

# HOW MUCH OF EXPERTS' KNOWLEDGE CAN BE USED IN eNS INSPIRE?

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**Abstract:** *Experts' knowledge in debtors' classification is often underestimated and underappreciated. However, practice shows that it can be very useful and efficient, though often intuitive and linguistically imprecise.*

*The paper presents the results of an experiment on how the experts' knowledge can be used in evaluation of potential debtors. It concerns the phase prior to the decision-making stage. Basing on expert knowledge a scoring system representing the preferences (usually 'soft' factors) was build in an electronic Negotiation System Inspire. It covers a pre-negotiation phase using a combination of Simple Additive Weighting method (SAW) and Linguistic Approach.. The analysis shows that experts' knowledge in the pre-decision process of debtors' classification, however difficult to quantify, can be useful – expressed by specific rating scores packages and can indicate which factors play more or less important role in the decision-making process. In the process of negotiating (trying to reach the compromise), the opportunity to decrease the number of possible options (features), intuitively leads the experts to the point in which they clearly articulate their preferences.*

**Key words:** *Negotiation Support, Ordered Fuzzy Number, Simple Additive Weighting Method*

**JEL codes:** *B4, C9, C02, C38, G40*

## 1. Introduction

Although credit risk is only one sub-group of banking risk, frequently it is the one that decides about default or survival. It is understandable that banks cannot unreservedly grant funding to any potential borrower – they must first examine the condition of a future debtor and classify the entity into appropriate group. To do so banks can use various methods (internal ratings,

standard credit risk models, neural networks, decision trees etc.) and though most of the implemented methods are quantitative, lately there has been a strong trend to include qualitative factors in a form of experts' knowledge which might seem subjective but often captures subtle nuances and can process complex processes in a way unattainable for quantitative models.

Due to that reason, the interest in experts' knowledge increases noticeably. It is clearly visible in the steps of credit risk evaluation and process of granting or rejecting funding by the bank. Otherwise, how can a fact be explained that the final credit granting/rejecting decision does not base solely on the results of financial (quantitative) analysis but on the experience of Credit Committee members (experts) who, of course, can follow the recommendations of the analysts or reject them. It clearly proves that the final decision is a result of the knowledge, experience and preferences of experts.

There are various approaches to capture the above elements (Wójcicka-Wójtowicz, 2020). Among those we can mention linear and non-linear credit risk models, neural networks, decision trees and many hybrids. Within the area of debtors' ratings there are many modifications and extensions (a review on financial risk assessment – including credit and bankruptcy risks – can be found in Chen et al., 2016). The modifications appear as a result of the shortcomings of existing models. The significance of experts' knowledge and experience, as well as other qualitative factors in credit risk assessment and debtors' classification, are recognised as increasingly influential and helpful in decision-making process. In (Grace and Williams, 2016) neural network and fuzzy logic systems for credit risk evaluation was developed and their performances were evaluated based on prediction accuracy metric. The conclusion was that despite comparable results, the fuzzy inference system could be easily understood by any user, however, the decisions made by the neural network system is not easily understood by the user, and in this case the user has no choice than to accept the output given by the neural network as the most appropriate output without any explicit reasoning. Also, in (Dadios & Solis, 2012) a hybrid fuzzy logic and neural network algorithm (HFNN) to solve credit risk management problem is tested. It is shown that HFNN model can solve credit risk management problem and is capable of self- learning similar to the traditional neural network. It can also generate the rules behind the discrimination of each account subjected to it and in this manner, it behaves much like a traditional fuzzy logic system.

One of the recently increasingly utilised pair is a Simple Additive Weighting method (SAW) combined with the Ordered Fuzzy Numbers (OFNs) (Piasecki & Wójcicka-Wójtowicz, 2019).

The paper consists of 6 sections. The first, being the Introduction, is followed by Section 2 which briefly presents the nature of negotiations. In Section 3 the main assumptions of implemented methods and approaches are defined. Section 4 covers the basic description of utilisation of experts' knowledge in eNS Inspire. Section 5 presents the conducted experiment and Section 6 concludes the paper.

## **2. Nature of Negotiations**

The general nature of negotiations comes from the main idea of a struggle between at least two parties of opposite objectives. Due to its nature it is also often perceived as a kind of bargaining. The fact that people are used to negotiating from young age, makes it natural to use that tool also in running a business.

During negotiations the participants must establish their objectives, preferences and potential (expected) outcome which may be modified in the process. Those assumptions are not revealed to the opposite party. The important part is to define the factors which influence the negotiations proceedings and the whole negotiation context, e.g. domination of one of the negotiating party or previous experience (deadlocks or disputes).

In case of credit risk, it is the bank (or other financial institution) that can be considered the dominant party as it is up to the bank whether the financing will or not be granted.

There are many negotiating systems amongst which we can list electronic Negotiation System (eNS) Inspire (Kersten, Noronha, 1999). It is a system supporting multi-issue negotiations. It provides many options/stages of the process, e.g. assessment of offers, management of communication and graphical display in a form of charts and graphs, but the most important issue is that it allows for including specific preferences concerning personal experience of the negotiating parties. In case of any negotiation and in this research, in case of debtors' assessment, the personal experience, preferences and knowledge play a significant role in the decision-making process. It is due to the fact that the final decision is taken at the meeting of a credit assessment committee, consisting of experts (higher level managers) who make their decisions basing on their personal, professional experience. Their main role is to use their ability to look at the future projections of the borrower's business and not just their past performance. Any underwriting agreements, financial projections and the health of the borrower's industry are all very important, as they will be leading indicators of potential volatility in loan payments, however, assessed features can frequently be conflicting or excluding one another.

### 3. Methodology - Basic Facts

The conducted research is a combination of approaches and methods, namely Simple Additive Weighting (SAW) method and Linguistic Approach (Wójcicka-Wójtowicz, 2020).

The SAW method is also called Simple Multi Attribute Rating Technique. It is used to facilitate a multi-criteria evaluation problem. The most significant part in this process is the determination of weights which include experts' personal and professional experience and preferences. This can be achieved by a scoring approach (described in Section 4).

In the first step of any linguistic approach, the imprecision granularity should be determined, i.e., the cardinality of the linguistic term set used for showing the information. The imprecision granularity indicates the capacity of distinction that may be expressed. The knowledge value is increasing with the increase in granularity. The typical values of cardinality used in the linguistic models are odd ones, usually between 3 and 13. It is worth to note that the idea of granular computing goes from Zadeh (1997) who wrote "fuzzy information granulation underlies the remarkable human ability to make rational decisions in an environment of imprecision, partial knowledge, partial certainty and partial truth." Also, Yao (2004) pointed out that "the consideration of granularity is motivated by the practical needs for simplification, clarity, low cost, approximation ...". For review variety of application linguistic models in decision-making see for example (Herrera, Herrera-Viedma, 2000).

In general (Herrera, Herrera-Viedma, 2000), any linguistic value is characterized by means of a label with semantic value. The label is an expression belonging to a given linguistic term set. Finally, a mechanism of generating the linguistic descriptors is provided.

In credit risk assessment, all linguistic assessments are linked with Tentative Order Scale (TOS) given as a sequence

$$TOS = \{Bad, Average, Good\} = \{C, B, A\} = \{V_1, V_2, V_3\}. \quad (12)$$

Any element of TOS is called a reference point and can be enlarged by intermediate values.

### 4. Experts' knowledge in eNS Inspire

Inspire offers a SAW-based tool that helps negotiators (hereinafter also called *experts*) to analyze their preferences in a stage of pre-negotiations. It lets them establish the priorities concerning the negotiation template. It is embedded in Inspire protocol in the initial phase prior to actual negotiations.

The way the experts' knowledge can be utilised is via a scoring system implemented in Inspire. A certain number of points is available to the expert to attribute them to all distinguished issues. This way the importance of each issue is established and, in turn, also its individual weight. Each of the issues must obtain the score between 0 and the issue weight. Then Inspire presents the list of selected complete packages with total scores. It is, however, easy to implement changes in the results of an initial scoring system as with each change Inspire recalculates the rates of issues and options.

There can be also a graphical visualisation of preferences which takes different forms. The most popular are circles. However, in case of circles, the size and radiuses of the circles are important as they indicate the significance of issues and options. Unfortunately, that being the case, may cause a few problems. It has been analysed in Brinton (1917) that circles as information presentation can cause the reader to misread the importance of the data by under- or overestimating the ratio between the area and the radius. There are also many other methods of visualisation of the information in negotiating problems (e.g. Miettinen, 2014).

This paper focuses on analyzing the negotiation process prior to making the final decision of building a scoring system by means of SAW by the experts – utilizing their experience, knowledge and preferences.

## 5. Case study

A significant part of the case study is including the appropriate issues in the proposed template. In the chosen problem there are five chosen general issues, considered to be the most important, were implemented with predefined salient options originating from the above mentioned linguistic scale. The general issues are the result of a number of criteria indicated in advance by the members of the credit committee and gathered in specific groups. The issues (in relation to a potential borrower/debtor) with the available options are presented in Table 1.

**Tab. 1** Issues and options

Issues	Options
general risk level	high; moderate; low
diversification	extensive; moderate; minimal
prospects / projections	good; moderate; bad
management	exceptional; acceptable; unacceptable
range of operations	wide; average; minimal

Source: own elaboration

The conducted experiment heavily relies on the preferences of experts-negotiators (2) who at this stage must attribute each individual issue with a number of scoring points (initially there are 100 points to be distributed between the issues). It is presented in Table 2.

**Tab. 2** Distribution of rating points.

Issues	expert 1	expert 2
general risk level	35	40
diversification	15	15
prospects / projections	25	20
management	5	10
range of operations	20	15

Source: own elaboration – case study basing on experts' choices

It is worth stressing that those groups include a number of factors and each expert can interpret a specific group differently, depending on their own personal experience. For instance, the issue group of general risk level can include not only level of credit risk but also the level of the market, trade, suppliers or customers risk.

After rating the issues, the options in each issue must also be rated similarly. In the Inspire system, for each issue at least one option must be assigned the maximum rating for the issue and at least one option must be assigned a rating of zero (www1). The assessment of options is presented in table 3 (expert 1) and table 4 (expert 2).

**Tab. 3** Rating options – expert 1

Issues	Options		
general risk level (max 35)	high (0)	moderate (20)	low (35)
diversification (max 15)	extensive (15)	moderate (10)	minimal (0)
prospects / projections (max 25)	good (25)	moderate (25)	bad (0)
management (max 5)	exceptional (5)	acceptable (5)	unacceptable (0)
range of operations (max 20)	wide (20)	average (15)	minimal (0)

Source: own elaboration basing on eNS Inspire template

**Tab. 4** Rating options – expert 2

Issues	Options		
general risk level (max 40)	high (0)	moderate (30)	low (40)
diversification (max 15)	extensive (15)	moderate (10)	minimal (0)
prospects / projections (max 20)	good (20)	moderate (10)	bad (0)
management (max 10)	exceptional (10)	acceptable (10)	unacceptable (0)
range of operations (max 15)	wide (10)	average (10)	minimal (0)

Source: own elaboration basing on eNS Inspire template

Having experts' ratings for each issue and each option, eNS Inspire calculates ratings for complete packages that are the subject of consideration. A single unit of 'a package' consists of all five criteria (options), for example:

- low general risk level,
- extensive diversification,
- good prospects,
- exceptional management and
- wide range of operations'

is one complete package. Individual packages and their ratings describe the expert's particular preferences. It can be observed that in case of both experts there are criteria which individual options are indifferent, for instance good or moderate prospects (expert 1), exceptional or acceptable management (expert 1 and 2), wide or average range of operation (expert 2). That finding, in turn, can result in decreasing the number of options as a conclusion can be made that experts do not differentiate those two states.

In the next step the list of selected complete packages is presented with the global scores.

What is really important is the fact that in the course of negotiation, in the process of reaching agreement, experts can change and adjust their scores.

The confrontation of experts' opinions and expectation leads to adjustment movements. Each expert needs to reconsider their original choices and evaluate the issues and options. In a perfect world experts should have similar preferences (considering the same entity) and their expectations and scoring should be alike. However, the whole process really can have only two outcomes: a compromise or a deadlock (no solution). The length of the process depends only on the experts' willingness to achieve a success (a compromise) but on the other hand this compromise cannot be imposed on them.

Despite their differences, in the carried out experiment (negotiations resembling a discussion during the credit committee meeting) after 3 rounds of negotiations the experts reached the following compromise – a package of:

- low general risk level,
- extensive diversification,
- moderate prospects,
- acceptable management and
- wide range of operations.

Due to this fact, the debtor would be classified to the group of potential debtors (borrowers). In case of deadlock, the application would be eventually rejected.

## 6. Conclusions

Taking a final decision is usually a long process. It does not only rely on quantified data but usually on human preferences and experience. Those, in turn, are difficult to express them in numbers and usually are expressed by qualitative factors.

However, methods and tools of negotiations, such as Inspire, can be useful by aiding the experts to present and process their preferences and knowledge. This tool can also be utilized not only to classify the potential debtors but also to rank them, not to mention ranking and rating the chosen options which are expressed by linguistic (imprecise) approach.

The fact that during the process of negotiations the number of possible options could be decreased also facilitates the decision-makers, helping them to focus on the most significant issues. Using the experts' knowledge allows for ranking the options but consequently also the borrowers. This can lead to classifying them into a specific, individual credit rating group connected with ratings similar to those of rating agencies.

The further ongoing research aims at implementing (in Inspire) ordered fuzzy numbers (as the technique to cope with the imprecision and inaccuracy) and, furthermore OF-SAW.

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