

EXPERTCHOICE[®] DECISION SUPPORT SYSTEM IMPLEMENTATION FOR VEHICLE SELECTION IN A COLOMBIAN SHIPYARD

IMPLEMENTACIÓN DEL SISTEMA DE SOPORTE DE DECISIONES EXPERTCHOICE[®] PARA LA SELECCIÓN DE VEHICULOS EN UN ASTILLERO COLOMBIANO

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ABSTRACT: This article shows the application of the decision support system (DSS) Expertchoice[®] for pick-up truck selection in a colombian shipyard company. The article begins with a description of such decision support systems, followed by a market availability analysis of such systems, and finally presents the application of the DSS Expertchoice[®] for pick-up truck selection in the company studied.

KEY WORDS: decision support systems (DSSs), software, Expertchoice[®], information systems.

RESUMEN: El presente artículo muestra la aplicación del sistema de soporte de decisiones – DSS (Decision support systems) para la selección de automóviles tipo camionetas en un astillero colombiano. El artículo comienza con una descripción acerca de estos sistemas de soporte de decisión, se analiza la disponibilidad de los mismos en el mercado y finaliza con la aplicación del sistema DSS Expertchoice[®] para la selección de las camionetas en la empresa de estudio.

PALABRAS CLAVE: sistemas de soporte de decisión (DSSs), software, Expertchoice[®], sistemas de información.

1. INTRODUCTION

Decision analysis processes are a core business activity of current management, in which managers should use their experience and all of the available information on the company in order to make the decisions that best suit its requirements [1,2]. Due to the complexity and the short time in daily operations for making this kind of decisions, managers need tools to facilitate these processes, but they also need to be certain about the decisions they are making [3,4].

Decision support systems (DSSs) are computer tools that help managers to make decisions, and are responsible for obtaining, analyzing, reporting, and even making decisions for themselves. This article provides a brief review of DSS and presents the use of one of these systems for the selection of pick-up trucks in a Colombian shipyard.

2. DECISION SUPPORT SYSTEMS

Decision support systems are a specific class of information systems that help business people to make decisions. These systems work under the scheme of modeling information, facilitating the decision making process [5,6]. Decision support systems allow for one to obtain relevant information from an unorganized set of data, which can be found in text documents, spreadsheets, and even in the knowledge of people, which becomes the input to solve decision-making problems, as well as generating strategies in companies.

According to Tech-FAQ.com [7], many companies have integrated these systems into their daily activities, as is the case of companies that constantly analyze their sales data, budgets, spreadsheets, and forecasts

to make decisions about the daily planning process. According to Tech-FAQ.com [7], although there is no universally-defined classification for DSSs, they can be separated into three basic categories: passive, active, and cooperative.

The passive decision support systems are responsible only for collecting and organizing information for its use by the people responsible for the decision; therefore, these systems do not suggest any specific response [7]. The active systems are responsible for collecting information, upon which they base an explicit presentation of one or more solutions to the decision problem [7]. A cooperative DSS is responsible for gathering the information, analyzing it, and then delivering it to the people responsible for decision making, and is also tasked to revise or refine the information. The name “cooperative” is derived from the cooperative work between software and people, with the intention of making the best possible decision [7].

Figure 1 shows the classification of DSSs in the three families mentioned in the previous paragraph, as well as their scope.

The classification in Fig. 1 is based on the interaction of the support system with users. A classification based on the functioning of such tools shows a separation into 5 types of families [7,8]:

- Communication-based DSSs
- Data-driven DSSs
- Document-based DSSs
- Knowledge-based DSSs
- Model-based DSSs

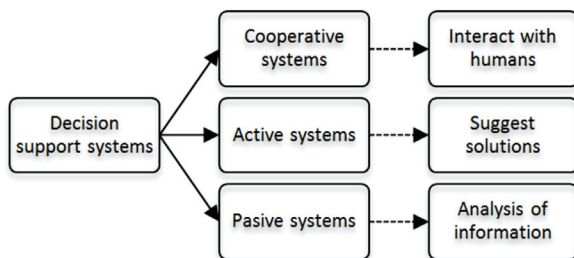


Figure 1. DSS classification and scope in decision making

A communication-based model is based on the communication of several people for making the

decisions. The data-driven DSS is responsible for collecting the information, which is then manipulated to meet the need of the person responsible for the decision. The document-based DSS system uses various types of documents (pages of text, spreadsheets, database reports, etc.) to solve decision problems, as well as to manipulate the information in an attempt to refine strategies.

Knowledge-based systems analyze specific rules stored in a computer or rules used by a group of humans, which allows one to establish whether a decision should be made. Finally, systems based on models use statistic simulations and financial models to solve decision problems [7].

It is important to note that although these are very good computer tools for analyzing information, and even though they give options to be selected as the best alternative, the final decision of the decision-making process must belong to people and not to software tools, which are inanimate machines that are incapable of considering many external factors in the analysis and can not contextualize the information they present, information which could modify the final decision.

3. DECISION SUPPORT SYSTEMS OFFER

On the international market, it is easy to find software suppliers who provide DSSs, due to their importance in helping companies. Table 1 shows a list of DSS manufacturers reported by DSSResources.com [8], which is comprised of more than 80 manufacturers. This demonstrates the broad offer available for such software tools.

Table 1. DSS design companies [8]

Actuate	EMC	JasperSoft
Axiom	Epocrates	Kalido
AdaptivePlanning	ESRI	Fair Isaac Corporation
Applix	Experian	Kognitio
Arcplan	ExpertChoice [®]	Magenta Technology
Avanco	EXSYS	MapInfo
BEA Systems	FacetDecisionMaking	InformationBuilders
Business Objects	Facilitate.com	Microsoft
Captaris	Greenplum	MicroStrategy
CentrifugeSystems	FrontlineSystems	Mindbox

Clarabridge	Geac	MIS AG
ClaritySystems	Symbol Technologies	MySQL AB
Cognos	Hummingbird	NAVTEQ
CSC	Hyperion	Netezza
Databeacon	IBM	Oco, Inc
DataMirror	ILOG	Omniture
Datanautics	Informatica	Oracle
Decisioneering	Scorto	Outlooksoft
Dimensional Insight	Insightful	Palisade
E Team	Intergraph	Pentaho
Polycom	Sybase	SAS
ProModel	Tableau Software	SGI
Purisma	Teradata	Spotfire
Retek Inc.	Tibco	SPSS
RiverLogic	WebEx	Stellent
SAP	webMethods	StottlerHenke

These systems use analytical models to analyze information and to guide those responsible for decision making. In addition, some of these models can use both quantitative and qualitative variables simultaneously. Table 2 presents some of the analytical methods for supporting the DSS processes which are most used.

Table 2. Decision making analysis methods classification [9] (adapted from [10])

Classification	Evaluation Technique
Economic approach (based on relationships)	Incomes associated to investment
	Return on investment
	Cost-profit analysis
Economic approach (discount techniques)	Net present value
	Internal return rate
Economic approach (future value technique)	Theory of real price of the option
Strategic approach	Technical relevance
	Competitive advantage
	Critical success factors
	Budget theory application
Analytic approach (budget)	AHP
	Scoring models
	Fuzzy logic
Analytic approach (others)	Risk analysis
	Value Analysis
Integrated approach	Multi-attribute profit theory
	Balanced scorecard (BSC)

One of the most widely used software for decision making in the industry is Expertchoice[®], of the U.S. House of Expert Choice software [11]. This software is based on the Analytic Hierarchy Process (AHP) for selecting the best alternative in a process of decision analysis that can be multi-attribute, multi-objective, and that also may involve several people in the analysis process.

4. THE AHP METHOD AND EXPERTCHOICE[®]

The Analytic Hierarchy Process, is based on structuring a problem in different levels so that the overall objective of the decision analysis process is the first level of hierarchy, followed by the factors, sub-factors, and criteria that need to be considered for the decision process [12,13]. Once the hierarchical structure for the decision problem is set, this objective and factor structure (called the *hierarchical structure*) is compared with the alternatives that can solve the particular problem, as shown in Fig. 2 [14].

Once the hierarchical structure is established, the person responsible for decision making should establish a set of preferences regarding the comparison of all of the factors and criteria of the hierarchical structure as well as a comparison of alternatives with respect to each criterion of the last level of hierarchy. The presentation of the preferences for each of the factors, criteria and alternatives in a table is known as the *preference matrix*, which is the starting point for the mathematical analysis of the AHP method.

The DSS software ExperTchoice[®], through a user friendly interface allows for one to:

- Get all the information about the hierarchical structure of the problem and the preferences of the evaluator in a quick and easy way.
- Automatically carry out all of the mathematical treatment of AHP for decision making.
- Develop a sensitivity analysis of the final answer given, in which the evaluator can modify the decision delivered by the software. (making Expertchoice[®] a cooperative tool).

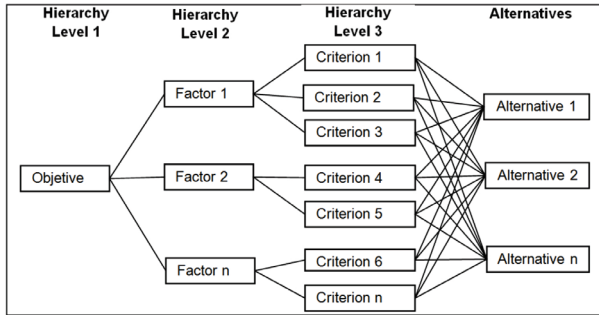


Figure 2. AHP method structure, adapted from [14]

In the next section, the Expertchoice[®] software application for the selection of pick-up trucks in a Colombian shipyard is presented.

5. DSS EXPERTCHOICE[®] APPLICATION

The central problem of decision in the company of the study is to select the brand of new pick-up truck to be acquired by the company to renew its fleet. The problem is structured with a central goal (selecting the best pick-up truck according to the needs of the company) and 8 critical factors for the decision. The number of possible alternatives is 6. The relevant factors for the company are:

- Price (in USD)
- Power (HP)
- Fuel consumption (mpg)
- Cargo capacity (Kg)
- Acceleration (sg 0–60 mph)
- Stopping distance (ft)
- Noise (dBA)

- After-sales service

Figure 3 shows the structure of the decision problem.

The preferences given by the evaluator of the company with respect to the factors of the perented structure are shown in Table 3. Preferences of the comparison between the alternatives and each of these factors were obtained in the same way.

6. RESULTS

6.1. Choosing the best alternative

Using the Expertchoice 5.1 trial version, it was possible to select the best alternative for pick-up trucks with the requirements of the company. The results of the preferences and the final score according to the global goal are shown in Figs. 4 and 5, respectively.

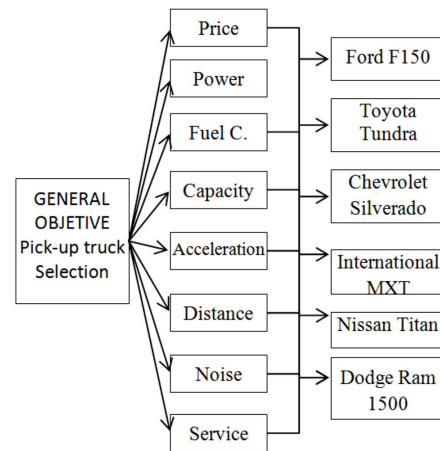


Figure 3. Decision problem structure

Table 3. Preferences matrix

	Price (USD)	Power (HP)	Fuel consumption (mpg)	Cargo capacity (Kg)	Acceleration (sg 0-60 mph)	Stopping distance (ft)	Noise (dBA)	After-sales service
Price (USD)		-3.0	-4.0	-3.0	4.0	-9.0	5.0	-7.0
Power (HP)			2.0	1.0	5.0	-3.0	5.0	-5.0
Fuel consumption (mpg)				3.0	5.0	-3.0	5.0	-4.0
Cargo capacity (Kg)					6.0	-3.0	7.0	-4.0
Acceleration (sg 0-60mph)						-5.0	3.0	-5.0
Stopping distance (ft)							7.0	1.0
Noise (dBA)								-9.0
After-sales service								

Inconsistency index: 0.09

Priorities regarding pick-up selection



Figure 4. Preferences toward the global goal (pick-up selection)

Summary regarding pick-up selection

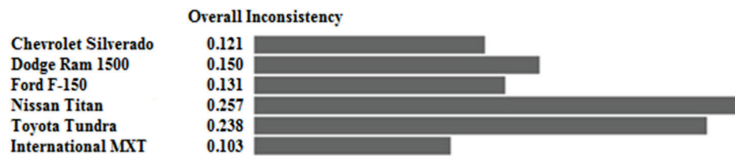


Figure 5. Final classification of alternatives

According to Fig. 4, it is possible to see that the factor that has the most weight is the after sales-service, followed by the stopping distance and fuel consumption. Figure 5 shows that the alternative that has the most weight is the Nissan Titan, which means that this is the pick-up truck that should be selected by the company, after considering goals and factor preference

From Fig. 5 it is also possible to observe that the overall inconsistency of the problem is less than 0.1. The consistency index is a measure of the balance that the evaluator has on the judgments that he delivers to the system, through the comparison matrix. A value of this ratio below 0.1, demonstrates an acceptable consistency and allows one to

continue with the application of the AHP method.

6.2. Sensitivity analysis

To perform the sensitivity analysis, the factors of after sales service, stopping distance, fuel consumption, and power were selected, since these have more relevance to the overall goal, as presented in Fig. 4. Using the Expertchoice[®]5.1 performance tool, it is possible to obtain the performance chart of each of the pick-up trucks with respect to the factors, as shown in Fig. 6. When making changes to the weight of preferences, it is possible to evaluate changes in the final result for the selection of the pick-up truck, which is the sensitivity analysis.

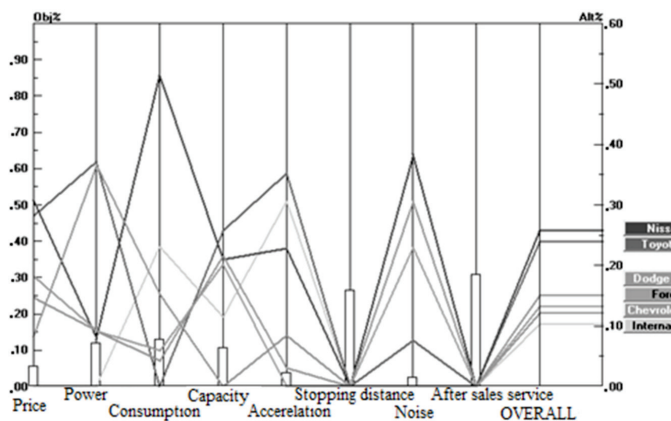


Figure 6. Alternative performance chart by goals

In Fig. 6, the shadowed lines correspond to the performance of each alternative for each factor. The white color bar determines the weight of the alternative corresponding to the weights determined

by Expertchoice[®]. Next, the sensitivity analysis is carried out for each of the four factors mentioned by increasing or decreasing the weight of the factors and then analyzing the outcome changes.

6.2.1. Variation in after-sales service and stopping distance

By changing the weight of the after-sales service factor, as shown in Fig. 7, it can be seen that there is no change in

the outcome; the Nissan Titan remains the best alternative. Therefore, the model is not sensitive to changes in this variable. A similar result occurs with changes in the stopping distance factor, as shown in Fig. 8.

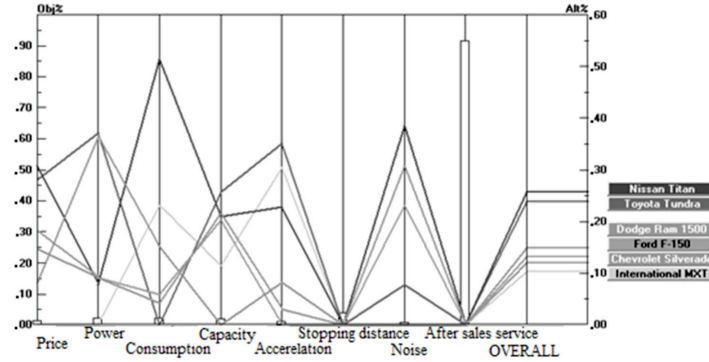


Figure 7. Sensitivity analysis: after-sales service factor

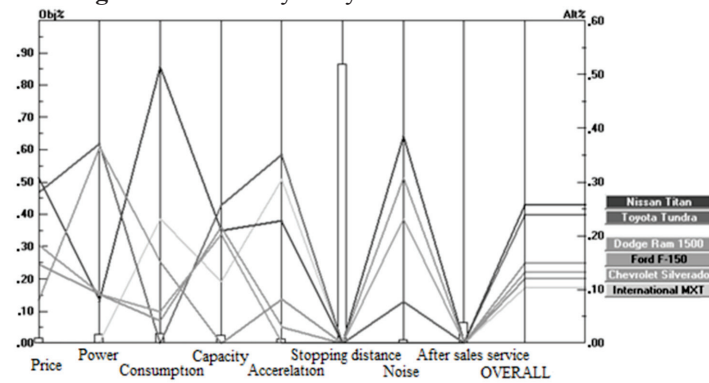


Figure 8. Sensitivity analysis: stopping distance factor

6.2.2. Variation in fuel consumption

If the fuel consumption variable loses weight, the final decision to choose the Nissan truck is modified, the Toyota Tundra becoming the best alternative. In

contrast to this, as the variable's importance increases, the decision is not altered and the selection of the Nissan Titan is strengthened. The graphs of sensitivity that show these movements in the fuel consumption factor are shown in Figs. 9 and 10, respectively.

Figure 9. Sensitivity analysis: fuel consumption, reduction of valuation

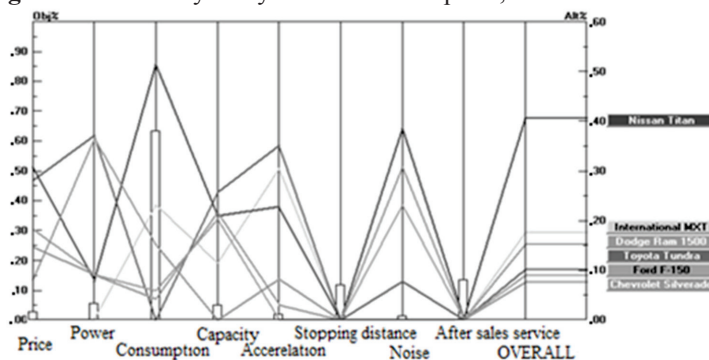


Figure10. Sensitivity analysis: fuel consumption, increase of valuation

6.2.3. Variation of power

In contrast to what happened with the fuel consumption factor, the sensitivity analysis reveals that in the case

of increased preference for the power variable, the final decision to choose the Nissan truck is modified, the Toyota Tundra becoming the best alternative. The sensitivity chart that illustrates this situation is presented in Fig. 11.

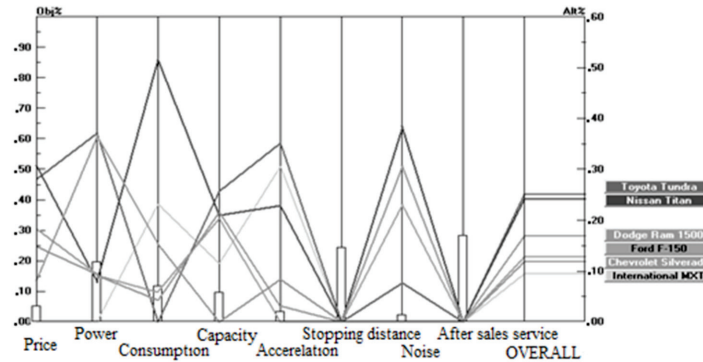


Figure 11. Sensitivity analysis: power

In summary, the sensitivity analysis of the variation in the preference of the four most important factors indicates that the model is sensitive to fuel consumption and power. In contrast, variations in the preference of after-sales service and stopping distance factors showed no impact on the final decision, calculated for the DSS Expertchoice®.

7. CONCLUSIONS

Decision support systems help humans in the decision-making processes, both in data acquisition and its processing, but these systems help especially in the use of analytical techniques that reduce subjectivity in decision analysis.

With the help of the decision support system Expertchoice®, it was possible to make a complex decision regarding the best pick-up truck for the Colombian shipyard in which the study was conducted. The complexity is caused by the high number of factors to take into account (8) and the different alternatives (6), which makes it so that a person or group of people who make the decision will not have clarity on the best choice, until they really consider all these elements.

As it was shown in the implementation of the Expertchoice® DSS, this is an easy to use system, which is based on the AHP method for solving problems of multi-objective analysis. In addition, this system not only delivers the final solution, but also allows

for a sensitivity analysis to visualize the impact of preference on the factors in the final decision, allowing for the evaluation of trends and the modification of the decision based on them.

Finally, the relevance of DSSs is demonstrated by the large amount of software companies that supply these kinds of systems to the market, which is derived from the amount of companies interested in acquiring this type of software to facilitate and/or improve their decision processes.

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