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Intuitivno spletno orodje za podporo procesom odločanja

Supporting the Decision Making Process using an Intuitive Web Based Solution

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Povzetek

Znanih je veliko metodologij in orodij za podporo odločanju, kot so na primer AHP, DEX, simulacijski modeli ipd. Čeprav so v teoriji dobro raziskani, je uporaba v vsakdanji praksi precej manjša. Razloge za to lahko poiščemo v pomankljivem metodološkem znanju, slabšem razumevanju kompleksnih odločitvenih situacij (na primer: nasprotujočih si kriterijev, šibkem razumevanju povratne informacije, skupinskemu odločanju). V članku opisujemo razvoj intuitivne spletne aplikacije ODESYS, ki je zasnovana na metodologiji večkriterijskega odločanja in povezana v okolje za sodelovanje v družbenih omrežjih. Uporabnost aplikacije smo preverili s poskusom, v katerem je sodelovalo 26 udeležencev, katerih naloga je bila rešiti predstavljeni odločitveni problem s pomočjo uporabe spletnega orodja. Mnenja udeležencev o uporabnosti orodja smo zbrali z vprašalnikom. Rezultati kažejo na to, da so uporabniki orodja visoko ocenili zaznano uporabnost in enostavnost uporabe, kar je vzpodbuda za nadaljni razvoj.

Ključne besede: sistemi za podporo odločanju, večkriterijsko odločanje, spletna system, okolje za sodelovanje

Abstract

There are many decision methodologies and tools for supporting decision-making processes, for example AHP, DEX, system dynamics models and others. Although they are well researched in theory, they are not commonly used in everyday practice. There are few reasons for that: lack of methodological knowledge and

misunderstanding of complex decision situations (conflicting criteria, misperception of feedback information, group decision-making etc.). In this paper we discuss the development of an intuitive web application, based on the multiple-criteria methodology in a collaborative social media environment, called ODESYS. A preliminary experiment was conducted to explicate the usefulness of the application's guidance of decision-making process. There were 26 subjects participating in the preliminary experiment to test the usefulness of the application. Their task was to solve the presented decision problem using the tool. After the experiment their opinions were gathered by a questionnaire. Results suggest that the perceived usefulness as well as the ease of use were rated high, which gives optimistic outlook for further work.

Keywords: decision-support systems, multi-criteria decision making, web system, collaborative environment

1 Introduction

Our lives are determined by the decisions we make. Choose well and you will prosper, make wrong choices and they will be your downfall. This great age of technology, that we are living in, challenges us with a great number of decisions that we have to process each day. The number alone is not the sole problem. These decisions are also increasing in complexity. When deciding we have to take into account many variables and consider possible consequences that will be a result of our actions. Unfortunately the human brain cannot possibly wrap around this level of complexity and still make an informed decision (Simon, 1991; Dubois, 2010). In order to overcome this deficiency, different methods have been developed to support the decision-making process, like analytic hierarchy process (AHP). Developed in the 1970's (Saaty, 2001) it is the most widely used and internationally accepted technique. There are other similar methodologies, like DEX (Bohanec and Rajkovič, 1999), Machbet (Bana e Costa et al., 1999), ANP (Meade and Presley, 2002) and others. Yet methods alone are not enough to efficiently support decision making. They have to be implemented in a software solution. Decision support systems (DSS) have been fulfilling this role since the 1960's. Although significant improvements have been made over the years from both a technological and methodological point of view, we still believe that they suffer from an inherent flaw.

In our opinion, existing general purpose decision support systems are too complex for use by the majority of individuals without any prior knowledge of decision theory and decision making techniques. This cuts off a significant portion of the population from the benefits of such software. Furthermore, the role of DSS lies not only in helping the decision-maker to find the solution that best fits his or hers goals and preferences. It is about supporting decision-makers' cognitive process and facilitating reflection about the problem. In fact, we can call this a learning process, in which the decision-maker systematically processes knowledge in order to minimize the possibility of making a wrong decision (Wang, 1997).

There are two types of learning supported in ODESYS: the single loop learning, which describes the alteration of our behavior in order to reach the stated goal (Argyris, 1996; DiBella and Nevis, 1998; Gephart et al., 1996) and the double-loop learning, which is usually present in a group setting. The core of the tool represents an implementation of the single loop learning process, where the user is encouraged to improve the model in accordance to his or

hers preferences and goals. Collaboration environment directly supports the double-loop learning, by sharing visions and beliefs, which encourage the user to reflect about different perspectives of a model and might result in the change of one's mental model (Kljajić Borštnar et al., 2011).

To address this issue we developed a general purpose web-based decision support system that is designed from the ground up from a user-centric perspective. Our approach was to apply the basic concepts of multi-criteria decision making, which have been in use for more than 60 years, to a web platform, using the latest available technologies in order to increase usability.

We believe that the decision making process can successfully be supported by such a system. It seamlessly guides the decision maker through the decision making process. By providing direction, instructions and help through every step of the way, it alleviates the need for prior knowledge of decision theory. The methodology is presented step-by-step instead. The decision maker is therefore able to focus on solving the problem at hand instead of thinking about how to use the system or study the method that is used underneath.

Our goal was to provide a framework that helps the decision maker to think about the problem, quickly and efficiently design a decision model, evaluate all alternatives and have the results displayed in a graphical manner for easy comparison. We presume that by using this tool, the decision maker is able to make a better decision by gaining a deeper understanding of the decision problem. Further, we believe that the tool would support teaching about the decision-making and/or efficiently support learning in the interactive learning environment.

To test the perceived ease of use and usefulness we conducted a preliminary experiment where students were asked to read a description of a decision problem and then try to solve it using our DSS. After they had chosen their preferred alternative, they were asked to fill out a questionnaire about the experiment and the system. We tested on two groups of students. The first group consisted of freshman bachelor's degree students and the second consisted of first year master's degree students. Our goal was to get information about the experiment itself and get a first look at the subjective opinions of the students about the system. With the data gathered we will be able to prepare a more elaborate study on a larger, more diverse sample.
By just analyzing the opinions, we were able to get information about our system and answered the question if we are headed in the right direction. In the future experiment, with a bigger sample, the possibilities of analyzing different aspects of the groups and comparing the results becomes feasible.

Methodology
Odesys method is based on combination of two methods for multiple-criteria decision-making: ABACON and Kepner-Tregoe. The decision-making process can be described by the following steps, that can be repeated:

1. Problem definition
2. Alternatives identification
3. Criteria identification
4. Evaluation
5. Analysis

The criteria identification involves identifying factors that influence our decision and priority definition. Where in ABACON the parameter priority is defined visually and there is no final score calculated the Kepner-Tregoe method assumes priority setting on scale from 1 to 10 (where 1 presents the least important parameter and 10 the most important one), and parameter evaluation on a scale from 0 to 10, where 0 is the least desired value and 10 the most desired one. Based on this the final score of an alternative is calculated as linearly weighted sum. Odesys method combines the two so that parameters priorities and alternative scores are presented both visually and with calculation. The priority is implemented by decreasing weight ration, where the most important criteria receive 100 point and all the following are calculated relative to that. The final alternative score is calculated as shown in Equation 1.

$$U(a) = \sum_{i=1}^{n} k^{(i-1)} t_i(a) \quad (1)$$

Where *U(a)* is the final score of an alternative, *n* the number of parameters, *k* the decreasing weight ratio.

The flow diagram presented in Figure 1 shows expanded decision process of ODESYS method with the six steps of modelling the decision knowledge and an additional step which assumes decision analysis by the crowds implemented by the social media.

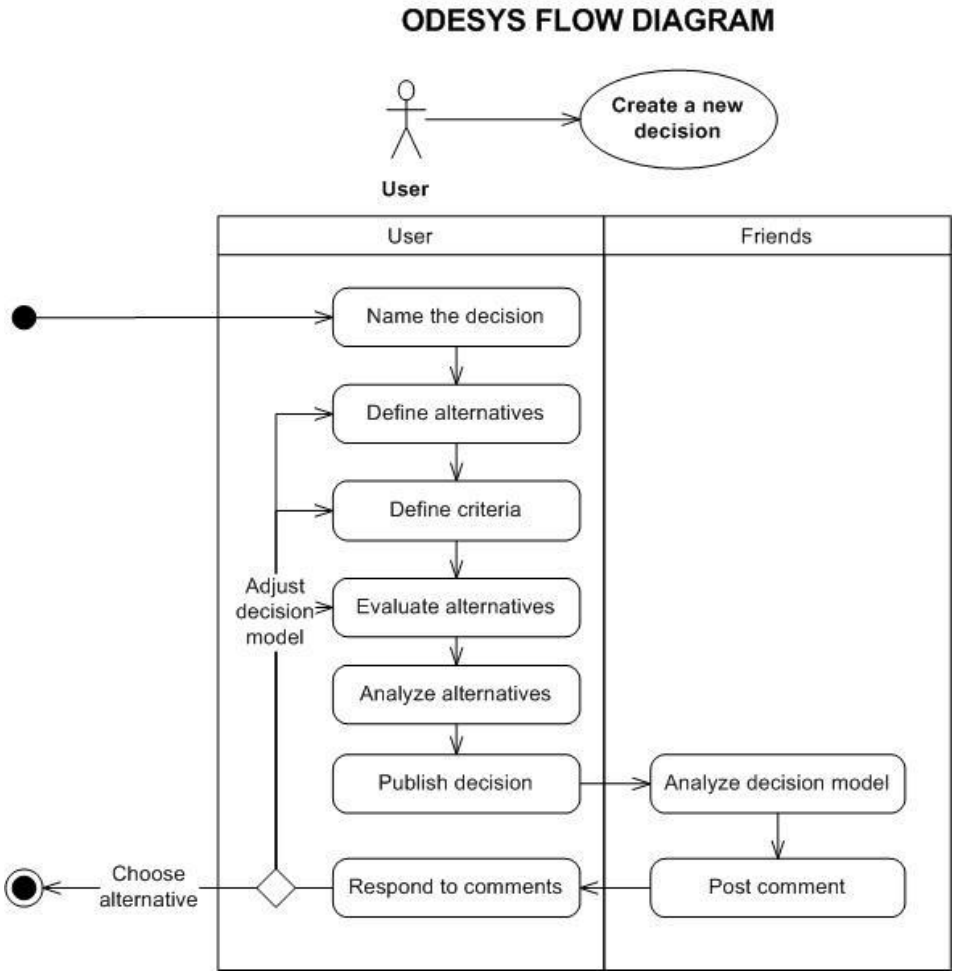

Figure 1: ODESYS Flow Diagram

2 Designing the system

Development on the decision support system began in 2010 as a part of the bachelor's degree thesis by Taj Pelc, who developed the first prototype of the system named ODESYS (Pelc, 2010). The system was later redesigned from the ground up with ease of use being the main guiding principle, but the application flow remained much the same. The main feature is a wizard-like six step process that guides the user through the different steps of solving a decision problem as can be seen from the application flow diagram presented in Figure 1.

There are a few presumptions that must be fulfilled so that the system may be used successfully. We presume that the user has a decision problem for which he is able to identify at least two alternatives and at least two factors by which the alternatives are going to be evaluated. We believe that these requirements are met by the majority of decision problems and therefore the system may be used for general decision support.

Another big feature of the system is the collaboration part, which is not a subject of this article, but is worth mentioning since it strongly influences the design of the system. Because of the implementation of collaboration on a decision problem, we have implemented Facebook Connect as the only option to log into the system. Although official numbers for the year 2011 have not yet been released by Facebook, according to TechCrunch there are indications that Facebook has reached 750 million active users (Kincaid, 2011). Logging in with a Facebook account can be done with two clicks and with such a potential user base we do not feel that an additional registration process exclusive to our application is necessary.

After the user has successfully logged into the system, he or she is able to create a new decision. Our system asks the decision maker to name his decision. By clicking start, he is then taken to the first step of building a decision model, the alternatives page. The system asks the user "What alternatives are you considering?" and he is then encouraged to enter alternatives through an input field. Help is available in the sidebar so the user is familiarized with what an alternative is and is given some examples. Detailed help is always available through a click of the help button.

Once two alternatives have been added, the second step (Figure 2) where the decision maker defines the criteria is unlocked and he is again presented with a question; "What factors influence your decision the most?". The factors may be entered via an input field, similarly to the alternatives page. A key difference here is that factors may be rearranged by priority from the most important on the top to the least important in the bottom. This is indicated by a movable area of the input field as well as in the description in the sidebar.

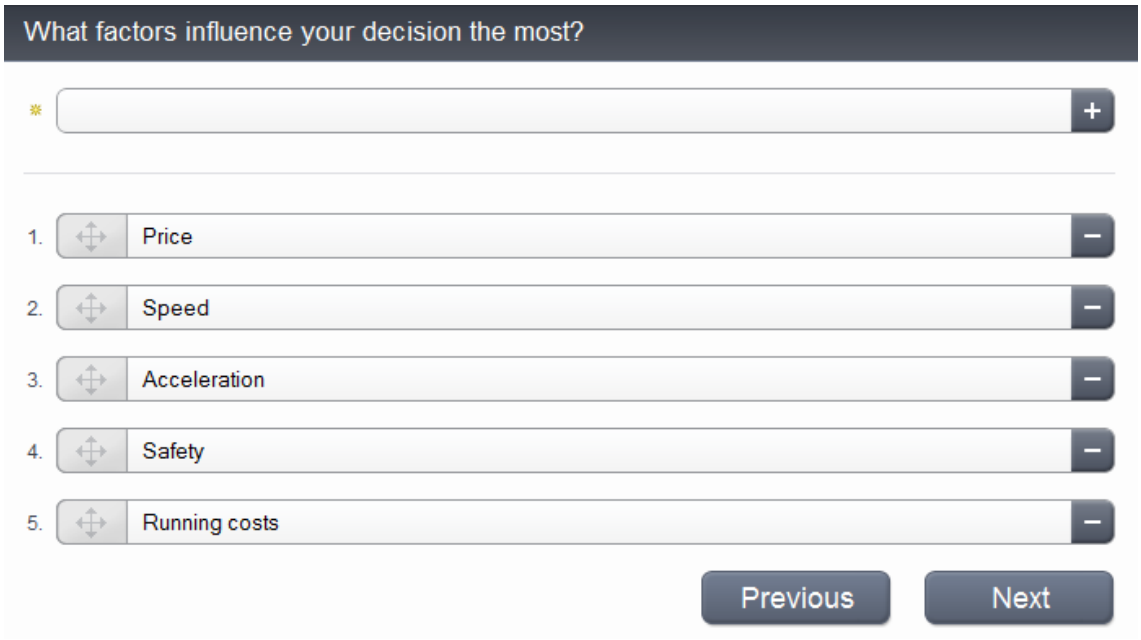

Figure 2: ODESYS Second step (Criteria)

After the user successfully adds two factors, the evaluation step is unlocked. By clicking next, the user is taken to the page where he is asked to: "Move each slider to the appropriate position to evaluate alternatives." Figure 3 presents how each alternative is then evaluated by each factor by the user with pages grouped by factors. In example if the decision problem was buying a car, all considered cars would be evaluated by price on page, safety on page two and so forth.

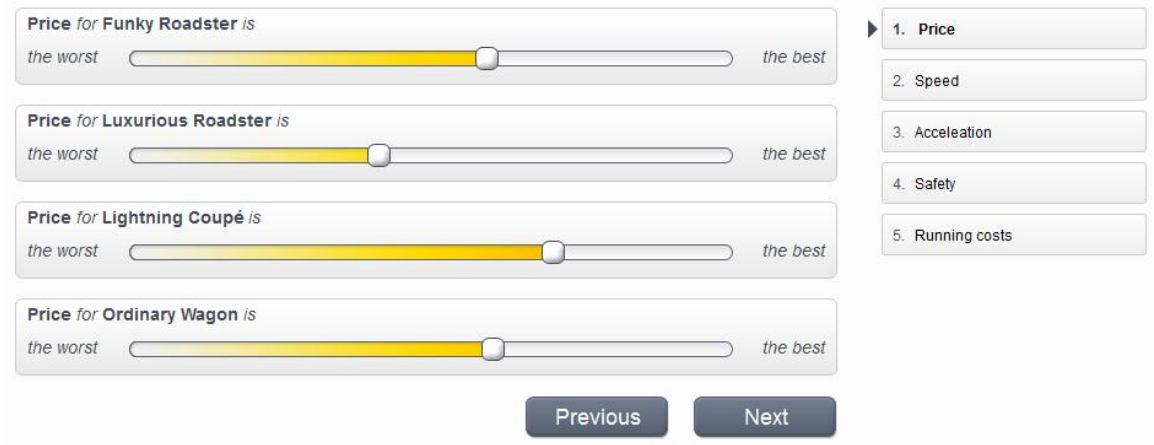

Figure 3: ODESYS Third step (Evaluation)

When all alternatives have been evaluated by each criteria, the user may then proceed to the analysis page (Figure 4). The user is encouraged to: "Compare alternatives to find which one is best suited for you". Here the system aggregates all the results from the evaluation page and displays a total score for each alternative. The highest scoring alternative is given 100 points and all other alternatives' scores are calculated relative to the highest scoring alternative. This is also displayed in a score graph. On the analysis page one is also able to see a detailed comparison. By default, the two highest scoring alternatives are drawn on the canvas side by side, so that the user is able to compare them at each criteria and see where the score difference comes from. He is also able to freely add or remove any off the alternative to see how they compare in detail. If insight is gained and the user wishes to change the decision

model or perhaps add another alternative, one that was not previously considered, he may return to any of the previous steps.

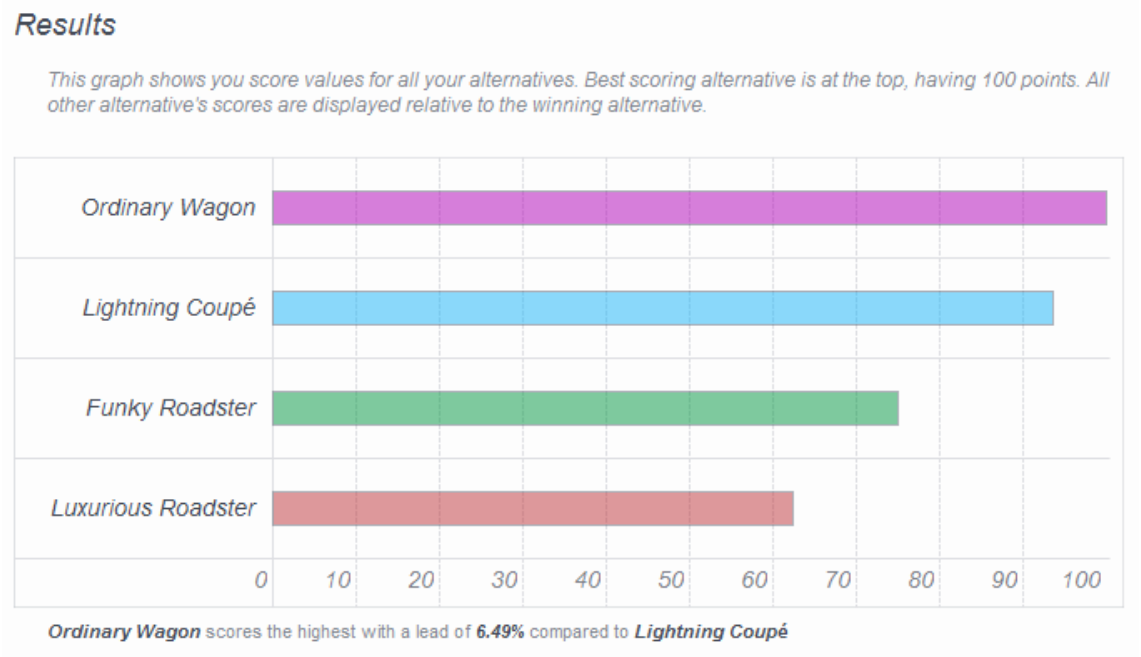

Figure 4: ODESYS Fourth step (Analysis)

This is an implementation of the single loop learning process. The user is encouraged to reconsider his model, find new alternatives or rearrange the order of criteria. By repeating this process, the user is able to gain a deeper understanding of the decision model. Something that is not as easy to do without such a system.

It is important to note, that the system does not find the best alternative and promotes it as the only logical choice. It simply provides the framework for the decision maker who is then able to play around with the alternatives and compare them in order to better understand the decision problem.

An upgrade to the process described above is collaboration on a decision problem. Since this is something that we were not experimentally testing, we will only briefly describe the logic behind it. After the decision model is made, the user is able to publish the decision on his Facebook wall and/or other popular social networks. His social circle is then invited to look at the decision model and the description, which the owner of the decision provided. This way they are able to identify themselves with the decision problem. Participants are then encouraged to provide feedback via a commenting form and post their opinions. This sparks the discussion about the decision problem and generates new ideas. Based on this new insight the decision maker is able to explore the decision problem even further.

3 Conducting the preliminary experiment

When designing the preliminary experiment our primary focus was to guarantee anonymity by not requiring users to log in with their own accounts. This way, they would not be reluctant to input their personal preferences when creating the decision model. Because our DSS uses Facebook Connect for authentication, we created anonymous test accounts. Each student was given a random test account with which he could log in and use the system.

When students were logged in, they were asked to read a description of a decision problem and then try to solve it using our DSS. We chose a decision problem with which the students could identify – choosing a mentor for a Diploma / PhD thesis. In the description we restrained ourselves from giving too much detail about the decision problem, thus making the decision problem soft and subjective to each individual student. Our goal was to let the students identify alternatives and factors from the description as well as leave them with open hands in regard to adding their own. In this context, the description of the decision problem was just a guideline for students and not a basis for the one and only valid decision model.

After making the decision by choosing the preferred alternative, students were asked to fill out a questionnaire about the experiment and the system. Two groups of students, in total 25 students, of University of Maribor, Faculty of Organizational Sciences were participating in the survey.

When designing our system we assumed that most of our potential users would be Facebook users. Another reason for choosing this social network service was assuming that our users mainly turn to their friends for support when making decisions. The results of our questionnaire confirmed our assumptions to be accurate. When asked which social network services do you use, 92% of students answered Facebook, whilst Twitter came second with 16%. This means that at least for the population of students on our faculty, the usage of Facebook is high enough to satisfy our simplified log-in requirements.

Based on data gathered, 75% of students agree that the experiment was well prepared and more than 90% of students understood the decision problem well. The time interval for the experiment was sufficient for more than 70% of the students, even though motivation was not as high with only 40% of the students stating that they were motivated to participate in the experiment. This could be explained by the timing of the preliminary experiment. Because it was conducted in May when classes are ending, focus and motivation are minimal. Based on the former statistics we conclude that the decision problem was presented well and could be used for another study in the student population. To reduce the effects of low motivation, we should conduct the experiment in fall, right after the classes begin, when both motivation and class attendance are high.

Investigating further leads us to a finding that more than 60% of the students think that ODESYS was helpful in supporting them to solve the decision problem. More than 80% of the students claim that working with ODESYS was intuitive and that it was quick and easy to get started. Furthermore, 80% of the students think that ODESYS provides a good overview of the decision-making process, and more than 90% of the students say that graphical representation of the results helped them better understand how alternatives compare among each other.

With over 90% agreeing ODESYS is simple to use, 70% of the students agree that it is also useful. Nevertheless, even though the system according to the results of the experiment seems to be easy to use, intuitive and helps the users to better understand the decision problems, only 4% of the students would use it on a regular basis. 64% of the students would only use it for complex decisions and the rest (32%) do not think using the tool would ever be necessary. These results seem counter-intuitive at first glance. Even though the system can provide benefits, which the students were able to identify, they are reluctant to use it. This could be attributed to the human factor. Students do not see the benefits of analyzing their decision-

making process and the problem being addressed, probably because they believe that they are good decision makers. If they get it wrong occasionally, they rationalize it. We believe that this is the key area to investigate in the follow-up study. What is the source of this inconsistency and how to adjust the system in order to overcome this limitation? Perhaps a change in the mindset is required in order for us to realize that few of us are inherently good at decision making and that using a system that enhances our understanding is a good thing. On the other hand, the system may not be providing decision support in a way that would help the decision maker to realize the benefits.

The results also revealed some interesting insights into the decision making of the students. When asked "Do you know the feeling of making a wrong decision?", students answered with: 92% rarely, but it happened and 8% yes, commonly. The interesting part was, no one answered with a "no". This is again curious. Even though the students realize that they are prone to making mistakes, almost all of them are willing to consider using the system only for very hard decision problems, which is again highly subjective. Where this threshold is positioned, depends on each individual and can mean that they would probably only use the system in a situation where they are unable to reach a decision otherwise.

When asked "Do you consider other people's advices?", students answered with: 64% "when arguments convince me" and with 36% "I'm always open to other people's opinions". Interestingly no one answered with "never", which means that students are generally opened to other people's advices. This is of course subjective as well, but gives a positive indication that the inclusion of social collaboration can prove to be useful and that further research is reasonable.

4 Conclusions

Decision theory, decision support systems and decision making software are complex topics to address, particularly because we still don't have a very good understanding of the cognitive processes behind decision-making. Some authors even state that rational decision-making is an illusion. Despite this, we believe rational decision making is important, be it in business or in our personal lives. People want to be successful and improve their quality of life. This can be achieved by making informed decisions. Having this in mind we have developed a web based tool to support a decision-maker in the process. Decision-maker is seamlessly guided through decision-making steps without needing a deep methodological knowledge. To support the social context of decision-making we placed the tool in the social media environment where decision-maker can connect to his or hers social network and further explore previously unforeseen perspectives if the specific decision problem.

ODESYS proved to be a useful, easy to use and intuitive decision support system. The results of the preliminary study gave us the necessary feedback and confirmation that we are on the right track. We will continue to support this project by developing it, making further research in the field of decision making, bearing in mind the limitations in understanding of science in this area and the human behaviour that is at times counter-intuitive and unpredictable.

We found interesting results and opened an interesting discourse during our research. Our main goals for the follow-up are exploring the inconsistencies that we found in our preliminary research as well as expanding our experiment to cover different groups of people

with a different background in decision support in order to see how each group views decision making.

Based on the results of the preliminary study we can conclude that by using the system the decision maker is able to gain a deeper understanding of the decision problem. In the future we will give more emphasis to the collaboration step of the implemented decision making process. Further, we believe that the tool can be used to support teaching about the decision-making process at any kind of education level for its ease of use. Also, it as can be placed in any sort of interactive learning environment, where students can use it to study their own decision problems.

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