ISSN: 1839 - 0846

AWARENESS, APPRECIATION AND FAMILIARITY WITH OPERATIONS RESEARCH AMONG MANAGERS IN QUOTED MANUFACTURING FIRMS IN NIGERIA

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ABSTRACT

Unconscious or informal application and failure to acknowledge the use of operations research (OR) approach by corporate managers has been going on globally for a very long time. This largely accounts for the inability of scholars to make accurate assessment of the level of application of operations research in the non-academic environment. It is therefore evident that asking an operations manager whether OR models or methodology is applied by his company may likely not produce a response that truly represents reality as some may be unknowingly making such applications. This study therefore examined the level of awareness of OR among corporations in the Nigerian manufacturing sector. It also assessed the extent of familiarity with OR models among managers in the manufacturing sector and their appreciation of OR techniques as a viable business decision-making tool. Consequently, steps that constitute the decision-making procedure of firms in the manufacturing industry of Nigerian economy were examined to determine the extent to which OR methodology or philosophy may have been incorporated.

Keywords: *Operations Research, Managers, Business Decision-making, Manufacturing Sector*
JEL Classification: *C44, M11, L60*

1. INTRODUCTION

OR is a quantitative tool for management decision-making generally believed to have developed during World War II even though many of its models were developed many years before the war. During the war however, those already developed models were brought together, greatly expanded, and successfully applied to military research and operations on the British side of the conflict. Spurred on by the success associated with OR implementation by the military, industry became interested in the use of OR. As the war ended, and industrial boom that followed was running its course, the plethora of problems caused by increasing complexity, prolific growth in specializations and unprecedented segmentation in organizations became significant. A large number of people, some of who served in or with OR teams during the war, but are now in business, realised that some of the business problems they were facing had characteristics similar to some they handled during the war but now appearing in a business context. OR application then made its way not only into business but also civil government. Thus for the first time in human history, entrepreneurs and professional managers had a framework for tackling business decision-making problems and achieving objectives set for business enterprises.

Today, the impact of OR application in the industrialised world is very outstanding such that virtually every business and government throughout the developed economies employs it and it remains an active area of academic research. Some managers and decision-makers in those highly structured environments insist that the application of OR in their businesses made the difference between success and failure in optimally utilizing the opportunities available to their enterprises (Berresford and Dando, 1978; Moore *et al*., 1991; Little, 2004; Agarwal *et al.*, 2010). In the developing countries, the situation with OR implementation is not quite clear. Scholars have been expressing divergent opinions on the adoption and relevance of operations research as a tool for business decision-making in the developing countries.

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In 1981, with particular reference to Nigeria, Kemball-Cook and Wright (1981) said "although there does not seem to be much OR activity as such in Nigeria, a large amount of work of an OR-type is apparently being done, but with a low implementation rate. Five years later, Idama and Tomlinson (1986) studied the applicability of OR in the Nigerian Civil Service. They concluded that: (i) there was no skilled OR staff in the Nigerian Civil Service, (ii) there was no awareness of OR by the staff in the system, (iii) the staff confused OR with social activities – a situation the researchers adjudged more dangerous than pure ignorance. In the same year, Ravn and Vidal (1986) said, "Although many applications have never been published in OR journals, OR is being used in underdeveloped countries to a greater extent especially by multinational firms, aid organizations, local private firms and the State". Five years later, Akingbade, Luck and Patel (1991) reported that many effective practitioners of OR do not publish because of pressure of work and commercial secrecy. They held the opinion that there was a great deal of OR content but in the soft or rudimentary form in what people were doing in the area of production management in the developing countries.

It is therefore reasonable to investigate whether or not Nigerian managers are still ignorant and confused about what OR really is after all these years. What is now the extent of awareness and appreciation of OR as a tool for corporate decision-making? How familiar are they with operations research models? Are they adopting OR methodology in their operations albeit unconsciously? These were some of the issues this study addressed.

2. LITERATURE REVIEW

2.1 Operations Research (OR) and Its Applications

In the literature, issues have been raised regarding the title "Operations Research" and its definitions. The British standard definition of OR is the "application of the methods of science on complex problems arising in the direction and management of large systems of men, machine, materials and money, in industry, business, government and defence. The distinctive approach is to develop a scientific model of the system incorporating measurements of factors such as change and risk with which to predict and compare the outcome of alternative decisions, strategies or controls. The purpose is to help management determine its policy and actions scientifically" (Operations Research Quarterly, 1971). Many other definitions of the discipline are found in the literature. Verma (2005) has a list of some of the definitions. None of the definitions is generally accepted as satisfactory. Many OR scholars have raised issues on the scientific character ascribed to OR through the definitions (Bevan 1976; Dando and Sharp, 1978; Carney and William, 1997). Another reason given why the definitions are seen as inadequate is that they fail to highlight the basic characteristics or attributes of OR such as interdisciplinary teamwork and systems approach to organisational problems (Verma, 2005).

The situation however is different regarding OR methodology. There is no dissension among management scholars regarding what OR methodology involves. The seven steps that make up the OR methodology or rational decision model are as follows (Black and Porter, 2000; Stevenson, 2012):

1. Identify or recognize that a decision-making situation exists. This may be a problem to be solved or an opportunity to be exploited.
2. Develop objectives to be achieved and criteria (what is important in the outcome) for selecting alternatives. When several criteria are involved, it is necessary to assign weights to the various criteria.
3. Generate creative and innovative alternatives one of which is to do nothing. This may involve considering past solution(s) as well as creative new solutions. If current situation is dissimilar to any ever experienced or past solutions are unsuccessful, then new creative solutions or alternatives must be generated. When old solutions have worked, new solutions still need to be considered because dynamics of rationality may reduce past solutions' effectiveness today. In addition, alternative solution may be an improvement over the past ones.
4. Analyse alternatives. This may be enhanced by the use of mathematical or statistical tools. Determine which alternatives will produce minimally acceptable results and eliminate all alternatives whose outcome is less than the acceptable minimum. Examine the feasibility of the remaining alternatives to determine the best results (those that maximize the desired objectives or minimize the undesired outcome).
5. Select alternatives that have the most favourable effect on the decision-makers objective or desired outcome.
6. Implement those selected alternatives.
7. Monitor and evaluate results. This includes gathering the right information and results or outcome from the implemented decision and comparing these with the objectives and standards set at the beginning. The aim here is to detect problems with the original decision so as to take corrective actions immediately.

ISSN: 1839 - 0846

The terms management science and decision science are sometimes used as synonyms for operations research or operational research in British usage (Wetherbe, 1979). OR is a discipline that deals with the application of analytical methods to help make better management decisions. OR encompasses a wide range of problem-solving techniques such as mathematical optimization, simulation, queuing theory, econometric methods, statistics, Markov decision processes, data envelopment analysis, neural networks, expert systems, and decision analysis, applied in the pursuit of improved decision-making and efficiency (INFORMS, 2012). Because of its focus on practical applications, OR overlaps with other disciplines, notably industrial engineering and operations management.

OR can be classified into three distinct set of categories: tools, models, and methodology. Tools include ABC Analysis, 80:20 Rule, and Break-Even Analysis. Blending models, optimized distribution system, portfolio optimization of assets would broadly represent examples of models. Methodology would include project management systems, multi-criteria optimization, game theory, simulation methodology, data envelopment analysis, enterprise resource planning systems and conflict resolution methods (Ravichandran, 2006). The tools, models and methodology of OR have found a variety of applications in different contexts. Most commonly used techniques and methods of OR, which can be freely applied by a progressive management in decision-making processes are: Linear Programming, Decision Models, Network Theory, Inventory Control Models, Queuing Theory, Sequencing, Game Theory, Simulation, Replacement theory, Reliability, Markovian Models (Erkan *et al.*, 2007).

According to INFORMS (2012), the major sub-disciplines in modern operations research include:

- Computing and information technologies
- Environment, energy, and natural resources
- Financial Engineering
- Manufacturing, service science, and supply chain management
- Marketing Science
- Policy modeling and public sector work
- Portfolio and revenue management
- Simulation
- Stochastic models
- Transportation.

2.2 Review of Empirical Studies

In the literature, not much work has been published to assess the level of awareness and appreciation of OR as a tool for management decision-making in Nigeria. The study by Idama and Tomlinson (1986) work conducted on the Nigerian Civil Service. The researchers formed the opinions that there was no awareness of what OR was all about, and that Nigerians then confused OR with social activities. Ehie and Smith (1994) had methodological problem and low response rate of 9.7%. Smith and Ogbu (1994) focused on financial institutions in Yola and restricted its investigation to six specified OR models. Akingbade (2002) reported that there is a great deal of OR content in soft or rudimentary forms in what many people are doing in Nigeria in the areas of production management and financial management, but that they were not conscious that a formal scientific rational analysis approach was being adopted. Merberk (1985) observed that this has been a global trend for a very long time. Most workers in contemporary organizations do not know what constitutes OR approach, OR methodology, OR philosophy or OR technique. To such ones, as long as no specific OR model such as linear programming or transportation is specifically mentioned, no OR is being applied. Smith and Ogbu (1994) referred to a case where the questions "Do you keep records which you use for controlling stock and production?" attracted positive responses, while "Do you use any OR techniques of scientific inventory control" led to negative responses. Statistical ideas were not always identified with OR methodology by many. Consequently, opinions expressed by an organization on the issue of awareness and appreciation of OR may need to be corroborated by careful examination of her management decision-making procedure to determine the extent to which OR methodology or philosophy is adopted.

Magbagbeola, Adetoso and Magbagbeola (2010) said, regarding the application of OR tools by small scale industry in Nigeria, that business owners may want to shy away from embracing the use of the tools. Small scale business owners in Nigeria shying away from the use of OR is a clear indication that they are yet to appreciate the efficacy and relevance of OR in business management decision-making. OR journals and related publications are dotted with published results of impressive performance by organisations most of which are as a result of OR adoption (Fernanda *et al.*, 2010; Jennifer and Lucas, 2013; Cipriano *et al.*, 2013; Lixin *et al.*, 2014; Xinhui *et al.*, 2014; Hein *et al.*, 2014).

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3. METHODOLOGY

Primary data were sourced for this study. The study was conducted among manufacturing firms listed in the Reports and Accounts of the Securities and Exchange Commission in Nigeria. Primary data were collected through administration of questionnaire to respondents from a random sample of forty-three out of seventy-two quoted manufacturing companies in Nigeria that were listed on the sampling frame. The list of manufacturing firms in the 2001 Annual Reports and Accounts of the Securities and Exchange Commission was the sampling frame for the study to ensure that newly listed firms are excluded.

Purposive sampling was used to select six respondents from each of the forty-three firms to give a total of 258 respondents. The key departments or units adjudged capable of providing the type of information this study required were Operations, Production/Factory, Research and Development, Management Information Systems, and Marketing. Six of the managers from these departments responded to the questionnaire. The researcher and four research assistants delivered the questionnaire personally to the firms, and collection was done the same way. The secretive nature of unquoted companies informed their exclusion from the study.

The first draft of the instrument was laid before some experts experienced in the art of developing questionnaire and minor corrections were made on it thereafter. A pilot study on ten managers selected from three industrial subsectors in the manufacturing industry was carried out to establish the sensitivity of the instrument. Ordinal scale with five points was used to measure the level of awareness of the respondent and appreciation of OR, with "1'' representing "very low'', "2'' representing "low'', "3'' representing "fair'', "4'' representing "high'' and "5'' representing "very high''. Extent of use of common OR was measured on a five-point nominal scale with "1'' representing "not used'', "2'' representing "little use'', "3'' representing "moderate use'', "4'' representing "frequent use'' and "5'' representing "extensive use''. A list of eleven actions or steps which could constitute management decision-making process was presented to the respondents for them to rate the extent to which such listed actions were observed during management decision-making in their organisations The list included the seven steps that make up the rational decision model. Provision was also made in the instrument for the respondents to specify and rate all other steps that may have been observed but not included in the list provided. A five-point ordinal scale was used in the rating with "1'' representing "never'', "2'' representing "seldom'', "3'' representing "sometime'', "4'' representing "often'' and "5'' representing "always''. To ensure that all the respondents give the same interpretation to the words used in the rating, the following note was provided as part of the instruction; "often'' in this scale means frequent, many times while "always'' means every time, continually, through all time. The respondent completed the questionnaire personally.

Descriptive statistics used in the presentation and analysis of data included contingency tables, percentages and weighted arithmetic mean. Just as Kurtz (1999) suggested, the values of the weighted arithmetic mean were interpreted in terms of the positions they represent on the ordinal scale.

4. RESULTS AND DISCUSSION OF FINDINGS

Forty-three (43) quoted companies constitute the sample of this study. Thirty-five of the firms participated by accepting and completing the questionnaire. The response rate based on organisational participation is 81.40%. Eight companies refrained from participating in the study. This is 18.60% of the sample. The actual number of respondents is 187 out of the 258 expected from the forty-three firms studied. On this basis, the response rate is 72.48%.

Table 1 shows subsectoral distribution of companies in the manufacturing sector that participated in the study. In keeping with the confidentiality statement of this study, the actual identity of these companies will not be disclosed. The data from the fieldwork will however be presented in aggregate form.

Table 1: Subsectoral Distribution of the Respondents

Industrial Subsectors	**Number**	**%**
Basic metal, iron and steel and fabricated products	27	14.44
Chemical and pharmaceuticals	75	40.11
Domestic and industrial plastic and rubber	5	2.67
Electrical and electronic	6	3.21
Food, beverages and tobacco	42	22.46
Pulp, paper and paper products, print and publishing	32	17.11
TOTALS	**187**	**100**

ISSN: 1839 - 0846

From Table 1, about 14% of the respondents came from the Basic Metals, Iron and Steel and Fabricated Products sector. The Chemical and Pharmaceutical sector accounted for 40.11% of the respondents which was the highest on the table, while 2.67% were from the Domestic, Industrial Plastic and Rubber sector. Six respondents representing 3.21% of the total respondents were from the Electrical and Electronic sector. Food, Beverages and Tobacco sector had 22.46%, while Pulp, Paper and Paper products had about 17% of the total number of respondents.

4.1 Level of Awareness and Appreciation of OR Methodology across the Industrial Subsectors

From Table 2, it is evident that the Chemical and Pharmaceutical subsector of the manufacturing firms had the highest level of awareness of OR, while the Food, Beverages and Tobacco subsector had the lowest. The few who responded from the Electrical and Electronic subsector could not rate their level of awareness of OR. The average weight for the entire respondents was 2.63, which gives a rating of "fair'' on our measurement scale.

Table 2: Level of Awareness of OR Methodology across the Industrial Subsectors

Industrial Sectors	Level of Awareness								
	CR	VL	L	F	H	VH	Tot	AW	Rating
Basic metal, iron & steel and fabricated products	0	0	18	0	9	0	27	2.67	Fair
Chemical and Pharmaceuticals	0	10	7	13	20	25	75	3.57	High
Domestic and Industrial plastic & rubber	0	0	0	5	0	0	5	3.00	Fair
Electrical and Electronics	6	0	0	0	0	0	6	0.00	CR
Food, beverages & tobacco	14	0	21	7	0	0	42	1.50	Low
Pulp, paper and paper products, printing & packaging	3	6	7	10	6	0	32	2.50	Fair
Totals	23	16	53	35	35	25	187	2.63	Fair
Percentages	12.30	8.56	28.34	18.72	18.72	13.36	100		

Note: CR =Cannot Rate, Tot = Total, AW = Average Weight, VL = Very Low, L = Low, F=Fair, H =High, VH = Very High. VL, L, F, H, VH has weights 1, 2, 3, 4, and 5 respectively.

Table 3 presents the responses on the extent that the respondents appreciate the use of OR as a management decision-making tool. The data identified Chemical and Pharmaceutical industrial subsector as having the highest level of appreciation for OR as a tool for decision-making. For all the other subsectors of the manufacturing industry, their level of appreciation of OR can be best described as fair except for the Electrical and Electronics subsector where the respondents could not rate their level of appreciation for OR as a tool for corporate decision-making. For the entire respondents, the level of appreciation of OR as a tool for corporate decision-making can be rated as just fair.

Table 3: Level of Appreciation of OR Methodology across the Industrial Subsectors

Industrial Sectors	Level of Appreciation								
	CR	VL	L	F	H	VH	Tot	AW	Rating
Basic metal, iron & steel and fabricated products	0	0	0	27	0	0	27	3.00	Fair
Chemical and Pharmaceuticals	0	5	10	20	15	25	75	3.60	High
Domestic and Industrial plastic & rubber	0	0	0	5	0	0	5	3.00	Fair
Electrical and Electronics	6	0	0	0	0	0	6	0.00	CR
Food, beverages and tobacco	0	0	14	13	15	0	42	3.02	Fair
Pulp, paper and paper products, printing & packaging	3	3	7	9	7	3	32	2.72	Fair
Totals	9	8	31	74	37	28	187	3.10	Fair
Percentages	4.81	4.28	16.58	39.57	19.79	14.97	100		

Note: CR =Cannot Rate, Tot = Total, AW = Average Weight, VL = Very Low, L = Low, F = Fair H =High, VH = Very High. VL, L, F, H, and VH have weights 1, 2, 3, 4, and 5 respectively.

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4.2 Level of Familiarity with Common OR Models

In Table 4, the respondents rated their level of familiarity with the common OR models. No response ''NR'' had a weight of "0", "VP" meaning "very poor", had a weight of "1", 'P', standing for "poor" had a weight of "2", "F" standing for "fair", had a weight of "3", "G", standing for "good", has a weight of "4", while "VG" meaning "very good" has a weight of "5". The result shows that 20.25% could not rate their familiarity with some of the thirty-two listed models, 7.17% rated themselves very poor while 8.74% rated themselves poor, 12.3% rated themselves fair, 18.88% rated themselves good 32.66% rated themselves very good. Consequently, the level of familiarity of 51.54% of the respondents could at worst be described as good. The total average weight based on the data from the responses is 3.00. This shows that on the average, the level of familiarity with those 32 models among managers in the manufacturing industry is at best fair. Only in six models could the managers' level of familiarity be described as at best good. In 22 models, the level of familiarity is rated fair.

Model	NR	VP	P	F	G	VG	Mean	Rating	Rank
Quality control techniques	17	0	0	26	51	93	4.02	good	1
Analysis of Variance	21	12	9	9	34	102	3.76	good	2
Capital rationing	13	7	26	4	43	77	3.67	good	3
Flow charts	17	9	3	38	43	77	3.67	good	4
Forecasting techniques	26	3	13	21	30	94	3.65	good	5
Inventory management	17	12	4	34	26	94	3.56	good	6
Statistical sampling techniques	34	4	21	9	17	102	3.48	fair	7
Job scheduling	26	8	17	30	21	85	3.43	fair	8
Material Requirement Planning	21	12	13	30	43	68	3.42	fair	9
Facility layout	26	9	3	38	47	64	3.41	fair	10
Maintenance analysis	34	9	3	21	43	77	3.4	fair	11
Breakeven analysis	30	7	26	4	43	77	3.36	fair	12
Decision tree	26	8	9	34	55	55	3.33	fair	13
Process analysis	34	8	30	4	26	85	3.26	fair	14
Transportation model	34	7	9	43	26	68	3.2	fair	15
Regression/correlation analysis	34	16	26	4	30	77	3.13	fair	16
Network analysis	38	21	4	13	51	60	3.06	fair	17
Arrow diagrams	21	21	17	51	26	51	3.03	fair	18
Goal programming	34	16	17	43	17	60	2.93	fair	19
Replacement analysis	43	15	26	9	17	77	2.93	fair	20
Linear programming	43	17	8	38	13	68	2.88	fair	21
Assignment models	34	15	26	9	73	30	2.87	fair	22
Simulation	51	8	34	9	34	51	2.64	fair	23
Integer programming	43	17	37	13	26	51	2.62	fair	24
Probability analysis	51	17	21	13	34	51	2.62	fair	25
Gantt chart	51	12	30	34	26	34	2.4	poor	26
PERT/CPM	68	21	4	17	43	34	2.26	poor	27
Bayesian statistics	43	26	32	26	47	13	2.25	poor	28
Nonlinear programming	60	42	4	13	38	30	2.09	poor	29
Markov chain	60	15	30	30	43	9	2.04	poor	30
Game theory	60	27	21	30	26	23	2.02	poor	31
Work Measurement	102	8	0	30	30	17	1.62	poor	32
Totals	1212	429	523	736	1130	1954	3.00	fair	
Percentages	20.25	7.17	8.74	12.30	18.88	32.66	100		

Table 4: Level of Familiarity with OR Models among the Respondents

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It is obvious from Table 4 that the most familiar of the 32 models listed is Quality control techniques with weighted mean of 4.02 (rated good), followed by Analysis of variance with weighted mean of 3.76 (rated good), the next is Capital rationing with weighted mean of 3.67 (rated good). Forecasting techniques with weighted mean of 3.65 (rated good) was in the fifth position; Inventory management with weighted mean of 3.56 (rated good) was in the sixth position in the descending order of familiarity of the models to the respondents. The other nineteen models have their weighted mean between 3.48 and 2.62 and the rating was fair level of familiarity. Seven of the models had their weighted means between 2.40 and 1.62 with a rating of poor, and these were; Gantt chart, PERT/DPM, Bayesian statistics, Nonlinear programming, Markov chain, Game theory and Work measurement.

Steps 1 – 7 in Table 5 constitute the rational decision-making procedure or operations research (OR) decision-making methodology. The data showed that 1.38% could not rate the extent to which OR methodology is used in decision-making by their firms, 2.90% said it is seldom used by their organisations. The opinion held by 10.77% of the respondents was that it is sometime used, 29.26% said that it is often used, but 55.69% said that it is always used. All the respondents were of the opinion that the OR methodology (Steps 1 – 7) was never completely ignored in their organisations' decision-making.

Objections were raised to the use of steps 8 – 11 as 20.86% rated as 'never' the extent to which those four steps form part of their decision-making procedure. The OR methodology was rated as 'seldom' followed by 2.90% of the respondents, while 12.43% gave the same rating to steps 8 – 11. The opinion of 10.77% was that the OR methodology was sometime adopted by the organisations in decision-making but 20.45% rated Steps 8 – 11 similarly as part of their management approach. Among the respondents 36.86% said they used OR approach often in management decision. On the other hand 27.27% of the respondents felt that steps 8 – 11 were also followed often. Over half of the respondents 55.69% rated as 'always' their adoption of OR methodology in decision-making. The same rating was given to steps 8 – 11 by 14.44% of those responding managers. A total of 69.23% said that at least those listed eleven steps were often followed by them in decision-making. It is evident that OR methodology in decision-making is very popular as 84.95% said it was used at least often by managers.

4.3 Discussions

From the analysis, 18.72% rated their level of awareness as fair, while 32.08% rated it as at least high. Those with low level of awareness (49.20% including those who cannot rate) constitute almost 50% of the respondents. Awareness campaign through seminars, workshops and conferences by operations research community and perhaps corporations is therefore necessary to heighten awareness in this sector of the economy. Operations Research Society of Nigeria may have a role to play here. The level of familiarity with OR of 12.3% of the respondents was rated fair, while that of 51.54% was rated at least high. This shows that about half of the respondents are familiar with the common models used in OR, 49.46% of managers in the manufacturing sector are at best fairly familiar with OR. Regarding the OR methodology, none of the respondents agreed that it has never been used in their organisations' decision-making processes. The opinion of 10.77% was that it is sometime used in their organisation, 84.85% held the opinion that their least assessment of the extent to which OR methodology is used by their organisation in decision-making is often. These results, while not very impressive, do not however portray complete ignorance of OR among Nigeria managers.

5. CONCLUSION

As emphasized by the Institute for Operations Research of Nigeria (INFORN) in 2011, OR is a discipline that can be applied in virtually every area of business and government such as in health care, manufacturing, finance, transportation, city planning, judiciary, defence, entertainment industry, etc. This study concludes that the level of OR awareness among managers in the manufacturing sector of Nigerian economy may be described as fair, so also is the level of familiarity with common OR models; but OR methodology was found to be a popular decision-making procedure by the firms in the sector.

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2001 Annual Reports and Accounts of the Securities and Exchange Commission

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ISSN: 1839 - 0846

Table 5: Steps that Constitute the Organisation's Decision-making Procedure

Step		Extent to which Step is Taken								
		CR	**N**	**S**	**ST**	**O**	**A**	**Tot**	**Aw**	**R**
1. Identifying the decision-making situation (problem/opportunity), which exists for the organization		0	0	0	20	47	120	187	4.50	A
2. Specifying the objectives and criteria for making decision.		0	0	0	22	94	71	187	4.26	O
3. Developing a list of possible alternatives one of which is to do nothing.		7	0	21	69	43	47	187	3.51	O
4. Analysing and comparing the possible alternative solution.		0	0	4	17	66	100	187	4.40	O
5. Selecting the best alternative solution.		4	0	0	10	53	120	187	4.50	A
6. Implementing the selected alternative solution.		7	0	0	3	30	147	187	4.64	A
7. Monitoring the result to ensure that the desired objective is achieved.		0	0	13	0	50	124	187	4.52	A
8. Using intuition		27	23	3	57	70	7	187	2.75	ST
9. Using past experience, the art of discovery, and guided trial and error.		0	0	30	50	50	57	187	3.72	O
10. Selecting as solution the very first option that meets the minimally acceptable requirement rather than pushing further for the best solution.		7	43	30	33	41	33	187	2.84	ST
11. Rationalizing a choice made purely on personal preference after the decision has already been made.		0	90	30	13	43	11	187	2.22	S
Totals:	For steps 1–7	18	0	38	141	383	729	1309	**4.34**	**O**
	For steps 8–11	34	156	93	153	204	108	748	**2.88**	**ST**
	For steps 1-11	52	156	131	294	587	837	2057	**3.81**	**O**
Percentages	For steps1-7	1.38	0.00	2.90	10.77	29.26	55.69	100		
	For steps 8-11	4.55	20.86	12.43	20.45	27.27	14.43	100		
	For steps 1-11	2.53	7.58	6.37	14.29	28.54	40.69	100		

Key: CR = Cannot Rate, N = Never, S = Seldom, ST = Some Time, O = Often, A = Always, AW = Average Weight, Tot = Totals, R = Rating