row-wise distribution shows how each element is affected by the remaining four elements.

**TABLE 5.** (I-Y) Inverse

I-Y				
1	-0.18	-0.4	-0.18	-0.27
-0.4	1	-0.2	-0.09	-0.18
-0.2	-0.09	1	-0.27	-0.09
-0.1	-0.27	-0.2	1	-0.18
-0.2	-0.36	-0.1	-0.27	1

Table 5 shows that the I–Y matrix represents the difference between the identity matrix and the correlation matrix (Y). The diagonal elements are all equal to 1, indicating that each variable retains its own independent contribution. The off-diagonal elements are negative, signifying that the effects in Y are subtracted from the identity structure. This reflects how these correlations reduce or modify the pure self-effect of each component. The magnitude of the negative values indicates the relative strength of the dependencies between the variables.

**TABLE 6.** Total Relation Matrix

(I-Y) <sup>-1</sup>				
1.891	1.101	1.17	1.04	1
1.081	1.838	0.96	0.86	0.9
0.75	0.736	1.61	0.82	0.6
0.789	0.952	0.83	1.67	0.8
1.02	1.195	0.94	1.03	1.8

Table 6 shows the matrix (I–Y)<sup>-1</sup>. (I–Y)<sup>-1</sup> is the inverse of I–Y, and it represents the overall or total effects of the interactions between the five components. Unlike Y, which considers only direct impacts, this inverse matrix takes into account both the direct and indirect effects that propagate through the system. The diagonal elements being greater than one indicate the amplification caused by feedback loops within the system.

**TABLE 7.** Calculation of Ri+Ci and Ri-Ci to get the cause and effect

Total Relation matrix (T)					
Equal importance	0.891	1.101	1.17	1.04	1
Moderate importance	1.081	0.838	0.96	0.86	0.9
Strong importance	0.75	0.736	0.61	0.82	0.6
Demonstrated importance	0.789	0.952	0.83	0.67	0.8
Extreme importance	1.02	1.195	0.94	1.03	0.8

Table 7 presents the total relation matrix (T) used to calculate the  $R_i + C_i$  (importance) and  $R_i - C_i$  (cause-effect) values for cause-and-effect analysis. Each row represents the degree of importance of a criterion, while the numerical values show the strength of influence between the criteria. Higher row sums ( $R_i$ ) indicate a stronger influencing power, while higher column sums ( $C_i$ ) indicate a stronger dependence.

**TABLE 7.** Ri and Ci

Ri		Ri	Ci
5.208797	Equal importance	5.208797	4.5304716
4.621622	Moderate importance	4.6216216	4.8214096
3.54637	Strong importance	3.5463699	4.5136902
4.006359	Demonstrated importance	4.0063593	4.4165342
4.951775	Extreme importance	4.9517753	4.0528175

Table 7 shows the calculated row sums ( $R_i$ ) and column sums ( $C_i$ ) for each level of importance. Higher  $R_i$  values indicate a stronger influencing power, while higher  $C_i$  values show a greater degree of dependence. This comparison helps to differentiate the driving (causal) factors from the dependent (effect) factors within the system.

**TABLE 8.** Calculation of Ri+Ci and Ri-Ci to get the cause and effect

Calculation of Ri+Ci and Ri-Ci to get the cause and effect		
	Ri+Ci	Ri-Ci
Equal Importance	9.7392687	0.6783254
Moderate Importance	9.4430313	-0.199788
Strong Importance	8.0600601	-0.9673203
Demonstrated Importance	8.4228935	-0.4101749
Extreme Importance	9.0045928	0.8989578

This table shows Ri+Ci and Ri-Ci of Equal Importance, Moderate Importance, Strong Importance, Demonstrated Importance, and Extreme Importance.

**TABLE 9.**T Matrix

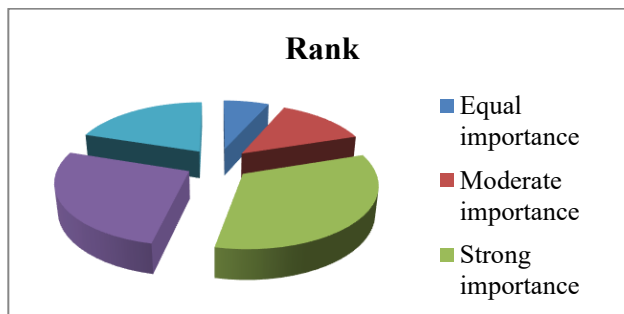
	T Matrix				
	0.890832	1.100689	1.168345	1.038156	1.010775
	1.081081	0.8378378	0.963964	0.8648649	0.8738739
	0.7498675	0.7355591	0.6122593	0.81558	0.6331037
	0.7885533	0.952305	0.8325384	0.6661367	0.7668256
	1.020138	1.195019	0.936584	1.031797	0.7682388
	Calculate the Average of the Matrix and its Threshold Value (Alpha)				
Alpha	0.8933969				
	If the T Matrix value is greater than threshold value then bold it				

Table 9 presents the total relationship (T) matrix, which shows the strength of the direct and indirect impacts between the factors. The average value of this matrix provides the threshold value ( $\alpha = 0.8934$ ). Values greater than  $\alpha$  indicate significant relationships, and these are highlighted to identify the dominant influences within the system.

**TABLE 10.** Rank

						Rank
Equal Importance						1
Moderate Importance						2
Strong Importance						5
Demonstrated Importance						4
Extreme Importance						3

Table 10 shows the final Rank of the analysis where “Equal Importance” is in the 1st Rank, “Moderate Importance” is in the 2nd Rank, “Extreme Importance”, 4<sup>th</sup> is in the Demonstrated Importance, 5<sup>th</sup> is in the Strong Importance is in the 5th Rank.



**FIGURE 3.** Rank

Figure 3 shows the final Rank of the analysis where “Equal Importance” is in the 1st Rank, “Moderate Importance” is in the 2nd Rank, “Extreme Importance”, 4<sup>th</sup> is in the Demonstrated Importance, 5<sup>th</sup> is in the Strong Importance is in the 5th Rank.

## 4. CONCLUSION

It is impossible to make a particular assessment belonging to health management based on the supplied facts without understanding the unique context or specifics being reviewed. Health management involves a wide variety of activities and can apply to many elements relating to healthcare that encompass administration, planning, coordination, additionally delivery. To give a relevant evaluation, certain objectives, targets, and indicators relating to health management must be considered. The sufferer consequences, access to healthcare, service delivery efficiency, cost-effectiveness, patient happiness, and quality improvement programmers are examples of such aspects. It is impossible to establish a definitive judgement on the inspection of health management without particular details associated with the requirements for evaluation and data available. More precise information or context would be useful in providing an assessment that is more accurate.

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