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IMPROVING THE DECISION MAKING PROCESS TROUGHT THE PARETO PRINCIPLE APPLICATION

Abstract

*Vilfredo Pareto (*1848 – 1923) *was studying the inequality of welfare distribution in Italy during the nineteenth century and developed a useful tool named „the principle 80:20", which was later adopted in many fields to explain that a small number of causes can be responsible for a large percentage of effects. The principle can be applied to indicate the priority of problem solving and determine the direction of business drivers' development. Separating the vital few from the trivial many, the management staff can improve firm performance. This paper, in particularly links the Pareto principle postulates to the decision making techniques and proposes different points of view for improving the purchasing process in a particular firm. The firm Mix Metal is a small trader in iron scrap present on the Croatian market since 2004. In this case the Pareto principle is adopted to rationalize the purchasing process and ensure better long term sales margins. The aim of the paper is to develop several points of view from which the root causes arise and problems can be interpreted. In particularly the paper tries to find for which suppliers and which types of material, the purchasing process must be reviewed and even end. The case is developed and presented using the case study methodology.*

Key words: decision making process, supply chain management, Pareto principle

1.   INTRODUCTION

A manager plans, organizes, staffs, leads, and controls teams by executing decisions. The efficiency and effectiveness of those decisions determine how successful a manager will be. Decision making and problem solving are ongoing processes of evaluating situations or problems, considering alternatives, making choices, and following them up with the necessary actions. Sometimes the decision making process is extremely short, and mental reflection is essentially instantaneous. In other situations, the process can drag weeks or even months. The decision making process begins when a manager identifies problem symptoms. An accurate definition of the problem affects all the steps that follow; if the problem is inaccurately defined, every step in the decision making process will be based on an incorrect starting point. Symptoms indicate that something is wrong with the company, but root causes are not identified. A successful manager doesn't just attack symptoms; she or he works to uncover the factors that cause these symptoms. Time pressures frequently suggests to a manager to move forward after considering only the first or most obvious answers. Thus, a manager should think through and investigate several alternative solutions before making a quick decision, because effective decisions make profit to the company while unsuccessful ones cause losses.

Many tools are suggested and used to improve the outcomes of the decision making process, such as the use of a brainstorming or dephi method, the involvement of lower level partecipants and so on. The objective of this paper is to examine the applicability of the Pareto principle 80:20 on the decision making process.

The aim of the paper is to develop several points of view from which root causes arise and problems can be interpreted.

Vilfredo Pareto was a philosopher and an economist born in France (1848) and died in Switzerland (1923), but most of his life he spent in Italy. As one of the most famous philosophers and mathematicians at the beginning of the twentieth Century, his studies had a big impact on the subsequent development of mathematical theories and models.

One of the most mentioned contributions, known as the Pareto principle 80:20, arises from an observation of unequal wealth distribution among Italian society members, which resulted in social classes formation. He applied the 80:20 principle to explain how 80% of property in Italy was owned by only 20% of the country's population.

Nowadays, the inequality of wealth distribution is measured by the human development index known as the *Gini coefficient*. The Gini coefficient is a number between 0 and 1, where 0 corresponds to perfect equality (everyone has the same income) and 1 corresponds to perfect inequality (one person has all the income and everyone else has zero income). Later, other authors found the principle extremely valuable and continued to apply this concept in other fields.

The focus of the Pareto principle is that by analyzing the problem sources, usually few causes appear more frequently than others. This principle serves as a general reminder to prove the relationship between inputs and outputs is usually not balanced. For instance, a lower fraction of efforts could drive firm's profits and vice versa, most of managers' time is often inadequately spent in activities that have a poor contribution in achieving company results. In any case, the Pareto principle 80:20 has many applications in economics as in other fields.

Surely, adopting the principle allows the decision making process to become more efficient, focusing on key activities (business drivers). Indeed, the whole concept is based on the vital few and trivial many concept.

This paper wants to point out the importance of certain types of material and suppliers in the purchasing process of an iron scrap trader which is trying to rationalize its purchasing process.

2. THE THEORETICAL BACKGROUND OF THE PARETO PRINCIPLE 80:20

2.1. The principle's different areas of application

Vilfredo Pareto has two interrelated contributions in the economic field: the *Pareto optimality* and the *principle 80:20*.

The Pareto optimality defines an optimal situation as one in which it is impossible to improve the utility of one, without diminishing the utility of someone else (Prager, 1993, p. 70). To explain his thoughts Pareto supposed there were two consumers and only one resource to distribute. If the resource amount to 20 units it can be equally distributed between two subjects in the following ways: (1,1), (2,2), (3,3), (4,4), (5,5), (6,6), (7,7), (8,8), (9,9), (10,10). At the point (10,10) all resources have been exhausted and no further equal distribution is possible. This means other combinations lead to positions of inequality: for example (11,9), (9,11) and so on. The point (10,10) is called the Pareto optimum where all resources are distributed and all participants have the same level of utility. Moving away from this point implies an increasing rate of inequality.

His thoughts are generally used to reflect and analyze situations of pronounced distribution imbalance. The principle 80:20 found important application in many areas, especially in the field of quality management. In fact, several years later (1969) Joseph Juran applied the principle to quality control functions and disseminates the Pareto analysis in Japanese and U.S. firms to resolve many problems of poor quality. Joseph Juran gives a new aspect to the principle introducing the concept of the "vital few and trivial many" to explain that a small number of causes is responsible for a large percentage of effects (Williams, 2007, p. 50). To obtain a better level of quality, key causes must be

addressed and remedied which will assure the whole process operates better. To assure more complete and thorough analysis the Pareto principle is used in combination with other quality management tools: the cause and effect analysis proposed by Kaor Ishikawa, the six sigma concept proposed by Motorola and others (Craft, Leake, 2002, p. 729).

Another important point of the Pareto analysis is the Pareto chart, a good tool to select data into categories and establish the number of times each category occurs. The data must be arranged in a hierarchical order, first the data that occur with more frequency. The most significant problems must be corrected first taking a limited number of activities that produce significant effects. The graphical presentation has a crucial role in terms of understanding and separating the essential (vital) from the unessential (trivial).

The graphical representation is simple to generate. The chart combines individual values represented in descending order by bars and cumulative value represented by a concave curve. It is also important to emphasize the proportion 80:20 is not fixed, it only illustrates if some categories have higher frequency of occurrence than others. Situations of more pronounced inequality indicate the principle 80:20 is more prominent.

Other authors in essence also confirmed the importance of the vital few concepts. Peter Drucker (1996) for example said that effective executives can not efficiently decide on many things at the same time and that is why they concentrate their efforts only on the important ones (Drucker, 1996). In fact, often, there is a tremendous gap between perception and reality in identifying the real causes of poor firm performance. Managers, usually, tend to focus on the most recent catastrophic issues and do not see the big picture (Williams, 2007, p. 50) what means they don't understand obstacles and problems under the surface. The essence of this principle in the management science is to encourage changes in order to ensure continuous improvement. Application of the Pareto principle highlights the weaknesses in the organizations' infrastructures (critical success factors) such as inadequate planning, monitoring, scheduling, reviewing, documentation management and so on (Lock, 1990).

Shigeo Shingo, a consultant of Toyota Motor Corporation illustrates the importance of Pareto principle with the following sentence: „The most dangerous kind of waste is the waste we do not recognize" (Williams, 2007, p. 50). This managerial approach describes the most significant benefit of the Pareto principle application: nothing left to chance, every process must be monitored. The Pareto principle supports management by fact, not management by emotion.

Another important guru in the field of quality management, W. Edwards Deming, interprets the principle with the following sentences: „Your system should be perfectly designed to the results you are getting" or „It is not enough to do your best, you must know what to do, and then do your best" (http://www.stateclaims.ie/.../David Vaughan CISIHIPres, 05.11.2012). So the

Pareto principle offers a way to prioritize the resource allocation to achieve maximum returns.

The application of the Pareto principle 80:20 is really widespread. The following table shows examples for different areas of application to indicate the principle simplicity and usefulness.

Figure 1

Areas of application of the Pareto principle 80:20

Application of the principle on the economic field	
Organization	- 80% of work is usually done by 20% of people - 20% of your staff will provide 80% of production - 20% of the project phases (the first 10% and the last 10%) consumes 80% of all resources - 20% of meetings give 80% of useful idea
Quality	- 80% of all effects can be explained by 20% of causes - 20% of defects cause 80% of all problem
Market	-80% of all profits come from 20% of firm customers -80% of sales come from 20% of products -80% of complaints come from 20% of customers -80% of your sales are made by 20% of your sales staff -only 20% of web sites deliver 80% of high quality information
Warehouse	- 20% of stock takes up 80% of warehouse space (ABC principle of managing inventories) - 80% of stock comes from 20% of suppliers

Source: own preparation

In the economic field, the principle is most commonly applied to the segment of quality management.

A lot of terms are used to indicate quality improvement efforts. For example: quality control, quality assurance and total quality management. Numerous approaches of quality management were suggested, in order to help industries improve efficiency and competitiveness. One of the most popular and often recommended approaches is the just mentioned philosophy of total quality

management (TQM) that seeks to integrate all organizational functions on meeting and surpassing customer's requirements and organizational objectives. In the last two decades the awareness of TQM has considerably increased and become a well established field of research in academia. Year in year out, TQM indicators were utilized to improve many models of performance measurements from concept to today's usage (Saraph, Benson, Schroeder, 1989). According to Boynton and Zmud (1984), critical success factors are those vital constructs that must be addressed to ensure success for an organization, and therefore, they represent those managerial or organizational areas that must be under special and continual manager attention (Talib, Rahman, Qureshi, 2010).

To go deeper with the Pareto principle 80:20 in the analysis, the distinction between effectiveness and efficiency must be clear. The **effectiveness** presents the extent to which planned activities are realized and planned results achieved, while **efficiency** presents the relationship between the achieved result and the used resources (HR EN ISO 9000:2000, p. 45).

So, it is not only important to *do things right,* but also to ensure you are *doing the right things*. Pareto's principle should serve as a reminder to stay focused on the 20 percent of work that is really important and leads to results. It's not just important to "work hard" and "work smart", but also to work smart on the right things. (http://www.pinnicle.com/Articles/Pareto _Principle/pareto_principle.html,20.11.2012).

Once identified all problem sources management staff should concentrate its efforts on seeking solutions for problems with a higher level of priority rather than attempting to tackle the whole gamut of problems at once (Sanders, 1988, p. 37).

2.2. Benefits and weaknesses of the method

The application of the method can be useful in many cases but wrong applications are also possible. It is important to take into account cases where the application of this principle is incorrect and confused. Identifying incorrect applications is essential in order to point to the incomplete analysis and inaccurate conclusions.

The principle is applicable almost on any type of systems, processes or activities. It is only important to conduct an accurate analysis that helps in ranking organizational problems, encouraging organizational learning and increasing group cohesiveness. While there are a lot of advantages it is also important to emphasize some weaknesses. The first one is that the principle is a static concept so it does not offer a dynamic view. It analyses different aspects of the problem but does not suggest a possible solution. At the same time it has limited significance for small data sets and

qualitative data can not be directly included in the calculations and graphical representation. The most common reasons of incorrect application are linked to the incorrect calculations or incorrect result interpretation. For example the CRM methodology (Customer relationship management) presumed that to maximize profits firms focus their resources on attracting and retaining the top 20% of elite buyers that create 80% of profits and gives minimal least-cost services to the bottom 80%   (Read, 2010). Generally, demand curve of elite customers is very elastic. Simplified, this means that minimal fluctuations in quality or price will result in losing the customers. So, the application of the Pareto principle in this case, after a certain time, could result in a reduction of income. So, from the marketing perspective, it is not justifiable to ignore the trivial many a priori! Borgan J. says *"True 80% of your business could come from about 20% of your customer base. But, try to list those 80% that are not your top customers and discover their expectations and difficulties… Excluding them because they are not profitable at the moment, your enterprise could lose a big opportunity… The fact of the matter is that your profitable customers of tomorrow are more likely than your casual customers of today."* (Brogan, 2010).

In this case, following the Pareto principle, a very logic question arises: Would this 20% be capable of adding enough value to the firm currently and also in future business? (Whitney, (2003), Pareto and profits, *Tooling & Production*, Vol. 69, no 4, p. 44).

Generally, difficulties associated with Pareto analysis include the following (Karuppusami, Gandhinathan, 2006):

- Lack of understanding of how it should be applied to particular problems

- Misrepresentation of data

- Inappropriate measurements depicted

- Inaccurate plotting of cumulative percent data

To overcome difficulties and assure a correct application it is important to make sure that the next activities are undertaken: defining why the tool is used, identifying the most appropriate measurement perspectives, properly conduct data collection and selection, properly develop graphical presentation and carefully draw conclusion.

3.   THE METHODOLOGICAL FRAMEWORK

As influenced by a growing number of factors, the decision making process becomes increasingly complex. In this paper, the Pareto principle methodology is used in combination with the case study methodology. A case study is a method of learning about a complex instance, based on a comprehensive understanding of an instance obtained through extensive description and analysis that perfectly complements the Pareto methodology. It organizes and displays information to show the relative importance of various problems or causes of problems. It is a form of a vertical bar chart that puts items in order (from the highest to the lowest) relative to some measurable effect of interest. Placing the items in descending order of frequency makes it easy to discern those problems that are of greatest importance or those causes that appear most frequently than others. Thus, a Pareto chart helps teams to focus their efforts on activities where greater results are assured. As the case study methodology includes a couple of tasks: design a case study, collect the data, analyze the data, report the results, the Pareto principle needs to be developed respecting several steps:

Step 1→ Develop a list of items that have to be analyzed

Step 2→ Fix possible aspects to be considered in the analysis

Step 3→ Prepare a table with three columns: in the first column sort the elements in decreasing order. The first column contains information about considered phenomena. In the second column it is necessary to calculate the percentage of each item in grand total and the third column aggregates individual percentages[1] from the second column. Elaborating immediately the graphical representation, the second column of the table shows the structural distribution of considered items (presented by columns in the graphical representation) while the third column represents the cumulative curve. The combination of structural and line diagrams, indicates if the Pareto principle is proven or not. The answer to this question is met considering the point where the cumulative curve intersects the last column of the structural chart.

Step 4→ When everything is calculated it is necessary to develop a clear graphical presentation. The Pareto chart consists of one X axis and two Y axes. It is necessary to proceed as follows:

-      on the X axis it is necessary to list the items from highest to lowest (ex. types of error, defect…).

-      label the left vertical axis with an absolute measuring scale (ex. number of reported errors, delivered quantity per each suppliers, income per each

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[1] The cumulative percent for an item is the sum of that item's percentage and all other items that come before it in the ordering by rank. This first value in the cumulative column is equal to the first percentage in the second column.

customer), then label the right vertical axis with the cumulative percentages (the cumulative total should be equal 100%).

Step 5→ Analyze the diagram identifying those items that appear most frequently or in a greater amount than other. If there appears to be no pattern (what means bars are essentially all of the same height), think to include some other aspects in the analysis.

The usefulness of the Pareto principle actually lies in the fact that from a larger group of data there is possible to observe and compare various perspectives of analysis which sometimes lead to very different conclusions as described in the following case study.

The Pareto principle is very useful as a basis for upgrades to other methods, because it refers to aspects that should be further questioned and analyzed through other tools and methods. The Pareto diagram applied to a specific case study prioritizes problem areas while other methods as the Ishikawa diagram go into deep of the analysis discovering the source of certain tendencies.

4.   THE APPLICATION OF THE PARETO PRINCIPLE ON THE CASE OF MIX METAL

The firm Mix Metal is a small trader with a long tradition in collecting and selling iron scrap on the international market. Recycled materials are afterwards used in the metallurgical industry. The firm operates in eight European countries: Czech Republic, Slovenia, Italy, Romania, Croatia, Serbia, Bosnia and Austria. The subsidiary firm in Croatia has operated since 2004. As the company has fixed contract obligations, it is very important to ensure constant quality and quantity of materials to its customer. On the Croatian market, the firm has only one customer: ABS Sisak, specialized in production of metal product.

The number of iron scrap suppliers on the Croatian market is limited and the market is quite monopolized. So, to retain the customer base it is essential to ensure required quantities, but it is also important to assure a rationalized purchasing process which is discussed below, following the application of the Pareto principle. This section of the paper will discuss different points of view that arise applying the principle 80:20 and through which the purchasing process can be improved. The case presents how the principle can be applied on concrete data and how in some cases it can be useful also on small series.

To protect confidential information, the analyzed firm bares a fictitious name: Mix Metal. The number of suppliers and purchased quantities vary over time. The data presented below, refer to the last four semesters, from December 2012 to June 2014. Applying the Pareto principle will be possible to decide which suppliers or which types of materials are more profitable than others. The next

tables present a schedule of delivered quantities for the last four semesters: July-December 2012, January- June 2013, July- December 2013, January- June 2014.

The material is categorized by the formal Europian Union codes and the quantities are expressed in tons. The following explanations indicated what each type of material includes.

Figure 2

Iron Scrap classification codes (European classification)

Material classification	Description
E3+8	Old thick scrap- railway special demolition (profile min. 8 mm)
E2	New steel scrap- pantograph (the rest of the material that can not be used in the production process)
E1 C	Thin gauged material. Wrought iron and steel scrap, black and galvanized. May include all automobile scrap properly prepared (ex. car doors)
E5	Iron turnings, cast iron turnings, shoveling iron turnings (iron spen)
E1+ 02	Wrought iron and steel scrap, black and galvanized (ex. bike tubes)
E3+ 01	Good quality rail tracks
E3+6	Iron tubes (profile min. 6 mm)
E8-P	Massive iron sheets- ex. ship plating

Source: http://www.eurofer.org/eurofer/docs/EurSteelScrapSpec.pdf, (12/11/2012)

The next tables show purchased quantities per each semester including describing what kind of material and quantity supplier delivered by each supplier. Preparing the Pareto principle calculation it is necessary to filter the set of data adopting previously fixed aspects according to the current needs.

Figure 3

Purchased quantities of iron scrap (July- December 2012)

I Semester Type of material	Sup. 1 t	Sup. 2 t	Sup. 3 t	Sup. 4 t	Sup. 5 t	Sup. 6 t	Sup. 7 t	Sup. 8 t	Sup. 9 t	Sup. 10 t	Sup. 11 t	Sup. 12 t	Sup. 13 t	Total per material
E1/C		20		140	1	70	30							261
E1/02					8	10		25	15	22				80
E2	50			75		25		25	25		20			220
E3+01				10	1									11
E3+08	75		25	10	8	25		25	120			75	80	443
E5			35			20				15			20	90
E8-P									5					5
Total per supplier	125	20	60	235	18	150	30	75	165	37	20	75	100	1100

Source: firm internal data

In the first semester, examining the delivered quantities of material, Sup.4, Sup.9, Sup. Sup.6, Sup.13 and Sup.1 seems to be more important than others. On the other hand, adopting another perspective, the type of delivered material suggests material under codes E3+8, E1/C and E2 are the most important in the purchasing portfolio. The next three tables present data for remaining semesters and at the end of the section, it is explained how to combine the two perspectives.

Figure 4

Purchased quantities of iron scrap (January- June 2013)

II Semester	Sup. 1	Sup. 3	Sup. 6	Sup. 7	Sup. 8	Sup. 9	Sup. 10	Sup. 11	Sup. 13	Sup. 14	Sup. 15	Sup. 16	Sup. 17	Sup. 18	Sup. 19	Sup. 20	Sup. 21	Total per material
Type of material	t	t	t	t	t	t	t	t	t	t	t	t	t	t	t	t	t	t
E1/C											50	200						**250**
E1/02			20				29		124	39								**212**
E2	25	30			50				25									**130**
E3+01				50					25		50	75	60	75				**335**
E3+08			145	25	25	75	10	50	50	300		75	60	75	25	100	200	**1215**
E8								25								15		**40**
E5			25				10		30	50								**115**
Total per supplier	**25**	**30**	**190**	**75**	**75**	**75**	**49**	**75**	**254**	**389**	**100**	**350**	**120**	**150**	**25**	**115**	**200**	**2297**

Source: firm internal data

Figure 5

Purchased quantities of iron scrap (July- December 2013)

III semester	Sup. 2	Sup. 3	Sup. 8	Sup. 10	Sup. 13	Sup. 14	Sup. 20	Sup. 22	
Material type	t	t	t	t	t	t	t	t	Total per material
E1/C					50				50
E1/02				20	25				45
E3+08	25	70	150	10	25	20	40	150	490
E3+01					50				50
E5				10			10		20
Total per supplier	25	70	150	40	150	20	50	150	655

Source: firm internal data

Figure 6

Purchased quantities of iron scrap (December- June 2014)

IV Semester	Sup. 1	Sup. 3	Sup. 9	Sup. 10	Sup. 16	Sup. 18	Sup. 20	Sup. 23	Sup. 24	
Material type	t	t	t	t	t	t	t	t	t	Total per material
E1/C					250	50				300
E1/02	25			20						45
E2	50	50								100
E3+08		50	60	10		50			750	920
E3+01						10			700	710
E8		5		5						10
E5			10	10			15	15	50	100
Total per supplier	75	105	70	45	250	110	15	15	1500	2185

Source: firm internal data

Applying the Pareto principle on presented data, different conclusions can arise. First of all, it is important to fix some points of view on which the study will be focused in order to improve the company's purchasing process.

If we consider that relationship with each supplier implies certain fixed costs to guarantee the firm's survival, it is important to follow the level of delivered quantities by each supplier but also to provide quality. In this case, the adherence of contracted volumes per supplier and type of material will be considered to explain how the purchasing process can be improved.

The next table combines the data presented above, ranking suppliers and types of material in decreasing order.

To protect the suppliers' anonymity, substitutive names as Sup.1, Sup. 2 are adopted while the logic of data structure is retained.
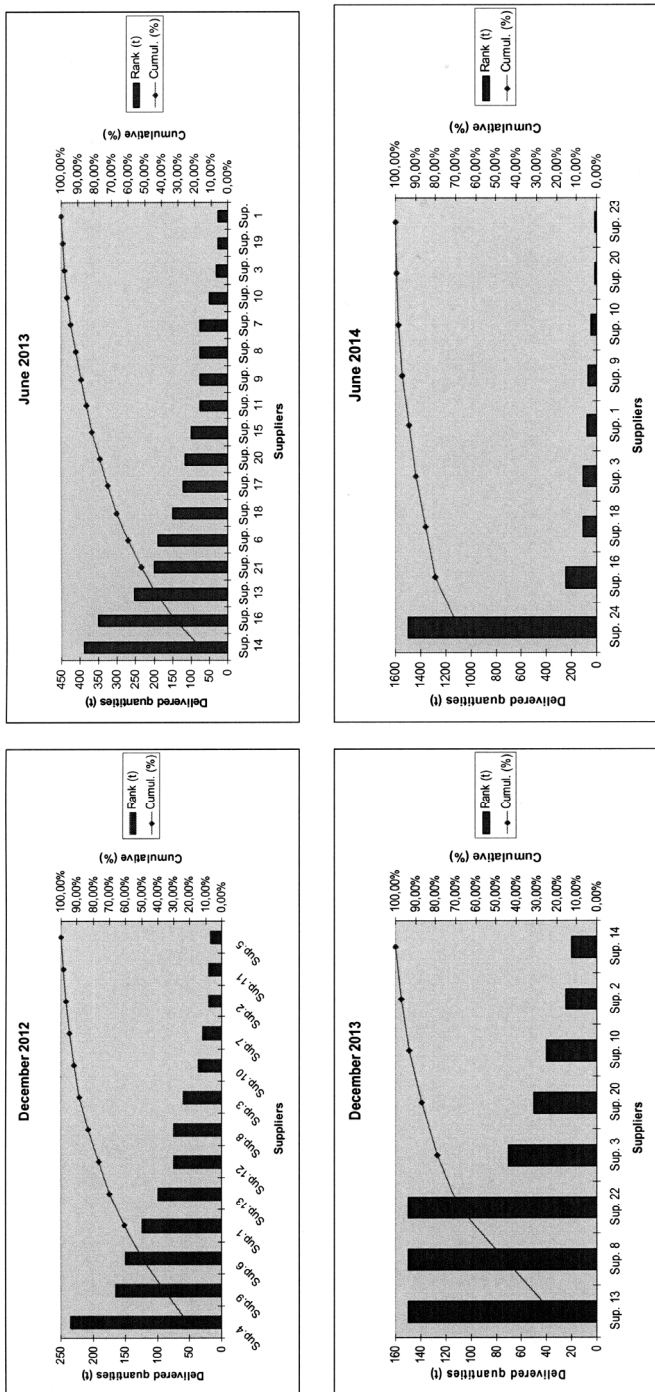
Figure 7

Suppliers and material ranking by quantities

I semester

Material	Rank (t)	Suppliers	Rank (t)
E3+08	443	Sup. 4	235
E1/C	261	Sup. 9	165
E2	220	Sup. 6	150
E5	90	Sup. 1	125
E1+02	80	Sup. 13	100
E3+01	11	Sup. 12	75
E8-P	5	Sup. 8	75
Tot.	1110	Sup. 3	60
		Sup. 10	37
		Sup. 7	30
		Sup. 2	20
		Sup. 11	20
		Sup. 5	18
		Tot.	1110

II semester

Material	Rank (t)	Suppliers	Rank (t)
E3+08	1215	Sup. 14	389
E3+01	335	Sup. 16	350
E1/C	250	Sup. 13	254
E1/02	212	Sup. 21	200
E2	130	Sup. 6	190
E5	115	Sup. 18	150
E8	40	Sup. 17	120
Tot.	2297	Sup. 20	115
		Sup. 15	100
		Sup. 11	75
		Sup. 9	75
		Sup. 8	75
		Sup. 7	75
		Sup. 10	49
		Sup. 3	30
		Sup. 19	25
		Sup. 1	25
		Tot.	2297

III semester

Material	Rank (t)	Suppliers	Rank (t)
E3+8	490	Sup. 13	150
E1/C	50	Sup. 8	150
E3+01	50	Sup. 22	150
E1+02	45	Sup. 3	70
E5	20	Sup. 20	50
Tot.	655	Sup. 10	40
		Sup. 2	25
		Sup. 14	20
		Tot.	655

IV semester

Material	Rank (t)	Suppliers	Rank (t)
E3+08	920	Sup. 24	1500
E3+01	710	Sup. 16	250
E1/C	300	Sup. 18	110
E2	100	Sup. 3	105
E5	100	Sup. 1	75
E1+02	45	Sup. 9	70
E8	10	Sup. 10	45
Tot.	2185	Sup. 20	15
		Sup. 23	15
		Tot.	2185

Source: company data

Figure 8

Suppliers and material ranking by quantities

I semester

Suppliers	Rank (t)	Cumul. (t)	Cumul. (%)
Sup. 4	235	235	21,17%
Sup.9	165	400	36,04%
Sup. 6	150	550	49,55%
Sup. 1	125	675	60,81%
Sup. 13	100	775	69,82%
Sup. 12	75	850	76,58%
Sup. 8	75	925	83,33%
Sup. 3	60	985	88,74%
Sup. 10	37	1022	92,07%
Sup. 7	30	1052	94,77%
Sup. 2	20	1072	96,58%
Sup. 11	20	1092	98,38%
Sup. 5	18	1110	100,00%

II semester

Suppliers	Rank (t)	Cumul. (t)	Cumul. (%)
Sup. 14	389	389	16,94%
Sup. 16	350	739	32,17%
Sup. 13	254	993	43,23%
Sup. 21	200	1193	51,94%
Sup. 6	190	1383	60,21%
Sup. 18	150	1533	66,74%
Sup. 17	120	1653	71,96%
Sup. 20	115	1768	76,97%
Sup. 15	100	1868	81,32%
Sup. 11	75	1943	84,59%
Sup. 9	75	2018	87,85%
Sup. 8	75	2093	91,12%
Sup. 7	75	2168	94,38%
Sup. 10	49	2217	96,52%
Sup. 3	30	2247	97,82%
Sup. 19	25	2272	98,91%
Sup. 1	25	2297	100,00%

III semester

Suppliers	Rank (t)	Cumul. (t)	Cumul. (%)
Sup. 13	150	150	22,90%
Sup. 8	150	300	45,80%
Sup. 22	150	450	68,70%
Sup. 3	70	520	79,39%
Sup. 20	50	570	87,02%
Sup. 10	40	610	93,13%
Sup. 2	25	635	96,95%
Sup. 14	20	655	100,00%

IV semester

Suppliers	Rank (t)	Cumul. (t)	Cumul. (%)
Sup. 24	1500	1500	68,65%
Sup. 16	250	1750	80,09%
Sup. 18	110	1860	85,13%
Sup. 3	105	1965	89,93%
Sup. 1	75	2040	93,36%
Sup. 9	70	2110	96,57%
Sup. 10	45	2155	98,63%
Sup. 20	15	2170	99,31%
Sup. 23	15	2185	100,00%

Source: firm internal data

Figure 9

Graphical representations

Source: own preparation

Results interpretation:

Graphical representation clearly presents the point where the cumulative curve intersects the last column (supplier). The Pareto principle, to be confirmed, has to show the vital few and trivial many concept, that allows highlight which suppliers provide larger quantities in the overall quantity structure.

In the first two cases the Pareto principle is not confirmed. For example, in the first semester, out of thirteen suppliers, suppliers Sup. 4, Sup. 9, Sup. 6 delivered 49.55% of the total amount. During the second semester, Sup. 14, Sup. 16 and Sup. 13, delivered the 43,23% of total quantities. That means in the first two semesters there were not few vital suppliers. In the first semester, the Pareto principle would have been confirmed taking into account five suppliers: Sup. 4, Sup. 9, Sup. 6, Sup. 1 and Sup. 13 which delivered approximately 70% of total quantity. In the second semester the Pareto principle would be confirmed taking into account seven of total 17 suppliers: Sup. 14, Sup. 16, Sup. 13, Sup. 21, Sup. 6, Sup. 18, Sup. 17. But, 7 suppliers in this case are too many to consider the Pareto principle has been confirmed. The Pareto principle is confirmed if the vital few and trivial many concept can be demonstrated. Mathematically, this means the imbalance have to be more pronounced than it was in the case of first two semesters.

It should also be taken into account that the Pareto principle is better if applied on an extended data set rather than on a short one as the projections are more accurate.

In the third case, the Pareto principle is substantially proven because the first three of total eight suppliers delivered almost 70% of the total amount and so they are relevant to business enterprises more than the remaining suppliers. But, in this case, it must be also taken into account that a smaller amount of data is considered and a large number of suppliers during the third semester is lost. Pareto principle is better demonstrated in the fourth semester where the first two suppliers, Sup. 24 and Sup. 16 delivered 80,09% of total amount and the company without them would not survive.

From the example, other important findings arise. Sup.13 has been constant during the first three semesters while in the fourth semester it disappeared. During the third and fourth semesters new suppliers occur: Sup. 22, Sup. 23 and Sup. 24. The last mentioned take an important place in the purchasing structure, delivering almost 70% of total quantity in the last period. Sup. 3 is present in all four semesters, and therefore is important although for small quantities.

How to reach the right conclusion?

The Pareto principle has many uses and benefits but it is important to be careful when drawing conclusions. Below, some suggestions are given how to proceed with it.

Wrong conclusion: suppliers that are not currently important should be eliminated from the purchasing list as they at the time are not able to deliver enough quantities and they incur costs, maintaining relationships as well as with those who deliver larger quantities. To adopt such conclusions, information must be collected and studied for a longer period, not only a few months, especially in the case of Mix Metal when finding new suppliers seems to be very difficult.

Right conclusion: in order to ensure continuous quantities to the customer it would probably be a good idea to conclude a permanent contract with top suppliers, and with others work without contractual obligations, therefore not leaving an opportunity for future business. In any case it is important to maintain contacts especially with those who delivered good quality materials, although currently maybe in small quantities.

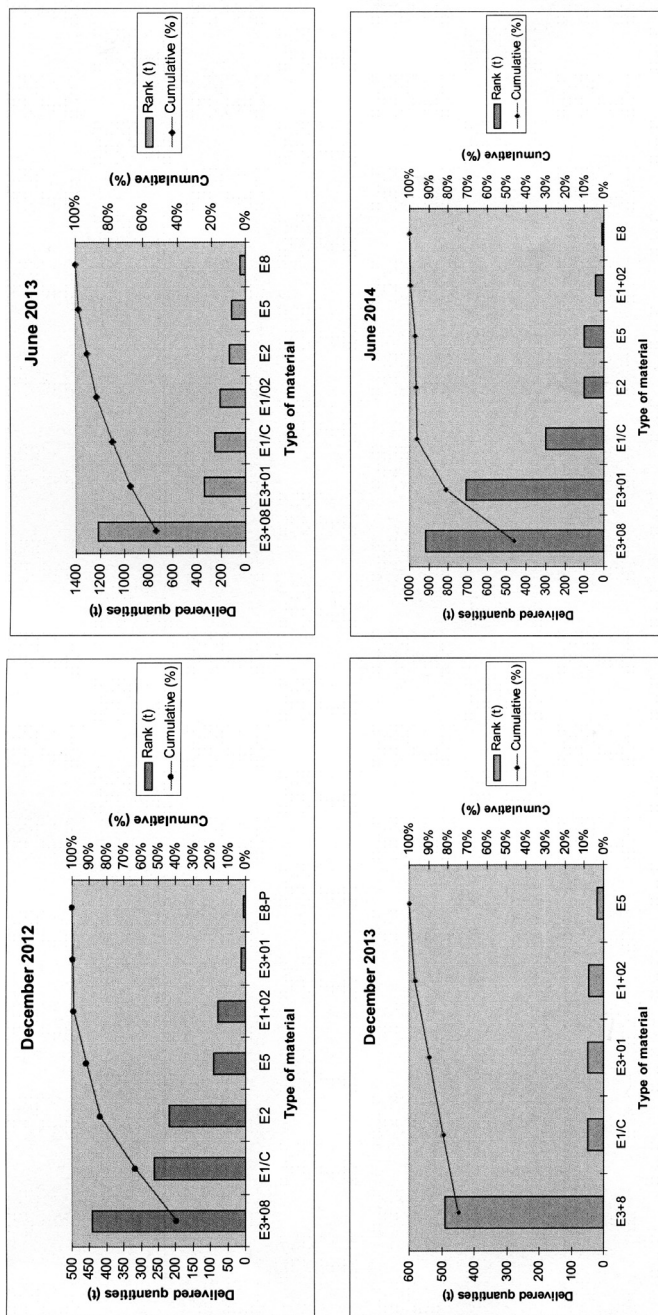From the analysis a new point of view arises analyzing delivered quantities per each type of material.

Figure 10

Developing the Pareto chart (quantity per each material)

I semester

Material	Rank (t)	Cumul. (t)	Cumul. (%)
E3+08	443	443	39,91%
E1/C	261	704	63,42%
E2	220	924	83,24%
E5	90	1014	91,35%
E1+02	80	1094	98,56%
E3+01	11	1105	99,55%
E8-P	5	1110	100,00%

II semester

Material	Rank (t)	Cumul. (t)	Cumul. (%)
E3+08	1215	1215	52,90%
E3+01	335	1550	67,48%
E1/C	250	1800	78,36%
E1/02	212	2012	87,59%
E2	130	2142	93,25%
E5	115	2257	98,26%
E8	40	2297	100,00%

III semester

Material	Rank (t)	Cumul. (t)	Cumul. (%)
E3+8	490	490	74,81%
E1/C	50	540	82,44%
E3+01	50	590	90,08%
E1+02	45	635	96,95%
E5	20	655	100,00%

IV semester

Material	Rank (t)	Cumul. (t)	Cumul. (%)
E3+08	920	920	45,89%
E3+01	710	1630	81,30%
E1/C	300	1930	96,26%
E2	100	1940	96,76%
E5	100	1950	97,26%
E1+02	45	1995	99,50%
E8	10	2005	100,00%

Source: company data

Figure 11

Graphical representations

Source: own preparation

Results interpretation:

From this second point of view the conclusion is completely different and a new dimension of interpreting data arises.

It seems that materials E3+8, E3+01 and E1/C are the most important in the purchasing portfolio. The Pareto principle, from this point of view is clearly confirmed, especially in the last semester, where 2 of total 7 types of materials provide 81,30% of overall quantity.

From this point of view, some other suppliers confirmed their importance in relation to the results presented above. Analyzing data from this other point of view Sup. 1, Sup. 6, Sup. 8, Sup. 12, Sup. 13, Sup. 20, Sup. 21 and Sup. 22 are also important and their relevance in the purchasing portfolio is confirmed in the charts above.

5.   CONCLUSION

This paper, in particularly focuses on the benefits of using the Pareto principle 80:20 in the decision making process, selecting most important suppliers and types of material and striving to rationalize the purchasing process. The principle is very valuable in ranking the priority of problem solving. Separating the vital few from the trivial many, the principle can improve the firm performance if correctly implemented. It helps the management staff to fix relevant problem areas and to focus on those activities which assure highest returns (business drivers).

The research questions posted at the beginning were directed to improve the quality of the purchasing process in terms of rationalization and improving efficiency. The tool is applicable in almost any branch and especially valuable if applied on a larger set of data and set up correctly.

It should also be noted that any analysis gives better results if different tools are combined, especially matching qualitative and quantitative methods. The Pareto principle points out disproportions in distribution and Ishikawa diagram helps identify and categorize the reasons of such disproportion. Therefore, the Pareto principle is usually used at the beginning of a particular analysis to point to the trends of certain phenomena. From a larger set of data, extract the phenomena on which to focus attention. The objective of this work in terms of methodology was to prove that business decisions except on intuition and creativity must be based on a detailed data analysis.

In this case, it seems to be most valuable to complement the analysis with the Ishikawa diagram, a method that goes deeper into the root of the problem and becomes very useful especially for the analysis on a smaller data scale as in

the considered case. It allows drawing conclusions with a greater level of reliability and facilitates to distinguish a right from a wrong conclusion.

The principle 80:20 separating the vital few from the trivial many stimulates the consideration of different points of view. Combining different perspectives the decision making process become more accurate. Adopting a multiple criteria to make a decision, over a long period of time, with a great certitude a firm can improve organizational results.

The application of various tools in the decision making process is a very actual and essential aspect of the decision making process. Due to the increasingly complex business environment, the conditions under which decisions are made become more and more complicated. Preparing and conducting the analysis, the application of those tools stimulates the cooperation between different organizational departments and hierarchical levels.

Having discussed the contributions of the Pareto's principle, some limitations should also be noted. To complete the analysis in the case study some information missed. For example the future market demand is not featured, average margins per each material and supplier are unidentified, the quality of materials each supplier delivered and the amount of complaints per each supplier remain unknown.

Future researches should continue to focus on the use of the Pareto principle in making decision, certainly in combination with other tools. Further researches have to make a step forward combining the Pareto principle with different tools present in the field of strategy and quality management. For example, the Ishikawa diagram in combination with the Pareto principle can emphasize the most important causes of observed disproportions, the combination with the flow chart technique can provide to determine the order of necessary corrective actions or the correlation chart important to describe the links between certain causes.

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POBOLJŠANJE PROCESA DONOŠENJA ODLUKA PRIMJENOM PARETOVOG PRAVILA

Sažetak

*Vilfredo Pareto (*1848. - 1923.) *je proučavao nejednaku distribuciju bogatstva u Italiji tijekom devetnaestog stoljeća i razvio korisni alat nazvan „princip 80:20". Kasnije je usvojen u mnogim područjima kako bi se objasnilo da iza većine posljedica stoji manji broj uzročnika. Primjena principa ističe prioritete u rješavanju problema ili razvoja ključnih aktivnosti poslovanja. Izdvajajući ono što je bitno iz skupine nevažnog, upravljačko tijelo može unaprijediti poslovanje tvrtke. U ovom radu uspostavljena je poveznica između tog principa i procesa donošenja odluka te se predlažu različiti aspekti za poboljšanje procesa nabave u određenoj tvrtki. Tvrtka Mix Metal je manje poduzeće koje se bavi kupoprodajom željeznog otpada na području Republike Hrvatske od 2004.godine. Ovdje je Paretov princip usvojen kako bi se racionalizirao proces nabave i dugoročno osigurale bolje prodajne marže. Cilj rada je predstaviti dublje razumijevanje korijena, odnosno uzročnika problema te analizu situacije iz različitih aspekata. U radu se posebno nastoji otkriti za koje dobavljače i za koje vrste materijala se proces nabave mora preispitati ili čak završiti. Razmatrani slučaj je predstavljen koristeći case study metodologiju.*

Ključne riječi: proces odlučivanja, upravljanje lancem nabave, Paretov princip

JEL klasifikacija: L21, L61, M11