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*The role of the algorithm of decision-making in achieving
the best alternative by using the Prométhée method –
a case study of computer selection*

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Abstract

This study aims to present a comparison between laptops based on the "PROMETHEE 1 & 2" method, in light of the rapid technological development and with the presence of many alternatives and standards in the market. The product that is suitable for its needs in light of the various criteria and alternatives, and this study concluded in the comparison between the best laptop computers on the market for the year 2021 and based on the most important criteria that the best available product is "Alien ware m15 R4" as the most suitable alternative among the available alternatives, especially for individuals who want In possession of an advanced laptop computer.

Keyword: The best choice, technological development, laptop, "Promethee" method

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1. INTRODUCTION

The emergence of technological technologies constituted a new era of global development and affected everyone, This development imposed a perfect storm of radically changing business models, and it was necessary to adapt to the latest technological developments in order to survive in this fast-paced environment, by making good use of new technologies through intelligence, And since digital transformation has become an imperative for the survival of institutions and countries and a guarantee of development and keeping pace with changes, on the other hand, the consumer has become very confused about choosing the best product for him in light of the great diversity of products that highlight the extent of rapid technological development And among these products is the laptop, which is witnessing a great and rapid development.

Competitors in it are taking advantage of technology as a point that distinguishes their products from the rest, which makes falling on the best choice in it a real problem that worries the consumer, especially since most products witness a great convergence in technical characteristics and remains The preference between them is based on criteria determined by the consumer alone, and according to some experts Such as "Li feHack" got there exchanged desktop computers with tablets and smartphones, it is expected that total laptop sales will reach 171 million units in 2023 compared to 166 million units in 2019, which makes the problem of choosing the best laptop computer is increasingly problematic.

– Study problem:

In our study, we will rely on the "PROMETHEE" method, which is based on the differentiation between the existing options based on the various criteria available to help choose the best computer, and this is by answering the following question:

How to access the best laptop in light of the rapid technological development on the way "PROMETHEE 1 & 2"?

– **Study hypothesis:**

To answer the problem of the study, we formulated the scientific hypothesis of this study as follows:

In light of the various options, the "PROMETHEE" method makes it easier to determine the best laptop based on the criteria taken into account through the comparison between these alternatives.

– **Objectives of the study :**

There may be many objectives through this study, but the main objectives that the current scientific study seeks to formulate are as follows:

- Clarify the extent of the difficulties that impede the selection of the best technological products in light of the development taking place.
- Reaching accurate and decisive results for laptops in determining the best product and then the best based on criteria that most consumers agree on.
- Presenting the "PROMETHEE" method, this is among the many methods that will reduce the difficulties and help in the best selection of products in light of the various alternatives.

– **Previous studies:**

- study (2005, Jean-Pierre Brans and Bertrand Mareschal) providing an overview of the PROMETHEE-GAIA methodology for MCDA, and begins with general comments on multi-criteria problems, asserting that a multi-criteria problem cannot be addressed without additional information relevant to the preferences and priorities of decision-makers, The information required by PROMETHEE and GAIA is particularly clear and easily identifiable for both decision makers and analysts, and consists of a preference function associated with each criterion as well as weights describing their relative importance, and There are two sections devoted to performing a PROMETHEE VI sensitivity analysis (human brain) and a PROMETHEE V procedure for multiple choice of alternatives

subject to constraints, then an overview of the PROMETHEE GDSS procedure for group decision making is given.

- Study (2020, Shankha Shubhra GOSWAMI) This study highlights the application of Preferred Rank Organizing Method or Rating Enrichment (PROMETHEE) I and II in selecting the best laptop model among six different models available in the market, Seven important criteria have been identified an Analytical Hierarchy Process (AHP) is adopted to calculate weights from the seven criteria and PROMETHEE is applied to select the best alternative.
- **Study méthode and tool:**In order to answer the questions asked and obtain reliable results, and by reviewing previous studies, it became clear that the appropriate method for the study is the case study method, and the “Promethee” method has been relied upon as the best way to choose the best product among the multiple alternatives.

2. The theoretical framework of the study:

In this aspect, a set of basic concepts of the study will be presented, which are represented in digital transformation, we will present the concept of digital development in the business environment, by mentioning the importance of digital development and its impact on reaching the best product, which was represented in the following:

– **The concept of technological development:**

Technological development is one of the most important topics that occupies an important place in the contemporary economic reality, It is now a top priority in various regions of the world through which it aims to achieve different and intractable goals. From a work-focused perspective, it can be defined as “benefiting from the use of new technological technologies in transforming products and to carry out the processes and organizations designed on a large scale in business organizations in a way that includes these changes and their implications for products, services and business models as a whole ”.(CHRISTIAN & Hess , 2015)

Technological development is expressed as “the innovation of new goods and production techniques” , and it can be defined as “the permanent growth in technological technologies that can produce goods and services at a lower cost of production, achieve goals and meet needs ”. (Ahmadi , 2018)

It is also seen as "replacing the old digital technology with newer ones and identifying new flexible business models suitable for the rapid change in the technological world " (Berman, 2012), It is much more than an accumulation of isolated actions, such as being on social networks, using digital media, and introducing new technologies into the organization, it is an ongoing initiative that requires major changes in mindsets and a real willingness to change in order to adapt to an ever-changing environment to keep pace with The digital age and the continuation of competition (Haydn , 2018) .

And according to the National Economic Association (NOEG 2019), it was considered “ to have the next version of a program that continues to evolve to confront continuous changes and reduce barriers in many areas and thus gain more strength over time” (Jörn , 2021) .

– **The importance of technological development:** Technological development in all its forms and means has taken over all societies of the current era, and has infiltrated all aspects of life in them , Where technology is used in various places such as homes, offices and official institutions in the countryside the city and the desert, and it has become natural for individuals to deal with it no matter their level of civilization or less, and whatever their age group, and technology has been able, thanks to its spread, to change the daily lifestyles of peoples, both on the side Economic, cultural and social, given the increasing influence of information and communication technology in our contemporary life in its various aspects (Sahanine , 2017) , There are a number of considerations that can highlight the importance of technological development : (Abdel Hakim & Sebti , 2018)

- The successive Internet developments and their technological interactions represented by the revolution of computerized information and communication networks, Technological or digital interactions in the past decade have become a reality .There are four broad industries moving towards building platforms and common platforms such as hardware and software, consumer electronics industries, communications industries, and content industries such as text, music, and research.
- Knowledge has become a major strategic productive asset, reflecting the emergence of information and knowledge-based economies.
- Technology has played a major role in improving existing services and creating new services that were not available before, in many areas, most notably banking, transportation, communications and others.
- All the data proved that information technology is the best weapon to confront the phenomenon of complexity, and this is a useful and effective factor in solving many problems in daily life.

– **The impact of digital development on choosing the best product:**

Although the influencing factors can be quite different between products, nowadays products offer new features and functionality that were not present in the products that preceded them, but the basic principles and facilities that support the best choice have not changed significantly, for example devices The laptop that offers a completely new product is different from its predecessor, due to the development of technologies and the emergence of other completely new technologies that require reconsideration and rebuilding of the supporting settings ,and determining the best product depends mainly on the characteristics of the product and determining the basic trends preferred by the user of the product, which differ mainly from person to person, but may correspond to a basic point, which is the extent to which this product meets the greatest desired need of it (Ruyu & Nosheena , 2022) .

3. case study of choosing a laptop based on the trade-off between technological alternatives:

The prominent development in the technological field has made it more difficult to choose the right product for the needs in light of the great momentum of these many products in the market, and in our current study “PROMETHEE” will be applied to choose the best alternative from the various alternatives available for the laptop, and this requires a good knowledge of the best available alternatives from devices Computer and compare to find the best laptop that fits different technological criteria. The "PROMETHEE" method is among the most common multi-criteria optimization methods, which is a compound word of "P" which means "Preference", "R" indicates "Ranking", "O" is "Organization", and “METH” means “Method”, “E” denotes “enrichment”, and “E” denotes “Evaluation”, that is, it is the method of organizing the preferential order of enrichment and evaluation, this method is characterized by its mathematical style and ease , and it has been adopted It is required in several areas such as industrial location workforce planning, investment evaluation banking, health care, tourism...etc, It is an improvement methodology that depends mainly on the methods of pairwise comparisons, and "PROMETHEE" consists of six methods that will be based in our current study on two methods "PROMETHEE 1" partial arrangement, and "Promethee 2" full arrangement, because they achieve the objectives of the study. (Jaroslav , 2020, p. 213)

– Identification of laptop computers (alternatives) and their specifications (standards):

Where the study included (7) technological criteria and other criteria for selecting a laptop among (08) laptops that were selected as the best version for the year 2021, and there is a useful feature or qualities of “useful qualities” and there is a “unhelpful trait”, after analyzing the criteria feature , it is found that there are unhelpful attributes (price and weight), while the rest are useful attributes, the purpose of selecting the type of attributes is for the value to be above the criterion that indicates

the useful attributes, but if the price and weight increase, this is a non-useful attribute, and then an adjustment is applied Array by criterion attribute type as described in the first step of the Promethee, and the following table shows the alternatives and criteria considered.

Table 1. shows the types of laptops and the criteria used in the evaluation process.

alternatives	standards							
	alternate name	Price (€)	Ram (GB)	Disk dir (GB)	Battery (Wh)	Number of processors	Screen Size (Inches)	Weight (kg)
Alternative 1	Lenovo ThinkPad X1 Carbon	1899.95	16	512	65	4	14	1.13
Alternative 2	Asus ZenBook Duo 14	1454.00	32	1000	70	4	14	1.57
Alternative 3	HP Elite Dragonfly	1800.00	08	256	50	4	13.5	1.27
Alternative 4	Alienware m15 R4	3648.00	32	512	86	8	15.6	2.36
Alternative 5	Dell XPS 15	2999.00	64	2000	97	8	15.6	2.05
Alternative 6	Acer Swift 3(AMD)	683 .00	12	256	45	4	14	1.45
Alternative 7	Dynabook Toshiba Satellite Pro L50	1149.95	16	1000	40	4	15.6	1.85
Alternative 08	Samsung Galaxy Book	649.00	16	1000	54	1	15.6	1.55

Source: Prepared by researchers.

– **The steps of the PROMETHEE method:** The steps involved are described as follows: (Jitesh J. , 2021)

Step 1: Evaluate the decision matrix for laptops:

A code will be given for each standard according to the following table:

Table 2. shows the standards and their corresponding symbols

Standard	corresponding symbol
Price	P
Ram	R
Disk dir	Dd
Battery	B
Number of processors	NP
Screen Size	Ss
Weight	W

Source: Prepared by researchers.

The decision evaluation matrix ($m \times n$) is constructed according to the following equation:

$$\begin{cases} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \dots & \dots & \dots & \dots \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{cases} \quad \text{Where } \begin{cases} i = 1, 2, 3, \dots, m \\ j = 1, 2, 3, \dots, n \end{cases} \quad X = [x_{ij}]_{m \times n}$$

where (m) is the number of alternatives and (n) is the number of criteria Then, in this step, the useful and non-useful attribute will be determined, i.e. the maximum value of the criterion with the useful attribute is taken, and the minimum value of the criterion with the non-useful attribute is taken, and the following table shows the evaluation of the decision matrix for the arrived laptops:

Table 3. shows the evaluation of the decision matrix for laptops

	(P) Min	(R) Max	(Dd) Max	(B) Max	(NP) Max	(Ss) Max	(W) Min
Model 1	1899.95	16	512	65	4	14	1.13
Model 2	1454.00	32	1000	70	4	14	1.57
Model 3	1800.00	08	256	50	4	13.5	1.27
Model 4	3648.00	32	512	86	8	15.6	2.36
Model 5	2999.00	64	2000	97	8	15.6	2.05
Model 6	683 .00	12	256	45	4	14	1.45
Model 7	1149.95	16	1000	40	4	15.6	1.85
Model 8	649.00	16	1000	54	1	15.6	1.55
Max	3648.00	64	2000	97	8	15.6	2.36
Min	649.00	8	256	40	1	13.5	1.13
Max - Min	2999	56	1744	57	7	2.1	1.23

Source: Prepared by researchers according to the "Promethee" method.

Step 2: Preparing the normative assessment: In this step, the normative assessment is prepared based on the settlement of the decision matrix contained in the previous table using the following two equations, according to the nature of the selected criteria.

Useful criteria use the following equation:

$$R_{ij} = \frac{[x_{ij} - \min x_{ij}]}{[\max x_{ij} - \min x_{ij}]}, (i = 1, 2, \dots, n, j = 1, 2, \dots, m)$$

For unhelpful criteria the following equation is used:

$$R_{ij} = \frac{[\max x_{ij} - x_{ij}]}{[\max x_{ij} - \min x_{ij}]} (i = 1, 2, \dots, n, j = 1, 2, \dots, m)$$

where (x_{ij}) is a performance measure (i) with an alternative in relation to criterion (j), and the following table shows the normal evaluation matrix.

Table 4. shows the normal evaluation matrix

المعايير	(P) Min	(R) Max	(Dd) Max	(B) Max	(NP) Max	(Ss) Max	(W) Min
Model 1	0.582878	0.142857	0.146789	0.438596	0.428571	0.238095	1
Model 2	0.731577	0.428571	0.426606	0.526316	0.428571	0.238095	0.642276
Model 3	0.616205	0	0	0.175439	0.428571	0	0.886179
Model 4	0	0.428571	0.146789	0.807018	1	1	1.918699
Model 5	0.216405	1	1	1	1	1	0
Model 6	0.988663	0.071429	0	0.087719	0.428571	0.238095	0.252033
Model 7	0.832961	0.142857	0.426606	0	0.428571	1	0.739837
Model 8	1	0.142857	0.426606	0.245614	0	1	0.414634
Max	3648.00	64	2000	97	8	15.6	2.36
Min	649.00	12	256	40	1	13.5	1.13

Source: Prepared by researchers according to the "Promethee" method.

Step 3: Calculate the estimated differences between one alternative with the other alternatives: At this stage, the differences between each alternative with the alternatives are calculated, according to the following equation:

$$D(M_a - M_b) = N_{(ij)} - N_{(ij)}, \quad i = 1,2,3 \dots m; \quad j = 1,2,3 \dots n.$$

Table 5. shows the estimated differences for the alternatives with respect to the other alternatives

Standards	Discretionary Variations "Alt 1"						
	(P) Min	(R) Max	(Dd) Max	(B) Max	(NP) Max	(Ss) Max	(W) Min
D(M1-M2)	-0.1487	-0.28571	-0.27982	-0.08772	0	0	0.357724
D(M1-M3)	-0.0333	0.142857	0.146789	0.263161	0	0.238095	0.113821
D(M1-M4)	0.58287	-0.28571	0	-0.36842	-0.57143	-0.76191	-0.91869
D(M1-M5)	0.36647	-0.85714	-0.85321	-0.5614	-0.57143	-0.76191	1
D(M1-M6)	-0.4057	0.071428	0.146789	0.350881	0	0	0.747967
D(M1-M7)	-0.2500	0	-0.27982	0.4386	0	-0.76191	0.260163
D(M1-M8)	-0.4171	0	-0.27982	0.192986	0.428571	-0.76191	0.585366
	Discretionary Variations "Alt 2"						
D(M2-M1)	0.14869	0.285714	0.279817	0.08772	0	0	-0.35772
D(M2-M3)	0.11537	0.428571	0.426606	0.350877	0	0.238095	-0.2439
D(M2-M4)	0.73157	0	0.279817	-0.28070	-0.57143	-0.76191	-1.27642
D(M2-M5)	0.51517	-0.57143	-0.57339	-0.47368	-0.57143	-0.76191	0.642276
D(M2-M6)	-0.2570	0.357142	0.426606	0.438597	0	0	0.390243
D(M2-M7)	-0.1013	0.285714	0	0.526316	0	-0.76191	-0.09756
D(M2-M8)	-0.2684	0.285714	0	0.280702	0.428571	-0.76191	0.227642
	Discretionary Variations "Alt 3"						
D(M3-M1)	0.03332	-0.14286	-0.14679	-0.263157	0	-0.2381	-0.11382
D(M3-M2)	-0.1153	-0.42857	-0.42661	-0.35087	0	-0.2381	0.243903
D(M3-M4)	0.61620	-0.42857	-0.14679	-0.63157	-0.57143	-1	-1.03252

D(M3-M5)	0.3998	-1	-1	-0.82456	-0.57143	-1	0.886179
D(M3-M6)	-0.3724	-0.07143	0	0.08772	0	-0.2381	0.634146
D(M3-M7)	-0.2167	-0.14286	-0.42661	0.175439	0	-1	0.146342
D(M3-M8)	-0.3838	-0.14286	-0.42661	-0.07017	0.428571	-1	0.471545
Discretionary Variations "Alt 4"							
D(M4-M1)	-0.5828	0.285714	0	0.368422	0.571429	0.761905	0.918699
D(M4-M2)	-0.7315	0	-0.27982	0.280702	0.571429	0.761905	1.276423
D(M4-M3)	-0.6162	0.428571	0.146789	0.631579	0.571429	1	1.03252
D(M4-M5)	-0.2164	-0.57143	-0.85321	-0.19298	0	0	1.918699
D(M4-M6)	-0.9886	0.357142	0.146789	0.719299	0.571429	0.761905	1.666666
D(M4-M7)	-0.8329	0.285714	-0.27982	0.807018	0.571429	0	1.178862
D(M4-M8)	-1	0.285714	-0.27982	0.561404	1	0	1.504065
Discretionary Variations "Alt 5"							
D(M5-M1)	-0.3664	0.857143	0.853211	0.561404	0.571429	0.761905	-1
D(M5-M2)	-0.5151	0.571429	0.573394	0.473684	0.571429	0.761905	-0.64228
D(M5-M3)	-0.3998	1	1	0.824561	0.571429	1	-0.88618
D(M5-M4)	0.21640	0.571429	0.853211	0.192982	0	0	-1.9187
D(M5-M6)	-0.7722	0.011337	1	0.912281	0.571429	0.761905	-0.25203
D(M5-M7)	-0.6165	0.167039	0.573394	1	0.571429	0	-0.73984
D(M5-M8)	-0.7836	0	0.573394	0.754386	1	0	-0.41463
Discretionary Variations "Alt 6"							
D(M6-M1)	0.40578	-0.07143	-0.14679	-0.35087	0	0	-0.74797
D(M6-M2)	0.25708	-0.35714	-0.42661	-0.43859	0	0	-0.39024
D(M6-M3)	0.37245	0.071429	0	-0.08772	0	0.238095	-0.63415
D(M6-M4)	0.98866	-0.35714	-0.14679	-0.71929	-0.57143	-0.76191	-1.66667
D(M6-M5)	0.77225	-0.92857	-1	-0.91228	-0.57143	-0.76191	0.252033
D(M6-M7)	0.15570	-0.07143	-0.42661	0.087719	0	-0.76191	-0.4878
D(M6-M8)	-0.0113	-0.07143	-0.42661	-0.15789	0.428571	-0.76191	-0.1626
Discretionary Variations "Alt 7"							
D(M7-M1)	0.25008	0	0.279817	-0.4386	0	0.761905	-0.26016
D(M7-M2)	0.10138	-0.28571	0	-0.52632	0	0.761905	0.097561
D(M7-M3)	0.21675	0.142857	0.426606	-0.17544	0	1	-0.14634
D(M7-M4)	0.83296	-0.28571	0.279817	-0.80702	-0.57143	0	-1.17886
D(M7-M5)	0.61655	-0.85714	-0.57339	-1	-0.57143	0	0.739837
D(M7-M6)	-0.1557	0.071428	0.426606	-0.08772	0	0.761905	0.487804
D(M7-M8)	-0.1670	0	0	-0.24561	0.428571	0	0.325203
Discretionary Variations "Alt 8"							
D(M8-M1)	0.41712	0	0.279817	-0.19298	-0.42857	0.761905	-0.58537
D(M8-M2)	0.26842	-0.28571	0	-0.28070	-0.42857	0.761905	-0.22764
D(M8-M3)	0.38379	0.142857	0.426606	0.070175	-0.42857	1	-0.47155
D(M8-M4)	1	-0.28571	0.279817	-0.56140	-1	0	-1.50407
D(M8-M5)	0.78359	-0.85714	-0.57339	-0.75438	-1	0	0.414634
D(M8-M6)	0.01133	0.071428	0.426606	0.157895	-0.42857	0.761905	0.162601
D(M8-M7)	0.16703	0	0	0.245614	-0.42857	0	-0.3252

Source: Prepared by researchers according to the "Promethee" method.

Step 4: Create a function or calculate the preference function: The aggregated preference function is calculated taking into account the weights for each criterion, according to the following equation:

$$\pi(i, i') = \left[\sum_{j=1}^m \omega_j * P_j(i, i') \right] / \sum_{j=1}^m \omega_j$$

where ω_j is the relative importance or weight of the criterion (j).

This is according to the following conditions:

$$P_j(Ma, Mb) = 0, \quad \text{if } N_{(ija)} \leq N_{(ijb)} \rightarrow D(Ma, Mb) \leq 0$$

$$P_j(Ma, Mb) = (N_{(ija)} - N_{(ijb)}), \text{ if } N_{(ija)} > N_{(ijb)} \rightarrow D(Ma - Mb) > 0$$

So that all negative values in the previous table are replaced by zero, while maintaining the positive values multiplied by the weight of each criterion, as weights are assumed for the studied criteria "Criteria weights" so that the sum of the weights is equal to one, and this is called determining the weighted aggregate preferences $\pi = (Ma, Mb)$ using the following equation:

$$\pi(Ma, Mb) = \frac{[\sum_{j=1}^n w_j P_j(Ma, Mb)]}{\sum_{j=1}^n w_j}$$

Table 6. shows the aggregate weighted preference function = (Ma, Mb)

Standards	(P) Min	(R) Max	(Dd) Max	(B) Max	(NP) Max	(Ss) Max	(W) Min	Aggregate weighted preferences
Weights	0.07	0.3	0.15	0.1	0.25	0.1	0.03	
Discretionary Variations "Alt 1"								AWP
Wj *D(M1-M2)	0	0	0	0	0	0	0.35772	0.357724
Wj *D(M1-M3)	0	0.1428	0.14678	0.26316	0	0.23809	0.11382	0.904723
Wj *D(M1-M4)	0.582	0	0	0	0	0	0	0.582878
Wj *D(M1-M5)	0.366	0	0	0	0	0	1	1.366473
Wj *D(M1-M6)	0	0.0714	0.14678	0.35088	0	0	0.74796	1.317065
Wj *D(M1-M7)	0	0	0	0.4386	0	0	0.26016	0.698763
Wj *D(M1-M8)	0	0	0	0.19298	0.42857	0	0.58536	1.206923
Discretionary Variations "Alt 2"								AWP
Wj *D(M2-M1)	0.148	0.2857	0.27981	0.08772	0	0	0	0.80195
Wj *D(M2-M3)	0.115	0.4285	0.42660	0.35087	0	0.23809	0	1.559521
Wj *D(M2-M4)	0.7315	0	0.27981	0	0	0	0	1.011394
Wj *D(M2-M5)	0.515	0	0	0	0	0	0.64227	1.157448
Wj *D(M2-M6)	0	0.3571	0.42660	0.43859	0	0	0.39024	1.612588
Wj *D(M2-M7)	0	0.2857	0	0.52631	0	0	0	0.81203
Wj *D(M2-M8)	0	0.2857	0	0.28070	0.42857	0	0.22764	1.222629
Discretionary Variations "Alt 3"								AWP

Wj *D(M3-M1)	0.033	0	0	0	0	0	0	0.033327
Wj *D(M3-M2)	0	0	0	0	0	0	0.24390	0.243903
Wj *D(M3-M4)	0.616	0	0	0	0	0	0	0.616205
Wj *D(M3-M5)	0.399	0	0	0	0	0	0.88617	1.285979
Wj *D(M3-M6)	0	0	0	0.08772	0	0	0.63414	0.721866
Wj *D(M3-M7)	0	0	0	0.17543	0	0	0.14634	0.321781
Wj *D(M3-M8)	0	0	0	0	0.42857	0	0.47154	0.900116
Discretionary Variations "Alt 4"								AWP
Wj *D(M4-M1)	0	0.2857	0	0.36842	0.57142	0.76190	0.91869	2.906169
Wj *D(M4-M2)	0	0	0	0.28070	0.57142	0.76190	1.27642	2.890459
Wj *D(M4-M3)	0	0.4285	0.14678	0.63157	0.57142	1	1.03252	3.810888
Wj *D(M4-M5)	0	0	0	0	0	0	1.91869	1.918699
Wj *D(M4-M6)	0	0.3571	0.14678	0.71929	0.57142	0.76190	1.66666	4.22323
Wj *D(M4-M7)	0	0.2857	0	0.80701	0.57142	0	1.17886	2.843023
Wj *D(M4-M8)	0	0.2857	0	0.56140	1	0	1.50406	3.351183
Discretionary Variations "Alt 5"								AWP
Wj *D(M5-M1)	0	0.8571	0.85321	0.56140	0.57142	0.76190	0	3.605092
Wj *D(M5-M2)	0	0.5714	0.57339	0.47368	0.57142	0.76190	0	2.951841
Wj *D(M5-M3)	0	1	1	0.82456	0.57142	1	0	4.39599
Wj *D(M5-M4)	0.216	0.5714	0.85321	0.19298	0	0	0	1.834027
Wj *D(M5-M6)	0	0.0113	1	0.91228	0.57142	0.76190	0	3.256952
Wj *D(M5-M7)	0	0.1670	0.57339	1	0.57142	0	0	2.311862
Wj *D(M5-M8)	0	0	0.57339	0.75438	1	0	0	2.32778
Discretionary Variations "Alt 6"								AWP
Wj *D(M6-M1)	0.4057	0	0	0	0	0	0	0.405785
Wj *D(M6-M2)	0.2570	0	0	0	0	0	0	0.257086
Wj *D(M6-M3)	0.3724	0.0714	0	0	0	0.23809	0	0.681982
Wj *D(M6-M4)	0.9886	0	0	0	0	0	0	0.988663
Wj *D(M6-M5)	0.7722	0	0	0	0	0	0.25203	1.024291
Wj *D(M6-M7)	0.15570	0	0	0.08771	0	0	0	0.243421
Wj *D(M6-M8)	0	0	0	0	0.42857	0	0	0.428571

Discretionary Variations "Alt 7"								AWP
Wj *D(M7-M1)	0.2500	0	0.27981	0	0	0.76190	0	1.291805
Wj *D(M7-M2)	0.1013	0	0	0	0	0.76190	0.09756	0.96085
Wj *D(M7-M3)	0.2167	0.1428	0.42660	0	0	1	0	1.786219
Wj *D(M7-M4)	0.8329	0	0.27981	0	0	0	0	1.112778
Wj *D(M7-M5)	0.6165	0	0	0	0	0	0.73983	1.356393
Wj *D(M7-M6)	0	0.0714	0.42660	0	0	0.76190	0.48780	1.747743
Wj *D(M7-M8)	0	0	0	0	0.42857	0	0.32520	0.753774
Discretionary Variations "Alt 8"								AWP
Wj *D(M8-M1)	0.4171	0	0.27981	0	0	0.76190	0	1.458844
Wj *D(M8-M2)	0.2684	0	0	0	0	0.76190	0	1.030328
Wj *D(M8-M3)	0.3837	0.1428	0.42660	0.07017	0	1	0	2.023433
Wj *D(M8-M4)	1	0	0.27981	0	0	0	0	1.279817
Wj *D(M8-M5)	0.7835	0	0	0	0	0	0.41463	1.198229
Wj *D(M8-M6)	0.0113	0.07142	0.42660	0.15789	0	0.76190	0.16260	1.591772
Wj *D(M8-M7)	0.1670	0	0	0.24561	0	0	0	0.412653

Source: Prepared by researchers according to the "Promethee" method.

Step 05: Create an aggregated weighted preferential functional matrix: This is done in two ways, namely:

– **The order of the best choice for laptops using the method "PROMETHEE 1:**

In this step a matrix (n * n) is prepared, where " n " represents the number of alternatives, and the highest rank is calculated through the partial arrangement method "PROMETHEE1", depending on the two equations on As follows:

$$\varphi^+(i) = \frac{1}{n-1} \sum_{i'=1}^n \pi(i', i), (i \neq i')$$

$$\varphi^-(i) = \frac{1}{n-1} \sum_{i'=1}^n \pi(i', i), (i \neq i')$$

Where (n) represents the number of alternatives, from here the partial order "PROMETHEE1" is obtained from the positive and negative higher order flows, according to the following three conditions:

$$aP^1b \quad \text{iff} \begin{cases} \varphi^+(a) > \varphi^+(b) \text{ and } \varphi^-(a) < \varphi^-(b), \text{ or} \\ \varphi^+(a) = \varphi^+(b) \text{ and } \varphi^-(a) < \varphi^-(b), \text{ or} \\ \varphi^+(a) > \varphi^+(b) \text{ and } \varphi^-(a) = \varphi^-(b); \end{cases}$$

$$aI^1b \quad \text{iff} \{ \varphi^+(a) = \varphi^+(b) \text{ and } \varphi^-(a) = \varphi^-(b); \}$$

$$aR^1b \quad \text{iff} \begin{cases} \varphi^+(a) > \varphi^+(b) \text{ and } \varphi^-(a) > \varphi^-(b), \text{ or} \\ \varphi^+(a) < \varphi^+(b) \text{ and } \varphi^-(a) < \varphi^-(b); \end{cases}$$

The following table shows that:

Table 7. shows the weighted preferential aggregate matrix

alternatives	Variant 1	Variant 2	Variant 3	Variant 4	Variant 5	Variant 6	Variant 7	Variant 8	φ^+
Variant 1	-	0.357724	0.904723	0.582878	1.366473	1.317065	0.698763	1.206923	6.434549
Variant 2	0.80195	-	1.559521	1.011394	1.157448	1.612588	0.81203	1.222629	8.17756
Variant 3	0.033327	0.243903	-	0.616205	1.285979	0.721866	0.321781	0.900116	4.123177
Variant 4	2.906169	2.890459	3.810888	-	1.918699	4.22323	2.843023	3.351183	21.94365
Variant 5	3.605092	2.951841	4.39599	1.834027	-	3.256952	2.311862	2.32778	20.68354
Variant 6	0.405785	0.257086	0.681982	0.988663	1.024291	-	0.243421	0.428571	4.029799
Variant 7	1.291805	0.96085	1.786219	1.112778	1.356393	1.747743	-	0.753774	9.009562
Variant 8	1.458844	1.030328	2.023433	1.279817	1.198229	1.591772	0.412653	-	8.995076
φ^-	10.50297	8.692191	15.16276	7.425762	9.307512	14.47122	7.643533	10.19098	83.39692

Source: Prepared by researchers according to the "Promethee" method.

– The order of choosing the best laptops using the "PROMETHEE 2" method:

In this stage a matrix (n*n) is prepared, where "n" represents the number of alternatives, and the following table shows that:

Table 8. shows the weighted preferential aggregate matrix

alternatives	Variant 1	Variant 2	Variant 3	Variant 4	Variant 5	Variant 6	Variant 7	Variant 8	φ^+
Variant 1	-	0.0511	0.1292	0.0832	0.1952	0.1881	0.0998	0.1724	0.9192
Variant 2	0.1145	-	0.2227	0.1444	0.1653	0.2303	0.1160	0.1746	1.1682
Variant 3	0.0047	0.0348	-	0.0880	0.1837	0.1031	0.0459	0.1285	0.5890
Variant 4	0.4151	0.4129	0.5444	-	0.2741	0.6033	0.4061	0.4787	3.1348
Variant 5	0.5150	0.4216	0.6279	0.2620	-	0.4652	0.3302	0.3325	2.9547
Variant 6	0.0579	0.0367	0.0974	0.1412	0.1463	-	0.0347	0.0612	0.5756
Variant 7	0.1845	0.1372	0.2551	0.1589	0.1937	0.2496	-	0.1076	1.2870
Variant 8	0.2084	0.1471	0.2890	0.1828	0.1711	0.2273	0.0589	-	1.2850
φ^-	1.5004	1.2417	2.1661	1.0608	1.3296	2.0673	1.0919	1.4558	-

Source: Prepared by researchers according to the "Promethee" method.

Step Six: Calculating the net flow of the higher order using the “PROMETHEE 2” method: In this step, the net flow of the higher order, i.e., the full arrangement method “PROMETHEE 2”, is calculated according to the following equation:

$$\varphi(i) = \varphi^+(i) - \varphi^-(i)$$

Where the value of $\varphi(i)$ is used to rank all the alternatives, the higher the value of $\varphi(i)$ indicates that the alternative is better than the alternative with the lower value $\varphi(i)$, so the best alternative is the alternative that has the highest value of $\varphi(i)$.

Table 9. shows the net flow and arrangement of alternatives (laptops)

alternatives	φ^+	φ^-	Net flow φ	ranking	alternate name
Variant 1	0.91922	1.50042	-0.5812	6	Lenovo ThinkPad X1 Carbon
Variant 2	1.16822	1.24174	-0.07352	4	Asus ZenBook Duo 14
Variant 3	0.58902	2.16610	-1.57708	8	HP Elite Dragonfly
Variant 4	3.13480	1.06082	2.073984	1	Alienware m15 R4
Variant 5	2.95479	1.32964	1.625147	2	Dell XPS 15
Variant 6	0.57568	2.06731	-1.49163	7	Acer Swift 3(AMD)
Variant 7	1.28708	1.09193	0.195147	3	Dynabook Toshiba Satellite Pro L50
Variant 8	1.28501	1.45585	-0.17084	5	Samsung Galaxy Book

Source: Prepared by researchers according to the "Promethee" method.

Analysis of the preference arguments for alternatives: Through the results obtained through Table No. (09), the best alternative is extracted among the other alternatives on the basis of the three conditions mentioned previously in the fifth step, and the table shows the following results:

Table 10. shows the analysis of the preferential media

Variant 1 M1 P M3; M1 P M6	Variant 2 M2 P M1; M2 P M3; M2 R M5; M2 P M6 ; M2 R M8;	Variant 3 M3 R M6	Variant 4 M4 PM1; M4 PM2; M4 PM3; M4 PM5; M4 PM6; M4 P M7; M4 P M8.
Variant 5 M5 P M1; M5 R M2; M5 P M3; M5 P M6; M5 R M7; M5 P M8.	Variant 6 M6 R M3	Variant 7 M7 P M1; M7 P M2; M7 P M3; M7 R M5; M7 P M6; M7 P M8.	Variant 8 M8 P M1; M8 R M2; M8 P M3; M8 P M6;

Source: Prepared by researchers according to the "Promethy" method.

We note from Table No. (10) that the obtained flow provides a complete arrangement, and its advantages are that it depends on clear and simple preferential information and depends on the comparative data instead of the absolute and order data. To select the two options in favor of those who preferred the two options, "Alternative 4" (Alienware m15 R4) was found to have the advantage over all other alternatives.

4. CONCLUSION

At the conclusion of our study, we can say that the "Prometh" method gave the required result and made it easier for the consumer to know the best "laptop" product based on multiple criteria and multiple options for these products and characteristics, which in fact reflects the great acceleration of the technological world, and gave the PROMETHEE method "the tools that treat A problem that worries many because of the increasing technological needs and consumer requirements and this by ranking products without exception and on the basis of quantity and quality criteria, in addition, this study presented a good preference based on criteria agreed upon by the

majority of consumers for laptops and the most unanimous by professionals in The market for 2021, and in general, the result obtained can be determined by saying that the preference among the available alternatives was in favor of the fourth alternative, and that the order of the alternatives is as follows: 1- “Alienware m15 R4”, 2- “Dell XPS 15”, 3- “Dynabook Toshiba Satellite Pro L50”, 4- “Asus ZenBook Duo 14”, 5- “Samsung Galaxy Book”, 6 “Lenovo ThinkPad X1 Carbon” , 7-"Acer Swift 3(AMD)", 8-"HP Elite Dragonfly".

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