

# The Evaluation of Transport Vehicle Suppliers

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**Abstract**— If in a twenty-five million city somebody changes three undergrounds, it is transportation. If you go to the pub by bicycle in a village of one hundred and fifty people, it is also transportation, but it is different. In a city of hundreds of thousands of people, transportation is already a common concern, and so it is left to professionals to figure it out. This requires decisions. The purpose of this study is to illustrate the preparation of a decision. During the preparation of the decision, the experts of a Hungarian transport company of the city of one hundred thousand people had to consider that the application of the ROIs they considered important was not applicable due to the public service character and the long-life cycle. Expectations were very diverse, and most were non-quantifiable. The leader of the company commissioned a team of experts to prepare the decision, consisting of an economist, a railway mechanical engineer, a transport system organizer engineer, an electrical engineer and an electric plant manager, as well as a city politician and civil servant. As a consultant, I strived for a transparent decision-making process, using the algorithm of a knowledge-based system based on Artificial Intelligence. This knowledge-based system can overcome the limitations of a person's working memory and allow the exploration of the relationships between dozens of experts' expectations.

**Keywords:** *artificial intelligence, Doctus knowledge-based system, decision-making*

## I. INTRODUCTION

The balance between thinking and calculation has been upset. It is as if the only thing for decision-makers is to “bring the numbers”. Nothing is more natural than adapting to the spirit of the age and focusing on the data flood. They cling to the saying that numbers don't lie. It was deeply embedded in everyone. “Five hundred and one million, six hundred and twenty-two thousand, seven hundred and thirty-one. I am a serious person. I need exact numbers” – we can read in “The Little Prince” written by Antoine de Saint-Exupéry. The businessman in “the fourth planet” is a true homo economicus or economic man who always wants more. Many people believe that as the number of data increases, they can predict the consequences of their decisions in advance and thus control uncontrolled events. The role of luck and chance is denied. This is the illusion of knowledge, that is, over-reliance on data. This unreal world can easily fall prey to decision-makers and become counting agents instead of finding ways out. Hard data often turns out to be very soft information. They lack depth and detail and tell us nothing about non-quantifiable business information. Information that is important to your strategy never comes

from hard data. The facial expression of the buyer, the mood at the factory, the voice of a government official, this can all be important information for the decision-maker [1].

Often, the decision-makers choose as they do because their intuition suggests that it is the right way to go. It is impossible to put intuition into words. Perhaps it is like jumping into the dark: distancing ourselves from data and relying on our feelings [2]. Can a first-glance decision be as good as planning, after a long period of thought? Malcolm Gladwell claims this is very possible [3]. Extraction of the essence often leads to better results than a more detailed, in-depth exhaustion of thought. Recognizing the big picture in words is an indelible, abductive conclusion. We all rely on our intuition, but it must be accepted that this requires experience. It is much more difficult to accept the consequence that a beginner may not have viable expectations. The strong belief in the perceived knowledge of the decision-maker often prevents them from revising their past expectations from time to time. According to Daniel Kahneman we also perceive a new decision-making situation we are unfamiliar with because of our overconfidence and is unable to formulate new expectations [4]. As we see a pathway that meets our expectations that can be translated into words, we can think of expectations that we were unable to put into words before seeing the pathway.

In the seventies, it was Herbert A. Simon, a winner of Nobel-prize in Economics [5], who recognized that we cannot search for the best, the optimal, because it is impossible to find all the ways. It has been a few decades since, but there are still organizations trying to encourage decision-makers to do so. The order of access to the exits is based partly on expectations and partly on luck. First, I see it all, accept it or throw it away without explaining the details. Decisions, therefore, depend on the order in which the pathway are known. In organizations where decision-making processes are determined by a series of rigidly prescribed steps, decision-makers need to “tell them” their expectations. They focus on working “well”. They depend on others' expectations, so their fitness is reduced. If, after a long period, they set out on their own, they will be unable to put into words what they are looking for. They will be incapable of making decisions. They will imitate the action patterns of others and enjoy spending their free time in karaoke bars to sing “well” to others' songs [6]. Richard Thaler [7] writes of Herbert Simon that he received the Nobel-prize in Economics in vain because we can safely say that he had little influence on economists. Most economists overlooked Simon's work because it was too easy to override bounded rationality by providing a valid but insignificant concept. We

can expect radical changes in the life of an organization only from decision-makers who can make paths that others do not. They are driven by passion and curiosity, and instead of “how”, “what” is done is at the centre of interest. It comes first to “doing good”, which is – as Robert Pirsig [8] defined – dynamic quality, and then to “doing well”, which is a static quality. The order is irreversible. If this is the order, then the search for the way out should also be. Then knowing what we are going to do will make it easier to determine how we are going to do it. “What” to do cannot be extrapolated from the past when it goes well or even when it goes wrong.

**II. THE USED METHOD**

Research into decision-making is perhaps beyond childhood disease when it was imagined that algorithms - a series of rigidly described operations - would dispel any doubts. Applied Operations Research ignored basic and applied research and developed useful algorithms that optimized well-structured sequences of operations. Mining the experts’ experiences is a difficult task, and it can only happen during a conversation. Making a decision is much more than a reason to act. It provides an opportunity to define virtue and truth, to discover or interpret what is happening, what the decision-makers are doing, and what explains our actions. It is an opportunity to spread glory and responsibility for what has happened, and thus to practice, question, and reinforce friendships, oppositions, power, or status. The fact that decision-makers spend more time on symbols, myths, and rituals is because they are better known than the expected outcome [9].

More than twenty years ago, the Doctus Knowledge-based system was created by combining knowledge elements of decision-making, artificial intelligence and cognitive psychology [10]. More than a hundred knowledge bases have already been built with the decision-makers of domestic and foreign companies. Doctus is also present in education and has been purchased and used in education by several domestic and foreign universities. One advantage of expert systems is that they do not have to quantify all expectations. They can also handle concepts. This is very important as decision-makers can place a lot of expectations only on conceptual scales. Another important benefit is that you can track the operation of the system transparently, without the need for specialized knowledge to understand the reasoning behind the software. Knowledge-based systems have two components: the framework (shell, shell, skeleton) and the knowledge base. The knowledge base implements symbolic knowledge representation, that is, describes expert knowledge in terms of concepts and occasional rules. In most decision-making textbooks, as Charles Handy, one of the greatest doyens of influential business thinkers, said, that the humanity has been tried to be numbered, passion and desire placed in a hierarchy of needs [11]. But in business decisions, soft information will never be measurable. In recent years, development has shifted to experience mining. The importance of this was well illustrated by the November 2013 issue of Harvard Business Review, which focused on smart decision making. One article outlines the tools used in decision support [12] and expert systems are also in place, confirming that experts in decision-making do not only believe in hard methods. The new trend in decision-making is based on the fact that we can only express a few expectations, and when a solution comes up, new,

unspecified expectations also emerge. Artificial Intelligence models the human thought into words with if-then logical rules. Based on this, machine learning can start something with tacit knowledge. The essence of tacit knowledge is that it is wordless and can never be explained.

The Doctus knowledge-based system inferred from explicit cases and rules, a chained implementation of deduction [13]. Understanding this conclusion is supported by a back-chain explanatory option. From the explicit cases of the experienced decision-maker, the ID3 algorithm [14] can reveal some of the tacit knowledge. This is the induction that results in a model graph [15]. It only contains informative, that is, viable properties. Existing and on-the-go knowledge bases can outline typical patterns of thinking that describe the experiences of decision-makers. By recognizing these patterns, decisions become transparent and can be explained [16]. As Kahneman writes, the model of intuitive decision-making as pattern recognition develops Herbert Simon’s previously published ideas. He was perhaps the only scientist admired and recognized by all those involved in decision-making research [4]. Business decision-makers do not express their expectations in numbers but use concepts such as weak, excellent or better. It connects these concepts with a few thousand rules. This is not a problem. However, it is difficult to pull out a lot of rules, and the knowledge engineer can help with this expert system. The essence of rule-based expert systems is to extract the sometimes logical rules between the values of expectations from the experience of experts. Doctus Knowledge-based System can be used to prepare decisions, such as planning the transportation of a city of hundreds of thousands, to select a new vehicle supplier.

**III. KNOWLEDGE ENGINEERING**

The knowledge engineer was a member of the expert team. The difficulty in acquiring knowledge was that not only several experts but also many decision-makers were involved in defining the rules. They grouped their expectations into four main areas: Technical Feature, Economic Feature, Traffic Feature and References. This can be described by a deductive graph shown in Fig. 1. Besides, if-then logical rules between the values of each attribute were defined. These attributes depend on additional attributes, as indicated by the small lines on the right side of the graph’s letters.

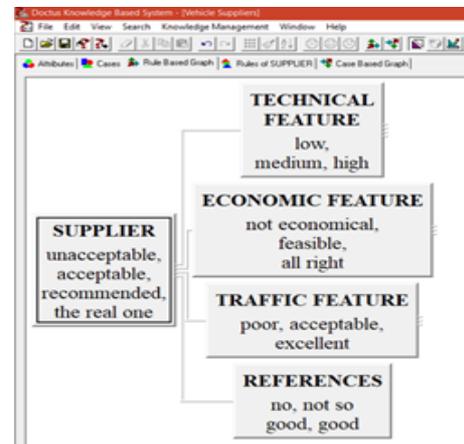


Fig. 1. Deductive graph

In this knowledge base, experts collected a total of eighty attributes, of which fifty-three were independent and twenty-seven dependent. Seventy-four if-then logical rules were used by experts to determine the values of dependent attributes. For example, look at the if-then logical rules for the three values of the Economic Feature. Fig. 2 shows that Economic Feature depends on the Operating Costs, the Credit and the Purchase Price attributes, but they also depend on the values of additional attributes.

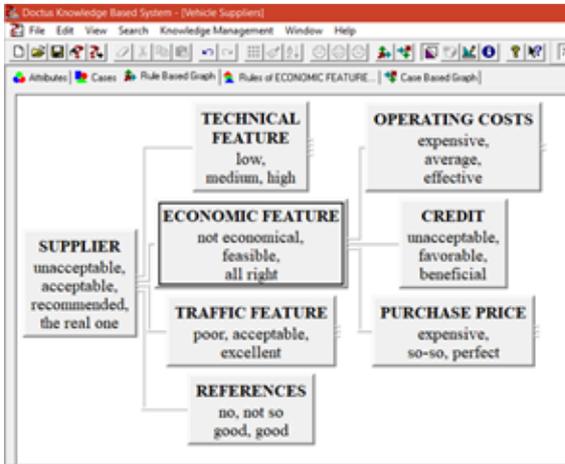


Fig. 2. The attributes of the Supplier

Examining the if-then logical rules, Fig. 3 depicts that the Economic Feature is all right if the Purchase Price is perfect and if the Credit is beneficial and if the Operating Costs are average or effective. The Economic Feature is all right as well if the Purchase Price is so-so and if the Operating Costs are effective and if the Credit is beneficial. It is important to note here that these rules were spoken there and then by the experts who were entrusted there and then to choose a supplier. In such a situation there is no single right solution, that is, this knowledge base can only be applied there and then.

	CREDIT	unacceptable	favorable	beneficial
PURCHASE PRICE	OPERATING COSTS			
expensive	expensive	not economical	not economical	not economical
expensive	average	not economical	not economical	not economical
expensive	effective	not economical	not economical	not economical
so-so	expensive	not economical	not economical	not economical
so-so	average	feasible	feasible	feasible
so-so	effective	feasible	feasible	all right
perfect	expensive	not economical	not economical	not economical
perfect	average	feasible	feasible	all right
perfect	effective	feasible	feasible	all right

Fig. 3. The if-then logical rules of the Economic Feature

The experts examined three possible suppliers of the new tram. Supplier A, supplier B, and supplier C are described with thirty independent attribute values. No one would think it was smooth. The basis of collective thinking [17] is to give the same meaning to most of the concepts. The appropriate attitude and expertise of the knowledge engineer are essential to resolve the contradictions between the experts. Under the

stated if-then logical rules, deductive reasoning rated supplier A as “the real one”. Fig. 4 shows this result.

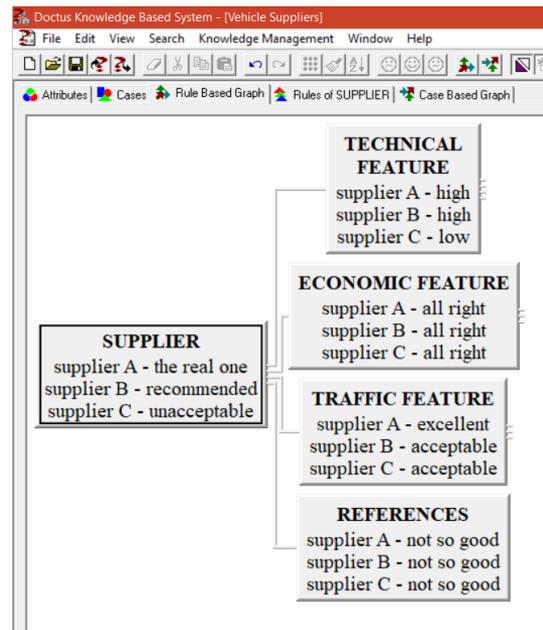


Fig. 4. The result of Deductive Reasoning

This is a decision proposal that has the greatest benefit of being transparent, explainable and thus easier to accept.

#### IV. THE MACHINE AND THE HUMAN

The big question now is whether machines will be able to replace man as a decision-maker. More and more research is calling for a radical change in the workplace and the workplace of the future, mainly due to the process automation based on artificial intelligence and industrial cyber applications. Changes are well illustrated by the spread of the concept of industry 4.0 but replacing processes with machines will have a huge impact on people's behaviour and decisions. In the 1990s, the realization of the rule-following behaviour defined by James G. March and Herbert A. Simon as an identity emerged. Already back then, many people were concerned about what they would do and how they would behave when routine activities were taken over by machines. It was expected that the study of the non-rule-following person would be in focus, and this was supported by research by Richard H. Thaler, a winner of Nobel-prize in Economics in 2017, on health, well-being and happiness decisions [18].

Everything has become “smart”, or at least that's what it's called. This is almost as trendy today as it was a decade ago, something like “e”. Knowledge-based systems based on Artificial Intelligence never wanted to replace the decision-makers. The knowledge stored in knowledge bases cannot be more than what they know, but without machine learning, they would not be able to extract it from their working memory. Many have tried to describe the decision process. Nobody succeeded, so it is still up to the decision-makers to use the knowledge they need right then and there. It is impossible to make decisions based on a few step descriptions of decision processes. Decision-maker reasoning is an internal monologue whose building blocks are meaningful symbols. It is not made up of data and does not

operate according to the laws of mathematical logic. It is impossible to describe the reasoning of the decision-maker with hard data. There is no justification for a tool that ignores the convictions and intentions of decision-makers. Nevertheless, many believe that managing big data can replace the decision-maker. Just a push of a button and we'll find a pathway.

Who wants an Artificial Intelligence that has its own will? Maybe those who believe nothing of their own. Don't dream of a world where there are only crosswords that can be easily deciphered by robots instead of us. Perhaps it is worth thinking about how to live with machines that do not read and understand, just pretend. Nevertheless, Todai Robot passed the entrance exam for the University of Tokyo [19]. Noriko Arai, an Artificial Intelligence researcher at the TED2017 conference [20], talked about how we can help children be extraordinary in the things in which we humans will always be better than Artificial Intelligence.

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