

# Relationship between Human Decisions and an Expert System

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*Abstract: It could be hard to make decisions in the mass of information. Many stimuli veins us nowadays, we cannot choose from only one or two options, we must make as objective decision as possible. Due to ICT there are some software available on the market for supporting us to make decisions. The study shows the relationship between a quality manager's decision of an investment at an automotive supplier and a knowledge-based expert system's verdict of the same investment.*

## 1. Theoretical background

In life, we always must make decisions. It could be about business, school, relationships, jobs or even buying jeans. This is actually a problem because if we make wrong decisions we will have to pay the price for it, one way or another.

We call it a problem when we would like to reach a particular goal but we do not know the way of it. Things become harder when we realise that these problems can be examine different way, depending on our thoughts and experiences. People like to choose the one that certify their way of thinking even if they do not know it. People are not looking for the best available alternative. They don't search alternatives, they choose the first thing that satisfy their expectations. This means that our choices cannot be rational enough. Herbert Simon realised this fact about human mind, that we have bounded rationality. He won Nobel Memorial Prize in Economic Sciences for "for his pioneering research into the decision-making process within economic organizations" in 1976 [1].

Daniel Kahneman is also a professional in behaviour economics. He said that people in their life choose mostly well. But sometimes we choose very fast in some cases. For example if someone is guilty or not. We say: "I think..., in my opinion... etc", so we are actually uncertain in that specific question, the decision is based on uncertain events. Kahneman won the Nobel Memorial Prize in Eco-

conomic Sciences “for their analyses of markets with asymmetric information” in 2001 [2].

There are also some other scientists who also researches decision-makers’ behaviour. Richard Thaler who is an expert in behavioural science, he explains the differences between humans and so-called econs. How does he mean humans? Decisions can’t be modelled, because we are not numbers, not attributes, we are humans. We see concepts. On the other hand econs can decide the best possible alternative, and economists think that people choose like this, humans cannot. Thaler won the Nobel Memorial Prize in Economic Sciences for “for his contributions to behavioural economics” in 2017 [3].

There are some models that explain how we decide in everyday life. Rational model: It means that the decision makers make consistent, result maximized decision, trying to know every possible alternatives. Nonetheless, decisions are not that easy to make. People cannot know every alternatives or rank them. Bounded rational model: Simon and March said that decision makers satisfied with the first alternative. In theoretical level decision making includes many roles and people, it is quite a complex process. I will try to explain some factors of it in the following [4]. According to Simon there are two types of decisions:

1. Ill structured decisions: These decisions are always important, there are not any approved techniques making it, it is not a daily routine. In this situation the decision maker must define judgments, assessments, and assumptions.
2. Structured decisions: These decisions are routines, well known techniques to making it [1].

There are some roles in decision making: decision maker, problem raiser, decision preparative, analyst, expert and an executor.

- Decision makers have the most difficult role because they have to take responsibility for the decisions they have made. A decision maker can be a person or a team. They have the permission to take care of the resources, make the purchase.
- Problem raiser could be anyone or anything, a manager at the company or industrial trends in today’s competitive world.
- Decision preparative can be the one who has enough knowledge to distinguish among the possible choices. A new investment is not only an engineering question, it has financial, logistical, legal, environmental consequences. They have to offer alternatives, they cannot make the decision.
- Analysts and experts must have lexical and practical knowledge to help making the right decision. They can be inner colleagues, consultants or even a software.
- Finally, the decision has to be executed when it is possible [4].

There are four phases of making decisions: Recognising the problem, defining the possible solutions, choosing from the alternatives and apply the decision [4].

## 2. Supporting decision makers

There is a software called DoctuS which helps decision makers to choose as rational as possible. This is a knowledge-based expert system. “The term knowledge-based decision support refers to using software tools called knowledge-based systems (KBS), expert systems (ES), or knowledge-based expert systems – as they utilize knowledge bases and are expected to perform at the level of a human expert” [5]. DoctuS does not replace the decision maker it just helps him or her, it makes a suggestion. With this software decision-makers can evaluate all cases and after deductive reasoning can get a suggestion. This suggestion is explainable, and the process of decision making becomes transparent [6].

To map alternatives there has to be a theoretical background of it. “The knowledge base embodies the symbolic representation of knowledge, describing practitioner knowledge with concepts connected by “if... then” rules” [7]. Our mind is consisted of concepts, these are not concrete data because we do not see number or scales, and we think by concepts. That is why user of this program has to build the knowledge database of the alternatives. The choosing is based on if-then rules. This gives the logical rules for the decision. For example, if something is not important, the decision will be influenced that way. Finally, deductive reasoning, which is a logical notion. It is based on premises, with specified methods it converts attributes, wherewith we get a conclusion [8]. It is a top-down logic. It means that if something is important is one thing, then it will be important in other things too.

There is a specific process of using DoctuS, these are the following:

1. The decision comes up for the decision maker, and for an expert who is professional in that specific area.
2. Defining the problem.
3. Collect knowledge.
4. Define if-then rules
5. Get the result

### 3. Case study

The decision is about an investment of a 3D measuring device. It was at a Japanese owned automotive supplier, which employs about 100 people. It produces small sized plastic parts into cars, mostly check valves. The decision-maker is the quality manager of the plant. I made an interview with him about the already made investment, what were the aspects of the decision.

#### 3.1. Deep interview with decision-maker

Before building a knowledge base, I had to explore the topic of 3D measuring and the background of the investment. I made a deep interview [9] with the quality manager of the company. With this qualitative method I could recognize the main attributes and values of the topic.

**Q: Why did the company had to invest into a 3D measuring device?**

*A: Due to the improving technology, we produce smaller, more complex parts with narrower size tolerances." This is why measuring by hand is not an option anymore because measuring this way puts a lot of uncertainty into the measurement. There had been an old 3D measuring device but it is out of order and it is not profitable to have it repaired. Another important aspect of investing into a 3D measuring device is more proper and automated measuring of incoming goods.*

**Q: Which expectations were the most important in the decision?**

*A: These were the price, technical parameters, and maintainability.*

**Q: How could you define technical parameters?**

*A: It depends on expendability and accuracy. Expendability is important for the company to have a multifunctional device. It should has a probe and an optical sensor. Both are essential at a company which produces small plastic parts. And it depends also on accuracy. Due to smaller parts and stricter customer requirements we need an accurate and a high resolution measuring device.*

**Q: How could you define maintainability?**

*A: It depends on service network and reliability of the manufacturer. Service network? If the measuring device gets out of order it is important to repair it as fast as possible. Reliability of the manufacturer? This is a complex value because there are a lot of subjective thoughts in people's mind. It is important to have a wide product line because we know that the manufacturer is serious in measuring devices.*

**Q: Which manufacturers were considered at the investment procedure?**

*A: Nikon, OGP and Zeiss.*

After this interview with the decision maker, namely the quality manager of the company, we watched the three devices. Figure 1 depicts them.



Figure 1.

Considered 3D measuring devices: Nikon, OGP, Zeiss

### 3.2. Building knowledge base

The main decision is choosing a measuring device. The decision-maker defined three important attributes: price, technical parameters and maintainability. Every aspect is important, and they depend on each other. Lower level of the knowledge base is also depending on each other. Figure 2 depicts the deductive graph of the knowledge base.

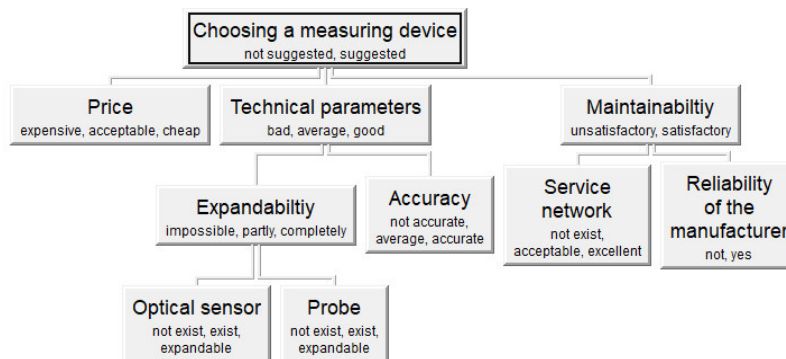


Figure 2.

Knowledge Acquisition

After drawing the deductive graph we have to define the if-then rules in every depending nodes. Figure 3 shows the rules of ‘Choosing a measuring device’. For example:

If ‘Price’ is cheap  
 and if ‘Maintainability’ is satisfactory  
 and if ‘Technical parameters’ are good  
 then ‘Choosing a measuring device’ is suggested.

	Price	expensive	acceptable	cheap
Technical parameters	Maintainability			
bad	unsatisfactory	not suggested	not suggested	not suggested
bad	satisfactory	not suggested	not suggested	not suggested
average	unsatisfactory	not suggested	not suggested	not suggested
average	satisfactory	not suggested	suggested	suggested
good	unsatisfactory	not suggested	not suggested	not suggested
<b>good</b>	<b>satisfactory</b>	not suggested	suggested	<b>suggested</b>

Figure 3.  
If-then rules

Figure 4 depicts the deductive reasoning of Doctus and the conclusion of the decision. The main problem is choosing the appropriate measuring device. The final result is the OGP, the other two devices are not suggested. Maintainability is satisfactory of every measuring devices, therefore it is an irrelevant aspect in this specific case. Technical parameters are both good for two measuring devices, one of the three has only average technical specifications. These two parameters can be regarded as the same result. There is a great difference in one aspect, this is the price. The OGP is cheap while the other two devices are expensive. Examine the parameters we can see that this is the relevant attribute so the OGP is the appropriate measuring device for the company.

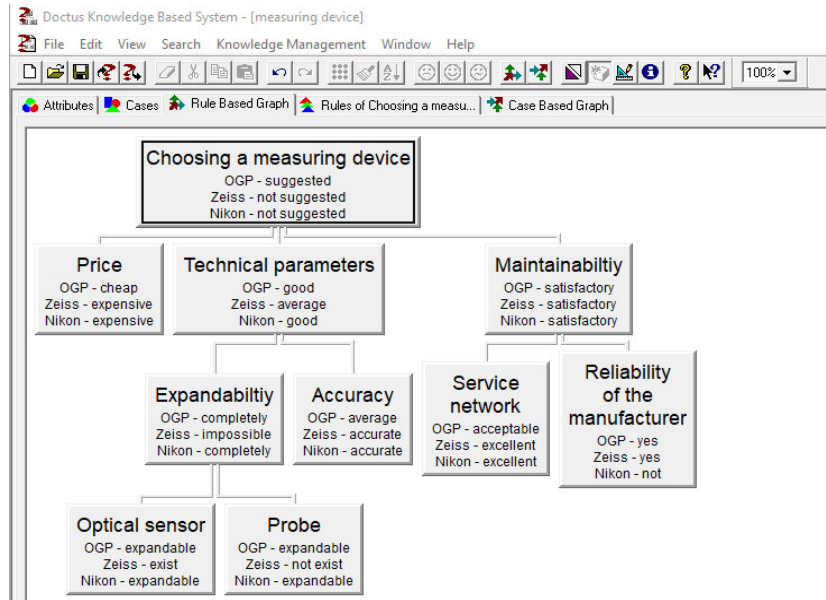


Figure 4.  
Deductive Reasoning

The decision maker found the software very interesting and useful. He understood how difficult to put his expectations put into words. The decision making became more transparent due to this software so it is easier to explain for the shareholders. He also proposed the OGP, the main reason why he choose this is because it is expandable well and the price of it is cheaper than the other two devices.

### Conclusions

It is hard to make decision in every part of life. When it is about money, decision-makers have to be as rational as possible. It is hard because many stimuli veins us nowadays and we are bounded rational. The study showed the result of a decision at an automotive supplier compared with the same decision made by a knowledge based expert system, called Doctus.

The decision was about an investment of a 3D measuring device where the company's and the expert system's decision was the same which means a rational decision. If more attributes were explored then the result would be different. It is worth get to know more aspects of investments at companies because allocation resources is a major matter, further researches are suggested.

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