ANALYZING AND MEASURING THE VALUE OF HUMAN RESOURCES USING VRIN ARCHITECTURE AND EXPONENTIAL INTEGRAL FUNCTION

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**Abstract.** The human resource is unique and may bring performance for organizations if these may know from time if it is valuable, rare, inimitable, or non-substitutable. To determine its value, the organizations must implement some specific programs, economical, statistical, and mathematical, as VRIN architecture. To calculate its value, there were used integral calculations, due to their graphic resambling (the exponential increasing for VRIN elements). The study is presenting the literature in the field, the importance of VRIN architecture and then is made a research based on using a mathematical function which may help practitioners and HR specialists to determine the value of human resources, to motivate and develop these resources. The advantages of using these two models are very important, cost-efficient and may contribute of growing individual and organizational performance.

**Keywords:** human resource, competitive advantage, VRIN architecture, integral function, performance.

1. INTRODUCTION

Mathematical modeling may be applied in many fields, including in human resources management. In our article is used the exponential integral function and VRIN architecture, which follows the same trend as this mathematical function. The resources refer to the assets of a company, and can be tangible (physical entities: land, buildings, equipment, inventory, and money), intangible (brand names, the reputation, knowledge of employees gained through experience, technology (patents, trade secrets) [1] and human (skills/know-how, capacity for communication and collaboration, motivation) [2]. Human resources are the only one which can produce and reproduce all the other resources [3]. Every employee is having its own knowledge, skills, and attitudes form the Knowledge Society [4]. Using exponential integral function, the organizations may improve human resources processes such as: training and development [5, 6], learning by using valuable resources [7] and strong principles as social responsibility [8], not-discrimination and ethics, recruitment and selection based on using simulation and mathematical models [9], communication between employees and managers using simulation [10-12] and based on relationship [13], or evaluation process, because performance is what matter in an organization [14].

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Human resources are an invaluable and intangible resource of the organization. The resource-based view emphasizes on VRIN approaches [15, 16]. The VRIN concept was developed by Barney J. in 1991 and argues that competitive advantage is attributable to those resources which are valuable, rare, inimitable, and nonsubstitutable [17]. The framework proposed is envisioned as providing organizing mechanisms for exploiting the potential of resources. Company-level orientation, strategy, and context are important characteristics of a company because they encourage a general and unified approach to the utilization of resources. Customer orientation is a company-level orientation that mobilizes resources, across a company, toward a common goal of understanding and serving customers. VRIN model predicts the attributes of resources, if they are indeed VRIN than the relationship between the personnel and the customers may last for a long time [18]. The performance may be obtained through its resources if they are VRIN by implementing fresh value-creating strategies that cannot be easily duplicated by competing firms [19].

Resources that can be evaluated using VRIN analysis: reputation, image, employees, recruitment process, relationships with communities, social and biodiversity supply chain, organizational culture or access to imputs [20], engineering, human interfering [21].

2. MATERIALS AND METHODS

2.1. ABOUT VRIN APPROACH AND FRAMEWORK

The specialists in the field add that VRIN approach based on resources, analyse the way an organization can obtain sustained competitive advantage. If an organization has the human resources according to VRIN architecture, they may achieve competitive advantage [22]. These must have the following characteristics [23]:

Valuable – are those resources that an organization has and help it to generate revenues by captalising opportunities and reduce costs by neutralising the threats [24]. Exmples of valuable capabilities: the ability to generate a strong relationship with a public organization, the ability to provide a very good quality for after-sale service offered for customers, the ability to increase market share, achieve a cost advantage or charge a premium price [25]. The value question- do the respective resources and abilities of a company permit an adequate reaction to opportunities and threats from the company environment? Answering yes means, that the resource is valuable forthe company [26]. The resource add value? [27]. Does a strength enable your organization to take advantage of an external opportunity or counter an external threat? If not, this strength can potentially hamper your organization. The „V” dimension requires that a resource be valuable in the sense that it enables a firm to conceive of and implement strathies that improve its efficiency and effectiveness [28].

Rare – are those resources possessed exclusively by a firm or by a few others from the industry. Examples of rare capabilities: capability derived out of an exclusive location or the presence of a highly satisfied and motivated workforce.

The rarity question – are only a few competitors in possession of the respective resources or abilities? If yes, the resource is rare [26]. How rare is the resource? [27]. I your strenght one which few organizations in your domain or niche have access to? Is your organization one that can lead and accomplish projects that no other similar organizations or individual can? What is unique and distinctive about your strenght? [29]. The „R” dimension requires to identify heterogenous resources that can be sources of temporary competitive advantage because they are rare and impossible for others to obtain [28].

Inimitable – are those resources possessed by the firm that are impossible, very difficult or not worthwhile to duplicate or substituted by the competition. The competence must be hard to imitate and hard to copy. A long-term strategy must be based on something that competitors cannot quickly copy [30]. To be inimitable the resources can be mixed over time to form a unique work culture, the results of a team cannot be easily traced back to individual contributions, social complexity may appear in special relationships, and human capital is not perfectly mobile [31]. Examples of inimitable capabilities: a favourable corporate image or the ability to acquire and integrate new businesses. The imitability question- is it impossible, or hardly possible for competitors to imitate resources and abilities of a company? [26]. Can other organizations that lack this strength build it up without a major investment in resources? [29]. How quickly the resource may be immitated? [27]. The „I" dimensions is intended to identify heterogenous valuable resources that offer firms will not be able to imitate or acquire in resource factor markets [28].

Non-substitutable – the focus being on value creation [32] and obtaining competitive advantage, this approach is resources-based and seeks to maintain and motivate those resources which became non-substitutable for organization [33], [34]. It is not possible to find a substitute of human resources, except by other valuable, rare, inimitable, and non-substitutable resources like technology in a limited leaning. Non-substitutability is lower for top management and higher for operatives [31]. Resources should be resistent to substitution. Substitutability can be of two forms [35]: a firm may be able to substitute a similar resource that enables it to develop the same startegy as its rival; a firm can substitute a very different resource that has the same effect over the long run. This means that if a resource is non-substitutable can sustain competitive advantage on long term.

Non-substitutability do not have startegic aquivalents [36]. Limitations on substituing the resource with an alternative that is capable of delivering the same outcome [37]. A resource to be non-substitutable means othe different types of resources cannot functional substitutes [38]. Not all the resources are VRIN, they can be only core resources and they help organization just to participate on the marketplace [37]. VRIN is depending on the company environment where it is acting [39]. Even if a resource is VRI, an equally important aspect is lack of substitues. If competitors are able to counter the firm's value-creating startegy with a substitute, prices are driven down to the point where profits are zero. A crucial part of the VRIN framewirk is to identify important barriers to entry, which can create disadvantages for new competitors attempting to enter the market [40].

2.2. THE ORGANIZATION OF VRIN ARCHITECTURE

The resources themselves do not confer any advantage for organizations if they are not organized to capture the value from them. A firm must organize its management systems, processes, policies, structure and culture to be able to realize the potential of its valuable, rare, inimitable and non-substitutable resources [36] (Table 1).

Organized resources are those resources possessed by a firm that could be used through approproiate organizational structure, business process, control systems and reward systems that are present in the firm. Examples of a firm which can organise its resources: the availability of competent R&D personnel and research laboratoires to innovate new and improved products continually or the availability of potential business partners who are competent and willing to integrate their information systmes with that of the firm. A business must be capable of taking advantage of the resource. Even if the resource is VRI, the business must be able to exploit it, otherwise it is of little use [25].

Table 1. Implications and performance for VRIN approach [41-43].

Are the capabilities valuable?	Are the capabilities rare?	Are the capabilities costly to imitate?	Are the capabilities organised or hard to substitute for usage?	Competitive implications	Organization performance	Are the capabilities strengths or weaknesses?
No	-	-	-	Competitive dizadvantage	Under average	Weaknesses
Yes	No	-	-	Competitive parity	Average	Strength
Yes	Yes	No	-	Temporary competitve advantage	Above average	Strength and distinctive competence
Yes	Yes	Yes	No	Sustained competitive advantage	More above average	Strength and sustainable distinctive competence
Yes	Yes	Yes	Yes	Core competency	Above average in long term	Strength and sustainable distinctive competence

The organization question – Is a company organised in such a way that its valuable, rare and unimitable resources and abilities can be optimally exploited?If the answer is yes, the highest possible manifestation of a competitive advantage for the respective resource or ability has been achieved [26]. Does your organization have the capabilities in place to use this strength to its full potential? [29]. The „O" dimensions is intended to identify which heterogenous valuable resources also make it possible for a firm to sustain any competitive advantage derived from its heterogenous resources [28].

VRIN framework suggests that only resources and capabilities that are valuable, rare, inimitable, and organizationally embedded will generate sustainable competitive advantage. Non-value-adding resources and capabilities may become weaknesses instead of strengths; valuable but common resources will lead to parity competitive advantage, and may become source of competitive advantage if they are difficult for competitors to imitate [44].

Resources are potentially valuable assets and people that are semi-permanently attached to a firm. Some of these resources are VRIN, and to keep this status, they maust be constantly renewed. The need for renewal is amplified in fast-moving environments such as those characteristics of high-tech sectors, but also occurs in low-tech industries [45].

2.3. RESEARCH METHODOLOGY- ANALYZING THE VRIN ARCHITECTURE EVOLUTION ACCORDING TO AN INTEGRAL FUNCTION

Be

$$f \div \Re \rightarrow (0, \infty), f(x) = a^x, \text{ where, a>0, } a \neq 1 \qquad (1)$$

In our case we choose the exponential function, e^x. This function is an irrational and transcendent number, with the derivate $f(x) = e^x$.

The exponential function is increasing slowly for negative values of x, and is increasing rapidly for positive values of x; is equal to 1 when x is 0. The value of y is always equal to skewness in that point (Fig. 1)
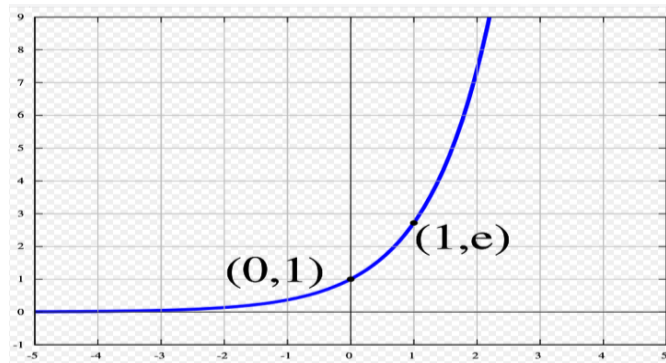
Figure 1. The graphic representation of exponential function.

The inverse of the function is the natural logarithm. The e number is called the number of Euler or constant of Napier and its value is $e \approx 2.71828...$ The exponential function

$$f(x) = e^x \tag{2}$$

is important partially because is the only untriviate function (till the multiplication with a constant) which is own derrivate, and thus its own primitive:

$$\frac{d}{dx} \cdot e^x = e^x \tag{3}$$

and

$$e^x = \int_{-\infty}^{x} e^t dt = \int_{-\infty}^{0} e^t dt + \int_{0}^{x} e^t dt = 1 + \int_{0}^{x} e^t dt \tag{4}$$

The VRIN approach only identifies strategically valuable resources and positive ones. It is unable to uncover weaknesses and gaps. But their identification and elimination can be strategically as important as the maintenance and buildup of strengths [46]. If it maneged badly, by unskilled specialists will bring no benefits for organizations [36].

Starting from these statements, we developed a model necessary for determining the value of human resources based on VRIN approach. We supposed from our experience, practical and theoretical, that resources, starting from valuable, rare, and gowing to inimitable and then to non-substitutable, are growing exponentially. Comparing the graphic reprsentation of VRIN resources and the graphic representation for integral calculus, we observe that they are very similar (Fig. 2).
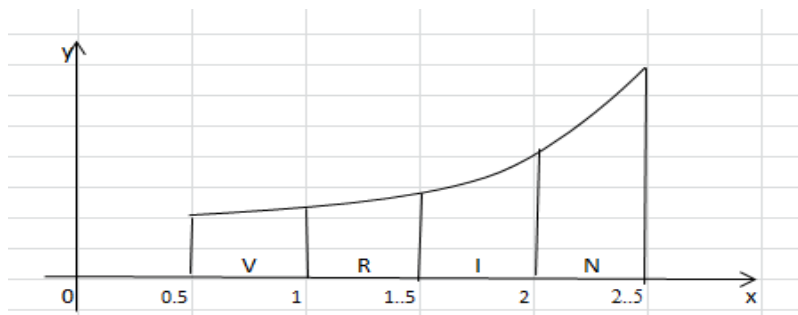

Figure 2. VRIN surfaces and the integral function graph.

In this respect was choosen the borderline interval for VRIN architecture and the integral function between [0.5; 2.5]. VRIN architecture is having limitation between 0.5 and

2.5, as: [0.5; 1] for V, [1; 1.5] for R, [1.5; 2] for I, and [2; 2.5] for N. We denote as I, the definite integral of function f on the interval [0.5; 2.5], and is noted as:

$$\int_{0,5}^{2,5} f_x d_x \qquad (5)$$

where 0.5 and 2.5 are the integration limits, [0.5; 2.5] being the integration interval, variable x is the integration variable.
Be

$$f : [0.5; 2.5] \rightarrow R \qquad (6)$$

then, according to Riemann theorem, f is integrable on [0.5; 2.5]. So, if f is continuous and integrable on [0.5; 2.5], then f is bounded by the range [0.5; 2.5].

The increasing of each element of VRIN architecture is exponential, thus, the area of the VRIN surfaces and the integral function is:

$$\int_{0,5}^{2,5} e^x dx = e^x + C \qquad (7)$$

Thus, we make some calculation, and than we proposed to determine the value of human resources.

3. RESULTS AND DISCUSSION

Using the integral function and unifying its graphic representations with VRIN architercture we followed the next rule: the value of human resource is increasing exponentially from V- valuable, to N- nonsubstitutable. Were chosen by the authors the next exponential values, as achieving three levels: $e^{x/3}$ (considered by the authors as the weakest value), $e^{x/2}$ (considered as the averarage value), and e^x (considered as the excelent value); all the three levels are applied for each VRIN resource.

1. Calculations made for V

- the weakest value

$$\int_0^{0.5} e^{\frac{x}{3}} dx = 3(e^{0.166665} - 1) = 0.54408064 \qquad (8)$$

- the average value

$$\int_0^{0.5} e^{\frac{x}{2}} dx = 2(e^{0.25} - 1) = 0.56805083 \qquad (9)$$

- the excelent value

$$\int_0^{0.5} e^x dx = e^{0.5} - 1 = 0.64872127 \qquad (10)$$

2. Calculations made for R

- the weakest value

$$\int_{0.5}^{1} e^{\frac{x}{3}} dx = 3(e^{0.333333} - e^{0.166665}) = 0.64276054 \tag{11}$$

- the average value

$$\int_{0.5}^{1} e^{\frac{x}{2}} dx = 2(e^{0.5} - e^{0.25}) = 0.72939170 \tag{12}$$

- the excelent value

$$\int_{0,.}^{1} e^{x} dx = e - e^{0.5} = 1.06956055 \tag{13}$$

3. Calculations made for I

- the weakest value

$$\int_{1}^{1.5} e^{\frac{x}{3}} dx = 3(e^{0.5} - e^{0.333333}) = 0.75932793 \tag{14}$$

- the average value

$$\int_{1}^{1.5} e^{\frac{x}{2}} dx = 2(e^{0.75} - e^{0.5}) = 0.93655749 \tag{15}$$

- the excelent value

$$\int_{1}^{1.5} e^{x} dx = e^{1.5} - e = 1.76340724 \tag{16}$$

4. Calculations made for N

- the weakest value

$$\int_{1.5}^{2} e^{\frac{x}{3}} dx = 3(e^{0.666666} - e^{0.5}) = 0.89703441 \tag{17}$$

- the average value

$$\int_{1.5}^{2} e^{\frac{x}{2}} dx = 2(e - e^{0.75}) = 1.20256362 \tag{18}$$

- the excelent value

$$\int_{1,5}^{2} e^{x} dx = e^{2} - e^{1.5} = 2.90736702 \tag{19}$$

Putting all the calculated values for VRIN on the three performance levels was obtained Table 2.

Table 2. VRIN architecture and its three performance levels.

The architecture	Weakest	Average	Excelent	Total
V	0.5440	0.5680	0.6487	1.7608
R	0.6427	0.7293	1.0695	2.4417
I	0.7593	0.9365	1.7634	3.4592
N	0.8970	1.2025	2.9073	5.0069
Total	2.8932	3.4365	6.3890	12.6688

3.1. FIRST CASE - VRIN REPRESENTED FOR EACH LEVEL OF PERFORMANCE

Representing the three performance levels of value for VRIN architecture it observes the rythm for each resource is different: is increasing exponentially from V to N, in a different manner for each level of performance. So, for the weakest level of performance is obtained the following graphic representation, according to the table above (Fig. 3).
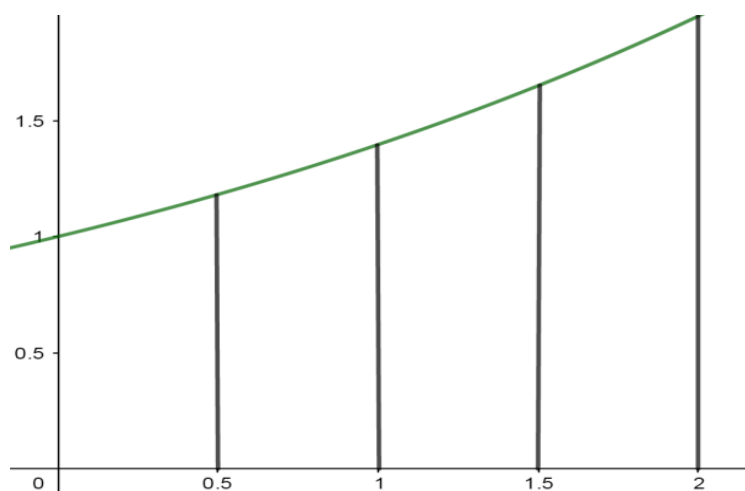
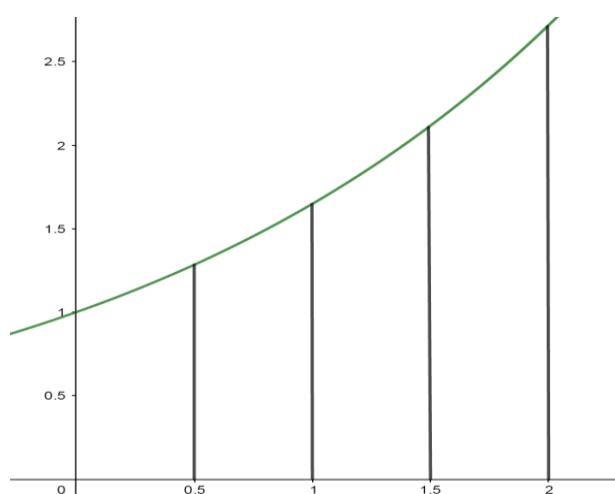**Figure 3. VRIN architecture for weakest level, $f(x) = e^{0.33x}$.**

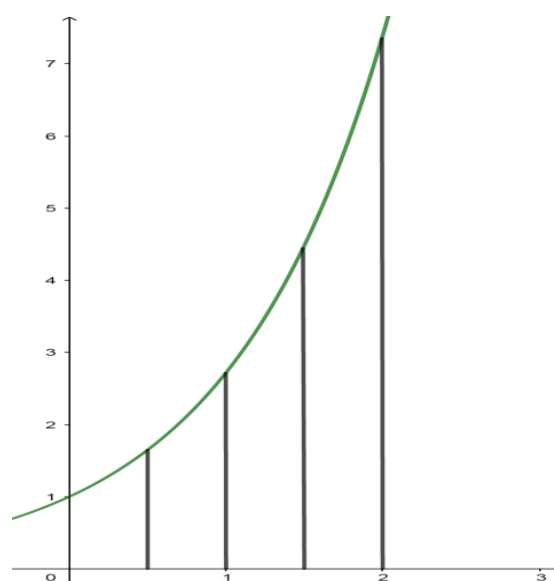**Figure 4. VRIN architecture for average level, $f(x) = e^{0.5x}$.**

Figure 5 .VRIN architecture for excelent level, $f(x) = e^{x}$.

Finally, it observes that the value is increasing slowly for VRIN architecture at the weakest level. For the average level of performance is obtained the following graphic representation, according to the table above (Fig. 4).

From Fig. 4, it can be seen that the value is increasing more rapidly at the average level for VRIN architecture. For the excelent level of performance is obtained the following graphic representation, according to the table above (Fig. 5).

Making the entire representation for the VRIN architecture at the three levels of performance (Fig. 6), are observed the differences between them. This we help us to make another representation, for each architecture element, in order to observe and propose improvements for human resource processe.
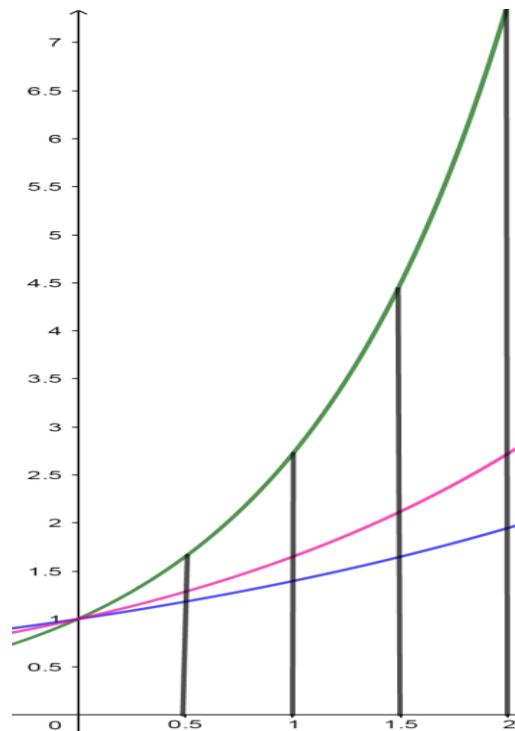

Figure 6. VRIN architecture for each level of performance- weakest (blue line), average (red line), and excellent (green line).

It was observed that the values obtained by each element of VRIN and its three levels, are increasing and the excelent for each element is matching with the first or the second value for the next element. Thus, we can make some proposals for improvement, at individual or organizational level.

3.2. SECOND CASE- EACH VRIN ELEMENT IS REPRESENTED FOR THE THREE LEVELS OF PERFORMANCE

The representation for V (valuable resource)

Making the graphic representation for valuable resource at the three performance levels is obtained (Fig. 7). For example, this representation is necessary for human resources managers in the process of career management.
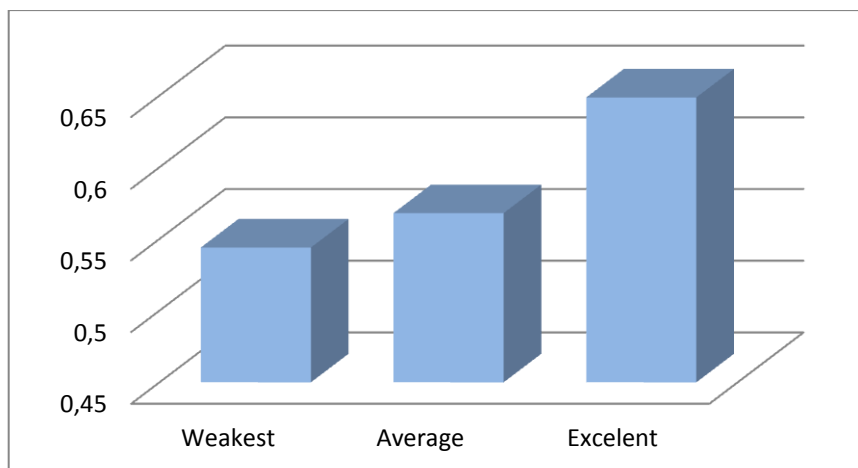
Figure 7. The graphic representation for valuable resource

Thus, the managers could observe using this model, that a valuable resource if it has the excelent value from the valuable category, an employee could be proposed to become a rare resource because its value is higher then the rare resource at the weakest level of performance (Vve=0.6497>Vrw=0.6427).

Thus, it could obtain a higher position in the organization and a better salary. The employee will be motivated in this way to be more responsible and obtain a better performance.

The representation for R (rare resource)

Making the graphic representation for rare resource at the three performance levels is obtained (Fig. 8).
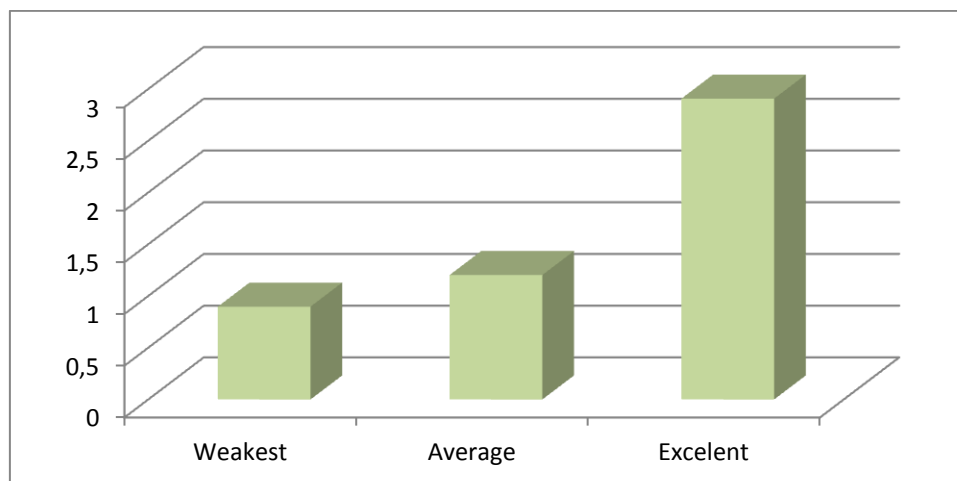

Figure 8. The graphic representation for rare resource

The same thing is observed for Vre=1.069 which is higher than Viw=0.759, and thus the rare resource with an excelent performance could become a hard to imitate resource at the average level or even close to excelent level.

The representation for I (inimitable resource)

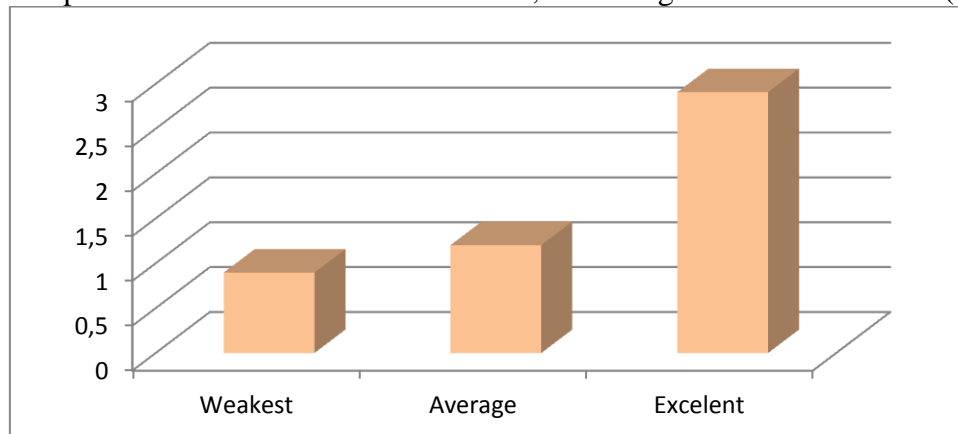The representation for inimitable resources, according to our calculation is (Fig. 9):

Figure 9. The graphic representation for inimitable resource

Therefore, for Vie=1.76 which may become a non-substitutable resource between average level and the excelent one (1.202 – 2.907).

The representation for N (non-substitutable resource)

Making the representation for the last resource is obtained (Fig. 10).
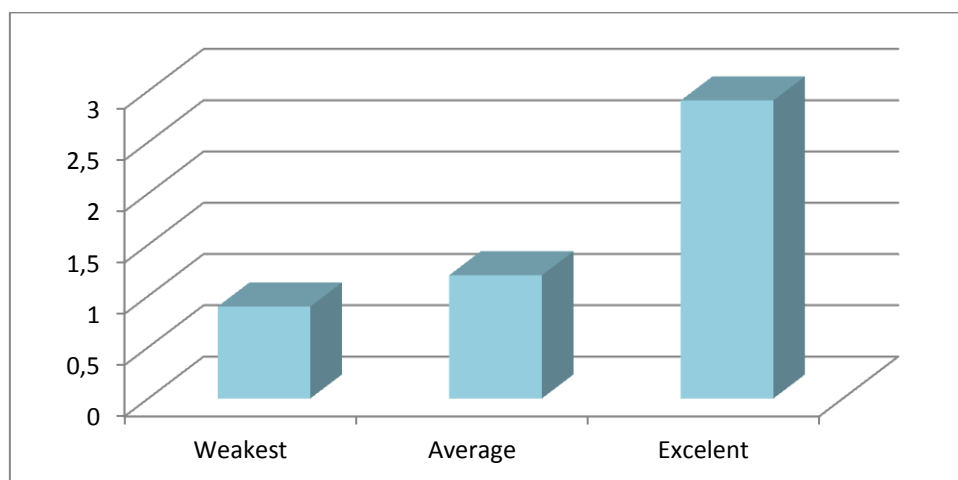

Figure 10. The graphic representation for non-substitutable resource

Fig. 10 shows that the value for non-subtitutable resource at excelent performance is very high comparing with the other two levels (the excelent level for the nonsubstitutable resource is very high - 2.9 compared to the weakest level - 0.89 and the average level - 1.2). Thus, this resource, obtaining such a performance may obtain even an executive function. Thus, the motivation will increase and the recruitment process for a middle function may be done from internal sources, reducing the costs and increasing the total performance.

4. CONCLUSIONS

The VRIN architecture may help organizations and especially the human resource managers in order to increase performance. The benefits for organizations may be: simulate employees' performance using mathematical models (as exponential integral function); improve internal recruitment process; improve development and training for employees with the weakest performance values; improve career management process; improve communication between employees and managers; improve performance evaluation process; improve activity based on strong principles such as: not-discrimination, social responsibility, and sustainable development principles; bring the right employee at the right place in internal recruitment process for execution and management functions.

Applying mathematical modeling, especially this model, the organization may bring the right employee at the right position (according to the non-discrimination principles and based on performance not on a-priori characteristics) and thus, the employee could obtain better individual performance and implicitly organizational due to financial and nonfinancial motivation. Another example of implementing this architecture and integral function is for development and training: for resources with the weakest values (be it V, R, I, or N resource) the evaluator, which must be very objectives, must send them to training, and after six month, when is taking place another performance evaluation, the employee if it is not obtaining a better performance and a higher performance level, the employee will be downgraded till the value specific for a performance levelor in other situations the employee will be not kept into the organization.

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