



An Expert System Approach for Quality of Life Evaluation

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Abstract

The aim of this study is to present an architectural framework of expert systems and to describe the design, development, and evaluation of an expert system for quality of life evaluation. A general goal of the article is to develop a prototype of expert system for social area to estimate quality of life. The presented expert system for quality of life evaluation was designated to be useful and helpful to specialists in social area. The proposed new expert system uses only qualitative data. That is the way it differs from the old methods for measuring the quality of life and the standard of living; all of them have been using only quantitative data. The expert system also uses certainty factor in its rules indicating the strength of belief in the rule. The system model consists of 150 rules covering 49 indicators of 8 factors for social area. These indicators cover: Economic situation; Housing and environment; Employment, education and skills; Structure of the household and family relationships; Balance between work and life; Health and healthcare; Urban subjective; Concepts of the quality of society. The indicators and the method of quality of life assessment were selected from series of discussions with human experts in the field of social sciences. An expert system shell called CLIPS© is used to develop a prototype of expert system which uses facts and heuristic rules to estimate the quality of life of people. The system was verified and validated for completeness, consistency, and correctness.

Keywords: Quality of life, rule-based expert system, verification and validation.

Introduction

Both terms standard of living and quality of life are recurrently discussed when it comes to economic and social wealth of the countries and their residents. Finding the key distinction between both of them is not so easy to be accomplished. They indeed overlap and that is why defining them is so difficult, and it is dependable on whom you ask. It is not only a semantic problem, but also in reality a matter of providing the opportunity for a valuable assessment whether someone should invest a certain amount of money in a country, or not.

The essential contrast between both terms is that standard of living is determined as more objective, whereas quality of life is defined as more subjective. This comes from the fact that factors, such as Gross Domestic Product (GDP), poverty rate and environmental quality, all of them related to standard of living, by their nature are able to be measured and represented with numbers. On the other hand, indicators related to quality of life like equal protection by the law, freedom from discrimination and freedom of religion are peculiarly qualitative; actually they are more difficult to measure. The knowledge about the features of both terms would provide us with a broad portrait of what life is like in a selective spot at an exact time. Ferrell, who has performed an important scientific survey on pain and quality of life, determined quality of life as well-being covering four areas: quality of life is physical, mental, social and spiritual well-being¹. The World Health Organization identifies quality of life as an individual

perception of their position in life in the context of the culture and values systems in which they live and in relation to their goals, expectations, standards and concerns. It is a broad ranging concept affected in a complex way by the person's physical health, psychological state, personal beliefs, social relationships and their relationship to salient features of their environment².

Considering that the Lisbon Strategy is a partial failure and the global recession that started in 2008 is still here, all of that has pushed ahead new ideas regarding the conception for quality of life. That is why the European Commission has urged on new approach when it comes to the pickup of economy in order to encompass all new different dimensions of human well-being, reaching out beyond the chasing of the GDP growth.

According to the European Commission Communication "GDP and beyond – Measuring the progress in a changing world"³, Member States should refine and work out data and indicators with the aim at complementing standard analyses of economic outcomes. Also, the number of national and international initiatives for a more precise analysis of economic and social advance has been rising steadily. In June 2007, for instance, the European Commission, the OECD, the Organization of Islamic Conference, the United Nations and the World Bank set up a conference on measuring the progress of society in the era of globalization⁴. In 2008 the economist John Stiglitz was appointed by the former French President as a chairman of a commission of experts, which main goal was to be prepared a

document on alternative approaches for measuring both subjective and objective dimensions of individual well-being⁵. With regard to new measures for gender inequality and for poverty, the United Nation also revealed its data in 2010.

Current economic recession has triggered the necessity for a “new” perspective on quality of life, different from the “old” one, and the key distinction between them mainly depends on the way in which they occurred. During the 1960s, when the industrial societies were in the age of abundance, the monitoring attention in terms of quality of life was optimistic and the relentless progress was considered as an important for measuring it and indeed lasting forever. As opposed to, the modern debate on the quality of life is determined by the current global economic recession, which is characterized by growing inequality and insecurity. This is the reason why the reestablished interest in quality of life has mostly taken the direction towards sustainability. This sustainability concept can also be found in the novel Europe 2020 strategy with a main focus on reducing the poverty levels and deep-laid inequalities in an economic situation where huge cuts in public services and spending are required. The general point here is that future generations should not to be put in a trap where they should be paying for their parents' debts. This displays the shift from a concept describing quality of life as relentless progress of humanity to the concept of quality of life as a shared and balanced process.

Quality of life factors and indicators for the expert system QLIFEX

After studying the literature and the methods used for quality of life evaluation^{6,8}, the author proposes a new model, which is based on eight key domains⁹⁻¹¹. The first six of them examine objective conditions, the rest consider subjective perception: Economic situation^{12,13}.

Indicators: Equal protection by the law; Right to vote; Right to be treated equally without regard to gender, race, language, religion, political beliefs, nationality, socioeconomic status and more; Revenues from environmental taxes; Territorial development and utilization of land; Frequency of food shopping.

Housing and environment¹⁴: Indicators: Insufficient space; Moisture and leaks; Old windows and floor; Phosphates and nitrates in the water; Generation of municipal garbage; Presence of smog.

Employment, education and skills^{6,15,16}: Indicators: Free education; Long life education; Pressure at work; Actual working hours; Job uncertainty; Requirements for promotion; Duration of work; Right to fair pay; Equal pay for equal work; Freedom from discrimination; Freedom of thought; Free choice of employment.

Structure of the household and family relationships¹⁷: Indicators: Time for housework; Support for household (payments, kinship, friendship, neighbourhood); Good relations in the family; Presence of a partner; Income.

Balance between work and life¹⁸: Indicators: Social relationships; Children at home; Additional learning and training; Autonomy in work; Support from the employer for balance of work – life; Right to privacy; Right to rest and leisure.

Health and healthcare^{8,16}: Indicators: Free healthcare; Disease control and prevention; Regular immunization; Rehabilitation and socialization; Extent of free dental services.

Urban subjective^{19,20}: Indicators: Current life satisfaction; People's optimism about their future; Expectations.

Concepts of the quality of society^{19,21-23}: Indicators: Trust in others; Assessing the quality of social services; Alienation in society; Despair; Uncertainty in their own communities (Tension in society).

Overview of expert systems

An expert system based method can be determined as an efficient decision-making strategy. An expert system is a computer program that replicates the reasoning of human experts in a particular domain. The resolving of difficult and unattainable real-life problems could be facilitated by usage of technology.

Expert systems are computer techniques that are possible to use for modeling the expertise of experts in a particular domain. Expertise embodies that exact knowledge which has been extracted through experience in a particular domain and by its nature is heuristic. Expert systems serve as tools to pattern the reasoning processes of experts and employ their knowledge in the solving of peculiar tasks. Expert systems can be utilized by non-experts to enhance problem-solving capacity. Expert systems could also help the experts as operating like well-informed helpers. These kinds of systems could work better if compared to a sole human expert in producing valuable judgments in a particular field of expertise²⁴.

The tasks of the expert system presented in this article are: to interact, to access knowledge, to make logical decisions, to result in conclusions, and to interpret its conclusions.

Design of expert system for quality of life evaluation: The goal of this research was to evaluate quality of life by resorting to artificial intelligence technology to up build and evaluate a demo version of the expert system. To be achieved the aforesaid aim, next ends were adopted for the research: Collect knowledge on social area and economics to develop a database; Categorize and group the database (facts)and knowledge base

(rules) by means of the CLIPS© expert system syntax; Develop a prototype of QLIFEX using the CLIPS© expert system shell; Verification and Validation of the prototype for consistency, completeness, correctness, precision, and usability. In the design and development process of this expert system for quality of life evaluation, we were using CLIPS: Expert System Shell. For each question from the knowledge base and for the output (advice), the shell possesses facilities by means of which can be explained how the output is derived. It comprises the rules presented in a proper syntax for its knowledge base. It contains the built-in facilities to create the rules that up build the knowledge base.

Structure of expert systems

An expert system is formed of two main parts: the part 'Development' and the part 'Run-time (consultation)', as presented in figure-1. The knowledge base (rules) and data base (facts) are constructed during the development part. The result and the advice are derived during the run-time part.

Methodology for building of the expert system for quality of life evaluation QLIFEX

In the expert system building process, the knowledge base development is the most significant part. The quality of expert system is strongly connected to knowledge base of the expert

system. The knowledge base in this expert system was built by using CLIPS with the support of domain specific human expert. The expert system building process is a multi-step process, and its end is to be developed a domain particular knowledge base. The input problem, the gaining of knowledge and the presentation of knowledge into the knowledge base identify the stages for building of the knowledge base in this expert system.

This section presents the procedure that was applied to develop and build the expert system QLIFEX. This procedure includes knowledge extraction and analysis (knowledge acquisitions and knowledge representation), usage of certainty factor, data base construction, production rules building, validity of the QLIFEX model, and system maintenance.

Knowledge acquisition and analysis: The most vital condition in the process of building of expert systems is to be found experts in their explicit domains. The process of knowledge acquisition consists of five sections: distinguish, gather, scan, interpret, and design. Latent sources, such as various websites, journals, books, textbooks, handbooks, and papers are used as complement sources. In most cases, the knowledge in the social area is achieved through discussions amongst skilled experts, while the knowledge from other sources, which is received and validated by the experts in the social area, is far more rarely (figure-2).

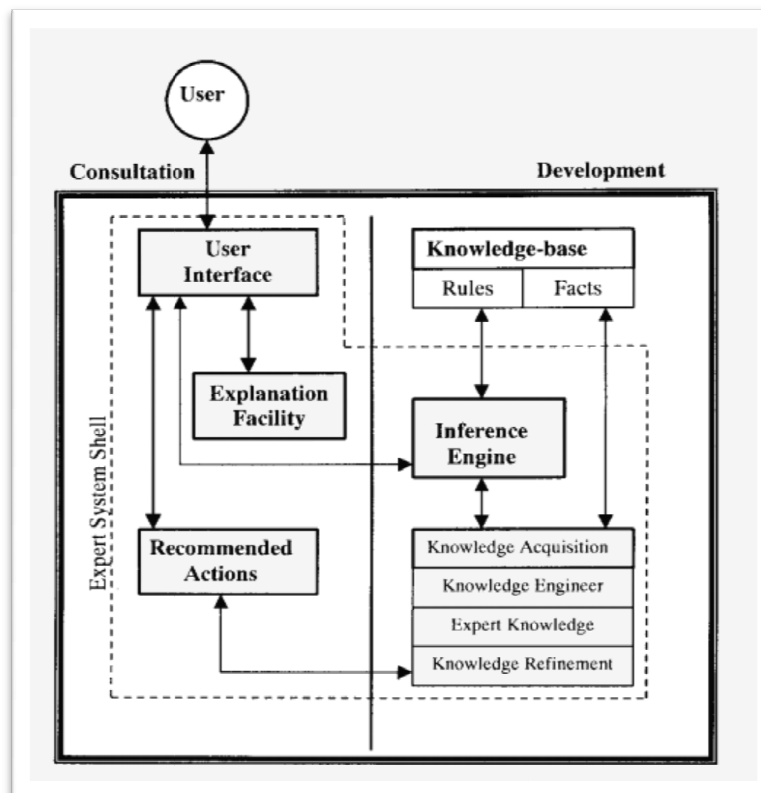


Figure-1
 Expert system structure²⁴

QLIFEX has been designed to help novices, in learning and training processes, and social research groups. To direct all these matters, the expert system has to consist of enough knowledge.

The important parameters in the expert system for quality of life evaluation are: econ-situation, hous-environment, employ-education, fami-relation, work-life-balance, health-care, urban-subject, concepts-quality-society.

The knowledge elicited by the expert provides a more accomplished outline, regarding how to categorize or to assort the information, if compares to the knowledge derived by other sources.

Often, in the process of expert system building, the major problem when it comes to the elicitation of knowledge by a domain expert is the fact that it is a process which requires additional time. In our system, the knowledge elicitation was done by means of sets of lengthy and intense dialogues and consultations with domain experts. The acquired knowledge was well documented in the form of everyday language.

Knowledge representation: Techniques which are included in knowledge representation of quality of life are production rules, indicating uncertainty, and designing system's inference engine. Various combinations of inputs and outputs compounded the production rules of the expert system. These rules are produced by using interview techniques, task solutions and protocols, and interrogatories and researches. Knowledge representation reveals the fashion in which information - from a logical paradigm - is more likely to be collected and linked in the human brain. To be organized and integrated diverse bits of knowledge - from the problem-solving perspective - a profound effort has to be undertaken.

Development of QLIFEX knowledge base - Production rules: The components of the knowledge base and the data base of our expert system are: Data base, which includes facts about the input problem; Knowledge base (rules), which transpose the problem state into a solution. The inference engine matches the facts and data against the production rules to identify which rules are appropriate. It serves in the following way: Match the data base (facts) against the knowledge base (rules); Choose which rule to execute; Perform the operations of THEN part of this rule.

In the representation of knowledge into knowledge base, the knowledge acquired from knowledge acquisition process is represented into structured form. A reasonable result of any expert system strongly depends on the quantity and the quality of the corresponding knowledge. It also depends on the way in which this relevant knowledge is represented. The graph of the QLIFEX expert system is shown in figure-3.

Some facts of the data base of expert system for quality of life evaluation are presented in figure-4.

There are many approaches for representing knowledge into the knowledge base. The knowledge of expert system for social area domain is represented by production rules (logical paradigm of simple IF – THEN rules) in forward chaining. The logical rules are separated into some items to direct the expert system how to decide problem, to perform operations, to go to another module, etc. The parameters are used as variable, and it determines the flow of the control amongst the modules in the knowledge base. These parameters serve different purposes. Number parameter is used for numerical values. Text parameters are used for text object. The value for any of the parameters is derived from user's answer to a question, through other parameters, or as a result of firing of rules.

The modules of expert system Questions Rules and The Rules are developed to perform transferring controls in accordance with the user's response. In figure-5, the variable valid-answers is shown.

The quality of life is measured in the ten-degree global scale: Perfect quality of life; Nearly perfect quality of life; Very good quality of life; Good quality of life; Moderately good quality of life; Somewhat bad quality of life; Bad quality of life; Very bad quality of life; Extremely bad quality of life; No quality of life. Figure-8 presents the relationships between the factors and the ten-degree scale for quality of life. The value of every stage from this scale is formed by a combination of different value of factors.

The module QLIFE-QUESTIONS contains 49 questions for indicators (figure-3). Some of them are shown in figure-5.

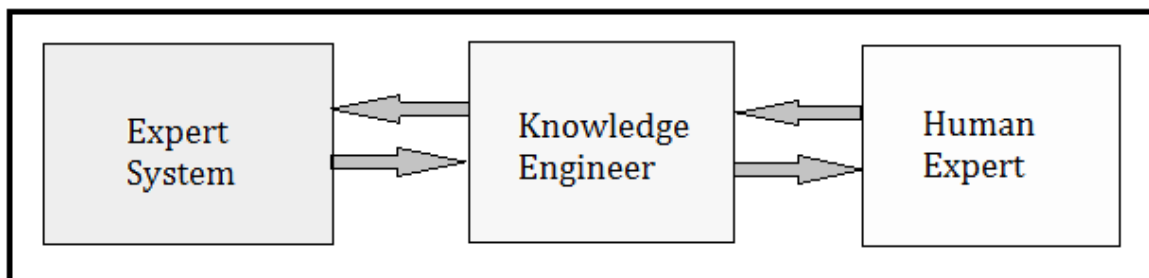


Figure-2
Knowledge acquisition

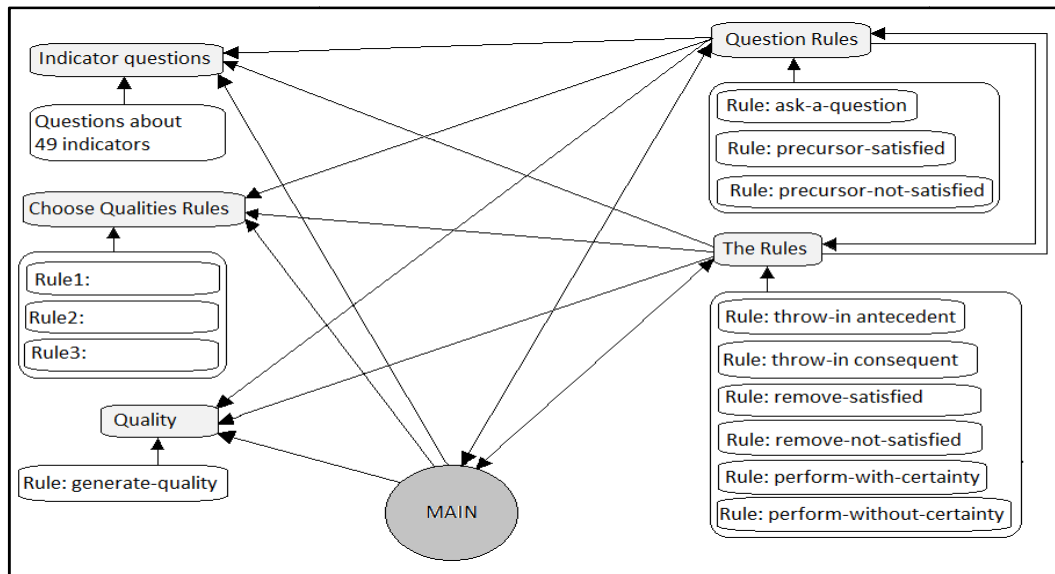


Figure-3

The structure and the organization of the data base and the knowledge base (facts and rules) of the expert system for quality of life evaluation

```
(deffacts QLIFES::the-qlife-list
  (qlife (name Perfect-quality-of-life) (econ-situation very-stable) (hous-environment completely-satisfied) (employ-education very-good-condition) (fami-relationharmonious-relationships) (work-life-balance well-balanced) (health-care completely-accessible) (urban-subject absolute-optimism) (concepts-quality-society very-satisfied))
  .....
  (qlife (name Bad-quality-of-life) (econ-situation very-unstable) (hous-environment hardly-satisfied) (employ-education bad-condition) (fami-relation inharmonious-relationships) (work-life-balance unbalanced) (health-care partially-accessible) (urban-subject pessimism) (concepts-quality-society very-satisfied)))
```

Figure-4

A part of the facts about quality of life

```
(defmodule QLIFE-QUESTIONS (import QUESTIONS ?ALL))

(deffacts QLIFE-QUESTIONS::question-attributes
  (question (attribute equal-law)
    (the-question "Do you have equal protection by the law: always often sometimes never? ")
    (valid-answers always often sometimes never unknown))
  (question (attribute right-fair-pay)
    (the-question "Are you satisfied with your right of fair pay: satisfied some-what-satisfied some-what-dissatisfied dissatisfied? ")
    (valid-answers satisfied some-what-satisfied some-what-dissatisfied dissatisfied unknown))
  (question (attribute social-relationships)
    (the-question "In terms of your social status, the social relationships are: very-important important unimportant very-unimportant. ")
    (valid-answers very-important important unimportant very-unimportant unknown)))
```

Figure-5

Some questions for the indicators

Generally, the rules contain two parts: an assumption (IF) and a conclusion (THEN), as each of them consisting, in turn, of a combination of assertions of a lower detalization level. The figure-6 is an example for production rules.

Presenting Uncertainty: In most cases knowledge is incomplete and uncertain. To tackle uncertain knowledge, the rules are associated with certainty factors or weights. They can be equal to -1 (when a fact is incorrect) and all the way up to +1

(if the fact is definitely true).The certainty factor may be a probability (from 0 to 1), percent - from 0% to 100%, unlimited scale - from $-\infty$ to $+\infty$.

The set of methods for using uncertain knowledge and uncertain data in the reasoning process is called reasoning with uncertainty. A serious subset of methods for that kind of reasoning is known as "fuzzy logic", and the systems that utilize them are called "fuzzy systems".

Figure-7, chiefly, depicts uncertainty in the rule-based systems. This uncertainty might occur in individual rules, in conflict resolution, and in an incompatibility of the rules within the inferences. The aim of the knowledge engineer is to minimize or eliminate these uncertainties, if possible. The minimization of the uncertainties in individual rules is a part of verification of the rules. The presence of the correct individual rules in a system is not enough as a condition for the system in providing a correct and a right output. Due to incompatibilities of the rules, inferences chains might not be correct, so validation is necessary. Verification can be considered as minimizing the local uncertainties, while validation is minimizing the global uncertainty across the whole expert system.

System output: The output of this expert system presents the degree of quality of life. This output is categorized in the ten-degree global scale for quality of life. This scale includes: Perfect quality of life; Nearly perfect quality of life; Very good quality of life; Good quality of life; Moderately good quality of life; Somewhat bad quality of life; Bad quality of life; Very bad quality of life; Extremely bad quality of life; No quality of life.

Figure-9 presents the relationships between the factors and the

ten-degree global scale for quality of life. The value of each degree of this scale is formed by combining the different values of the factors.

Development of a prototype of the expert system QLIFEX and development of the complete system

QLIFEX - System development: The process of development of an expert system for quality of life evaluation is based on traditional technology. It can be divided into six stages, which are relatively independent from the domain. The sequence of the stages (Selection of a problem, Development of a prototype, Implementation, Evaluation, Fitting, Maintenance) is not fixed. It allows to an each stage from the development process of expert system to be submitted new ideas, which may affect the previous decision and even lead to their processing.

It is considered that a prototype is an initial variant of an expert system aiming at inspecting the efficiency of the general knowledge presentation and logical conclusion scenarios being taken on to resolve a specific problem. The building of a prototype incorporates outlining a problem, picking out developmental tools (The CLIPS© software program was used to build a sample version of expert system planned to estimate the quality of life. The knowledge representation in CLIPS is in the form of simple IF-THEN rules in forward chaining^{25, 26}), and system concerns about developing the prototype, identifying the method of data analysis, diagnosing a proper source of data or knowledge, validation and verification of the prototype. The overall purpose of this survey was to build a sample version of expert system for quality of life evaluation hereby confirming the ideational relevance of such an expert system.

(rule (if food-shopping is sometimes and territorial-land is sometimes and equal-law is never)
 (then best-econ-situation is very-unstable with certainty 30 and best-econ-situation is unstable with certainty 50))

(rule (if job-uncertainty is no and long life-education is yes and right-fairpay is satisfied and freedom-thought is yes and freedom-discrimination is never)
 (then best-employ-education is very-good-condition))

(rule (if income is yes and relations-family is no and presence-partner is definitely not)
 (then best-fami-relation is partially-harmonious-relationships with certainty 40 and best-fami-relationships is inharmonious-relationships with certainty 50))

Figure-6
 Examples of production rules of the expert system QLIFEX

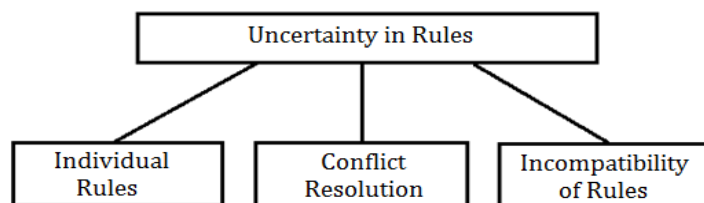


Figure-7
 Uncertainty in rule-based systems

(name Perfect-quality-of-life)
 (econ-situation very-stable)
 (hous-environment completely-satisfied)
 (employ-education very-good-condition)
 (fami-relation harmonious-relationships)
 (work-life-balance well-balanced)
 (health-care completely-accessible)
 (urban-subject absolute-optimism)
 (concepts-quality-society very-satisfied)
 (name Somewhat-bad-quality-of-life)
 (econ-situation unstable)
 (hous-environment partially-satisfied)
 (employ-education good-condition)
 (fami-relation partially-harmonious-relationships)
 (work-life-balance unbalanced)
 (health-care partially-accessible)
 (urban-subject pessimism)
 (concepts-quality-society very-dissatisfied)

Figure-8
 A part of output of expert system

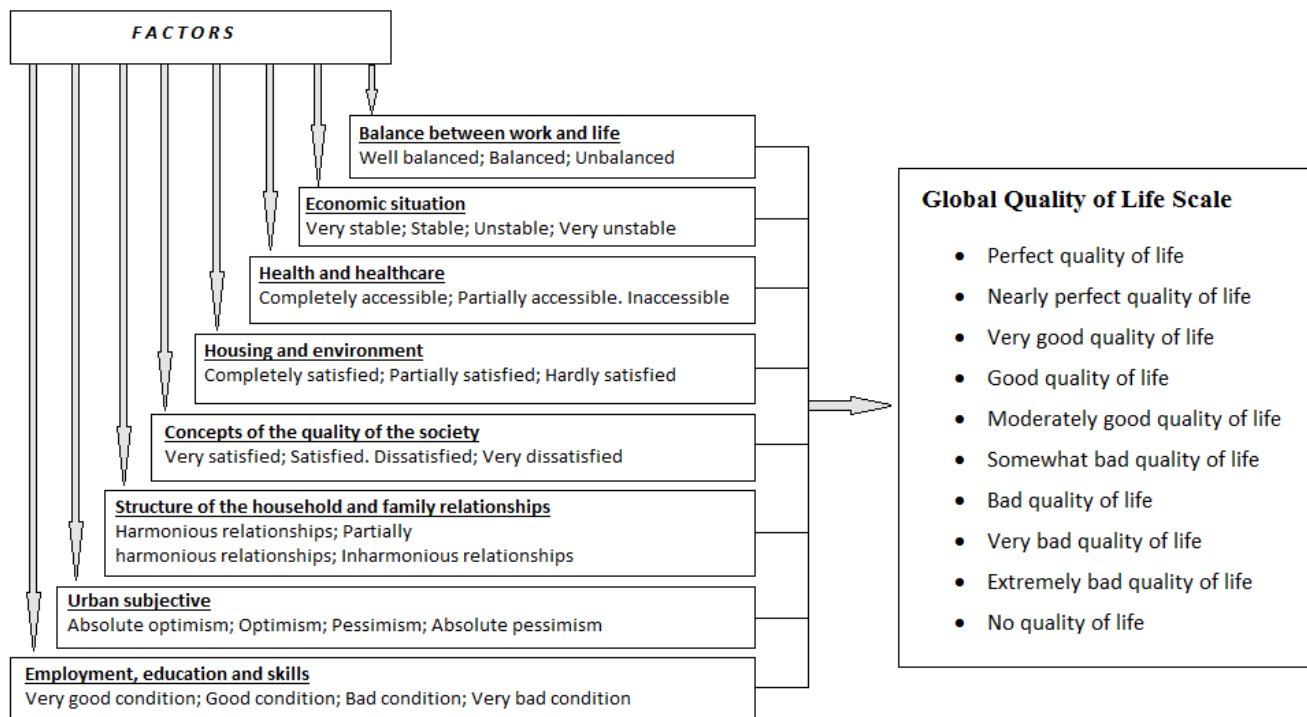


Figure-9
 Relations amongst the factors, the indicators and the global scale for quality of life

When the prototype is ready, the first thing system developers do is to verify and to validate the outcomes. Their main goal is to incorporate the required improvements so that the performance of the basic system to be refined. Before the final expert system grows into a position to be capable of putting in practice, it usually demands for a more precise additional information about the knowledge base and passes through considerable reiterations with demanded refinements.

QLIFEX Model: When the successful demonstration of the prototype executed on the computer, the QLIFEX model was rounded out and validated through the next steps:

The set of rules overlaying the whole coverage of the QLIFEX model was augmented – 150 rules; Adding the attribute values of the factors for assessment of quality of life; Completing the program was carried on by appending the execution rules; Validity procedure for the fully built QLIFEX model was performed as for the sample version (the prototype).

The complete computerized QLIFEX model contains 150 rules mirroring all features of the quality of life, social area and economics. For the architecture of the QLIFEX model, the synergy between consumers and the model as the general direction of data flow is from a significant importance for performing the evaluation.

Structure model: When the domain is complex, it is necessary the structure (architecture) of expert system to be designed in advance. The usage of CASE tools for creating UML-diagrams is possible. This allows faster and more efficient design, early detection and correction of errors that could affect the final result negatively.

Testing of the expert system: Initially, testing of the expert system was performed on a small portion of data. Validity of the syntax and verification of the data structure were determined by using the source code. The form of IF - THEN rules was used to be formatted the information owing to complicity of the existing data and the way in which this data might be elaborated. The “IF – THEN” syntax was able to take in a large amount of comprehensive information. This proved to be the accurate method for the expert system knowledge base building-up. The trial version that was run on the same segment of data assisted in finding all syntax errors and programming bugs.

Running QLIFEX model: Consumers interact with the QLIFEX model as choosing one of the existing answers for each question the expert system introduces. The attribute values for indicators are accredited successively and constitutionally by the QLIFEX model. The accredited value of each indicator is an initial value to the QLIFEX’s inference engine that directs the firing of relevant rules in the knowledge base.

When in the evaluation process, QLIFEX gives users the opportunity for more interpretations about any output by using the command WHY. The QLIFEX model shows the used rule

and how a certain output is a result of it in addition to other interpretations. At the termination of the assessment, the QLIFEX model exposes result in the following pattern: Attribute values for qlife (quality of life according to ten-degree global scale); Certainty (the value of certainty factor).

The result of QLIFEX depends on the choice of relevant attributes that mirror the correct case of life evaluation. The attribute selection is not a haphazard procedure. It strongly depends on proficiency to elicit the inputs and measurements from knowledge about social environment and real-life situations. If the final result of the evaluation of quality of life is not satisfactory, the QLIFEX model has to be revised. After finalizing such changes, a reassess can be made by using QLIFEX. After that the QLIFEX model exposes the improved result.

Expert system evaluation - verification and validation: Validity and Verification of the expert system are parts of the last stage of the expert system development process.

Verification is considered as the process in which punctuality and efficiency of the methodology are affirmed. Verification serves as a warranty that the expert system properly executes the specification. It confirms whether the knowledge base fits to both - its design demands and the software syntax used in its construction. The programmer performs a verification of the expert system. The built-in CLIPS© facilities for verification are used during the verification cycle of the prototype. The rules of the expert system QLIFEX were checked for inconsistency, syntax errors, and duplications. The rule syntax of the knowledge base and the inference engine system were undergone by verification as well. The standard checking process encompassed the following: rules with improper syntax, unnecessary rules, unused rules, subsumed rules, conflicting rules, and loop-rules (table-1). The process of checking for programming errors would prevent the system from making up a fake rule.

Validation as a process is the checking if the applied methodology provides enough guarantees that the intended result in terms of the expert system for quality of life evaluation is going to be met. In the expert system terminology, validation is defined as the process in which it is determined whether a proper answer is a logical consequence of a chain of accurate inferences. In our case, the validation process allowed the experts and the test users to determine the relevance of inputs and output of the expert system for pragmatic goals. Even though this method was viewed mainly as a subjectively oriented way, it managed to direct successfully practical situations and produce authentic outcome in a real-life situation. The validation process consisted of looking into the expert system for *completeness*; *consistency*, *correctness* and *precision*, and *usability*. The validation for completeness incorporated monitoring of the knowledge base for adequate IF-part and THEN-part of the rules.

Table-1
Examples for rule checking

<p>Conflicting rules</p>	<p>(rule (if equal-law is never and food-shopping is never and revenues-taxes is dissatisfied) (then best-econ-situation is very-unstable))</p> <p>(rule (if equal-law is never and food-shopping is never and revenues-taxes is dissatisfied) (then best-econ-situation is very-stable))</p>
<p>Conflicting rules with certainty factor</p>	<p>(rule (if autonomy-work is unimportant and social-relationships is important and balance-work is no and rest-leisure is sometimes) (then best-work-life-balance is unbalanced with certainty 10))</p> <p>(rule (if autonomy-work is unimportant and social-relationships is important and balance-work is no and rest-leisure is sometimes) (then best-work-life-balance is unbalanced with certainty 30))</p>
<p>Subsumed rules</p>	<p>(rule (if windows-under is yes and presence-smog is sometimes and phosphates-nitrates is no and insufficient- space is definitely) (then best-hous-envorenment is completely-satisfied))</p> <p>(rule (if windows-under is yes and presence-smog is sometimes and insufficient- space is definitely) (then best-hous-envorenment is completely-satisfied))</p>
<p>Subsumed rules with certainty factor</p>	<p>(rule (if right-privacy is no and children-home is sometimes) (then best-work-life-balance is balanced with certainty 20))</p> <p>(rule (if right-privacy is no and additional-training is maybe and children-home is sometimes) (then best-work-life-balance is balanced with certainty 40))</p>
<p>Unnecessary rules</p>	<p>(rule (if revenues-taxes is satisfied and territorial-land is always and equal-law is always) (then best-econ-situation is very-stable))</p> <p>(rule (if revenues-taxes is satisfied and equal-law is always And territorial-land is always) (then best-econ-situation is very-stable))</p>
<p>Unnecessary rules with certainty factor</p>	<p>(rule (if right-privacy is no and additional-training is maybe And children-home is sometimes) (then best-work-life-balance is balanced with certainty 40))</p> <p>(rule (if right-privacy is no and additional-training is maybe And children-home is sometimes) (then best-work-life-balance is balanced with certainty 40))</p>

The essential checking for relevance (completeness) of each rule according to the expert knowledge of domain was also done. This was achieved by checking the rule table of knowledge base. The process of software validity for checking upon *consistency*, *correctness*, and *precision* consisted of executing the expert system and utilizing the rule table to find system bugs. The expert system was checked for facts validation, unutilized facts, unutilized rules, run time errors, and unfired rules. Finally, the domain experts checked the expert system for the applicability (*usability*) by reconsidering the data base and the knowledge base for their practicability in real-life cases.

Improvements in the expert system were put together considering the experts' remarks, and they are revealed in the discussion and conclusion section.

Discussion: In social area, the applications of expert systems are primarily found in the subareas, such as the disease diagnosis, the diseases prevention and control, teaching and education, end etc. Many domain peculiar expert systems were being utilized at diverse levels²⁷⁻³⁰. The basic goal of building of all those systems, mentioned above, refers to improve the quality of life of people.

This article focuses on the necessity of an expert system which is designed to carry the intelligence and the information found in the expert's knowledge and to provide knowledge for quality of life evaluation for other specialists in the social area. We developed an expert system, which will be used for social area problems for which there is no single "correct" solution which can be encoded in a predictable algorithm.

A basic aim of this survey was to be developed a demo version of an expert system for quality of life evaluation. Conducting the validation process of the system source code for obvious and architectural problems was also set up as a goal. The literature review helped this research with indicating various quantified methods for evaluation of standard of living and quality of life and also pointed out the lack of qualified method. The lack of preceding research particularly corresponding with this topic made the dissection and the examination of the prototype and the expert system very difficult. The evaluation task was difficult just because there was no previously established standard for measuring the performance. That is why the only legitimate approach to rate the performance of the prototype and the expert system was the using of validation by various experts. All the reported problems were corrected after several source code validation processes.

Conclusion

The verification and the validation of expert systems are crucial for the development and the implementation of an expert system. This is more complex to be done for the expert systems rather than for the traditional programs.

The verification and the validity of expert systems are very

important steps that is why they must constantly be performed through the whole process of developing of expert systems; Validation is trying to determine whether the system works in a way that it was designed to work, and its level of accuracy; The validation technique performed for an expert system depends on the characteristics of the domain; Some shells for expert systems provide tools that can help in the verification and the validation of knowledge bases.

Evaluation of quality of life is a very serious problem in the social area in which the time taken for the problem design is generally long. Any model or system that aids in solving of this problem is profitable for installing an accurate assessment of life.

The new expert system QLIFEX is designed for a specific purpose – quality of life assessment. The importance of this expert system is determined by the case that it is not definitive to one area and covers a set of subareas of social area domain – Economic situation; Housing and environment; Employment, education and skills; Structure of the household and family relationships; Balance between work and life; Health and healthcare; Urban subjective; Concepts of the quality of the society.

There is a belief that the social society should use expert systems to solve one of the main problems of the social area domain - what is the level of quality of life?

We developed an expert system for this specific domain. It is projected for assisting in the explanation of quality of life and providing the evaluation for social life. In this article, the problem definition (quality of life evaluation), design and development of a prototype of the expert system for quality of life evaluation are presented.

QLIFEX offers several advantages: The system is constructed in such way that data base (facts), additional data, or knowledge base (rules) may be rewritten or updated without redefining the whole database; The new expert system model works with indicators like equal protection by the law, freedom from discrimination, freedom of religion, and etc. These indicators are difficult to be measured since they are qualitative. So, the proposed new expert system uses only qualitative data. That is the way it differs from the old methods for measuring the quality of life and the standard of living; all of them have been using only quantitative data.

The expert system QLIFEX was designed to be used from specialists from different areas. Furthermore, the expert system was designed as a classification/identification information system; Such expert system would be mostly beneficial for those consumers who are not specialists in social area and could not use the assistance of social experts in their research work for a better perspective on the area of quality of life; This expert system would be especially appropriate and could be used in the

learning and training of students from different faculties and specializations. For students majoring in computer science and mathematics the process of creating and evaluating of the system would generate interest, while the attention of students of humanities would be focused on the application of the expert system itself.

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