Sigitas Mitkus

Eva Trinkūnienė

MODELS OF CRITERIA SYSTEMS OF BUILDING DESIGN CONTRACT

Abstract

A number of multicriteria decisions must be made during construction investment processes. A number of support systems for multicriteria tasks of construction investment processes are available. Some of them are reviewed in this article. The effectiveness of the construction investment process is greatly influenced by the appropriate formulation of a building design contract (BDC). In order to formulate an efficient BDC, multicriteria techniques for evaluation and comparison of BDCs must be created. Beside technical, organisational and economic aspects of construction, legal aspects of a BDC must be also analysed in order to prepare such techniques. Therefore, legal decision making systems are also reviewed in the article. A conclusion can be made from the review that legal decision making systems for BDSs are not available currently. One of the main tasks in the creation of multicriteria support systems is the formation of a criteria system. Three models of criteria systems of BDSs are analysed in the article, and the best model for creation of multicriteria evaluation technique is determined. On the basis of this model, the importance of criteria should be determined and a multicriteria decision support system should be created in further research stages.

Introduction

Construction is a complicated process with a number of stages, which must be appropriately adjusted and managed. The entity that commissions construction must make different multi-aim decisions at various construction stages.

Most problems encountered during construction depend upon the selected contractor. Therefore, selection of a contractor is a very important stage in the implementation of an investment project. Patrick Sik-Wah Fong and Sonia Kit-Yung Choi [1] have analysed methods of contractor selection and noted that some methods are non-exhaustive and tend to be biased: there is a lack of opportunities to evaluate abilities of a contractor and to meet time, price, quality and security requirements at the same time. These authors have analysed possibilities to apply the Analytic Hierarchy Process (AHP) Method in contractor selection according to various criteria.

Architects and designers are no less important in the construction process. F.K.T. Cheung et al. [2] claim that price cannot be the only criterion influencing the selection of an architect. Authors have compiled a questionnaire and made an expert research, which helped to determine criteria that influence the selection of an architect and the importance of the criteria. An architect was selected using AHP method. The system for selection of architects was created on the basis of the model formed during the research.

Multicriteria methods may be used not only for selection of contractors. E.K. Zavadskas, L. Ustinovičius and A. Stasiulionis [3] have analysed possibilities to apply *Electre III* method in evaluation of effectiveness of investment to commercial buildings. Authors note that while evaluating effectiveness of investment to commercial buildings, the total effect of various criteria must also be evaluated: the amount of construction works in commercial buildings, trends, legal issues and available construction solutions.

J. Antuchevičienė [4] notes that rural buildings are an important part in Lithuania's economic potential. The author has introduced a system of criteria specially designed for reconstruction of rural buildings. The priority of rebuilding may be determined using the author's model, and multicriteria analysis methods may be used for evaluation. When information is incomplete or under-defined, methods based on the uncertainty theory are offered.

While analysing multicriteria building evaluation from the sustainable development perspective, J. Šaparauskas [5] reviewed guides, manuals, recommendations, databases, software and internet tools. The author offered an evaluation system on the basis of the analysis performed. Software based on MCDM-23 (multi-criteria decision-making) method was used for evaluation, and projects of individual houses *Kedras* and *Vasaris* were compared to test the principles.

One more important issue in construction is the selection of construction materials. E.K. Zavadskas, A. Kaklauskas and V. Trinkūnas [6, 7] have analysed systems of e-trading for construction materials and goods and have offered the model of an internet decision support system for trading in construction materials. The model is based on the determination of criteria which define construction materials and goods, on importance of the criteria and on application of multicriteria evaluation methods. A pilot internet decision support system for trading in construction materials was created on the basis of the model suggested by the authors.

The construction industry is among the most important branches in each country's economy. This is witnessed by the attempts of various authors to increase the effectiveness of construction solutions. Most of the above--mentioned authors solve various issues related to construction investment process. However, such an important question as the evaluation of BDCs remains unanalysed or almost unanalysed. Even when a contractor is selected and the price and terms of work agreed, at least several contract variants are still available. Selection of the most favourable variant is a multicriteria problem, and a technique must be created for its solution.

In order to create a multicriteria evaluation technique for BDCs, it is necessary to create a system of criteria characterizing BDCs, to determine the importance of the criteria and to select and adjust appropriate multicriteria evaluation methods. The system of BDC provisions is analysed in this article, contract provisions which may be considered criteria of BDCs are determined and models of BDC criteria systems are created.

1. Legal decision support systems

Many and various systems to facilitate contract making and legal issue solving have already been created. Two different types of rules were used in the system by Meldman: general norms defined in claims and special norms taken from precedent cases [8]. Disputable situations are immediately compared to precedents and the system determines a precedent that is closest to the violation of the civil law.

TAXADVISOR [9] used *EMYCIN* system to assist lawyers in land tax administration. The audit company *Ernst and Young* has created three legal expert systems: *VATIA*, *Latent Damage Adviser* and *THUMPER*.

In the *VATIA* (Value Added Tax Intelligent Assistant) [10] system, attention is paid mainly to VAT calculation. With the help of *VATIA* system auditors could analyse VAT payments of a client.

Latent Damage Adviser [11] was created on the basis of the 1986 Latent Damage Act (Australia). With the help of this system, experts of latent damage could solve some difficulties with less effort; however, it was too complex for non-experts, because they were not knowledgeable in abundant interrelated rules, which are characteristic to this sphere of law. The law is scarcely commented, complex and difficult to understand.

The *THUMPER* [12] system was designed for the employees of *Ernst and Young* who specialize in general taxation issues. With the help of this system information about taxes applied could be retrieved and activities regarding taxes could be planned. Three abstract legal models were implemented in the *THUMPER* system:
- The farthest level: consumer problems.
- Middle level: expert explanations and legislation.
- The level which represents legislation and legal cases.

One of the first *Rand* Corporation expert systems is *LDS*, which helps lawyers to solve inheritance disputes. The *LDS* system consists of laws, court cases and law principles; lawyers use this information operatively when they are preparing claims in inheritance cases.

SAL [13] is another system created by the *Rand* Corporation; it is also used to solve inheritance issues. Knowledge about losses, liability of the defendant, liability of the complainant, the main property distribution characteristics such as type of parties and legal mastery of the opponent were used in the *SAL* system. These two systems are important in that they represent first steps of IT in property distribution solutions.

WIRE IQ (Wire Intelligent Quantum) [14] is an Internet decision support system, which enables lawyers, insurers and reinsurers perform quantitative analysis for claims in property distribution and personal damages rapidly. In 1999, Douglas and Toulson analysed value determination structure in torts, property distribution and personal damage. A rule-based system must be the basis in this process. Claims are detailed (claim type, complainant, age, gender, salary, etc.) and included in the system. Rules used in the system help to determine the value of litigious property or tort. *WIRE IQ* database consists of thousands of records including disputes on property distribution and claims on damage remuneration. The system analyses variants, performs comparative analysis, selects precedents and forecasts.

Although the above-mentioned systems have been created by different authors, at different times and for different tasks, it is possible to distinguish one common feature: information and the sequence of problem solutions are specified basis of certain principles. To reveal peculiarities of contract agreements and to determine the system of criteria defining BDCs, it is expedient to classify and to model provisions of such contracts and to perform their systematic analysis.

2. The system of provisions in building design contracts

From the philosophical perspective, a system is a sum of interrelated and interconnected elements, which are integral and united. A system is more than a mechanic unity of its constituent elements. Interconnected elements of the system bring new quality to the totality. The whole system and the relations among elements change when elements are modified, added or removed. Each system may be an element of another macrosystem, and each element of a system may be a microsystem.

Such a complex thing as a BDC cannot be analysed without regarding it as a system with its own elements and its own relations among elements. The view of a BDC as a system is especially important when creating techniques allowing for a multicriteria evaluation of BDCs and a comparison of BDC variants.

After the analysis of the contents of BDCs, the conclusion can be made that the smallest element of a BDC as a system is a contract provision. While analysing a BDC (like any system), different models of systems can be formed depending upon research aims. Therefore, it is necessary to determine which model of a BDC best suits the aims specified in the article.

2.1. The model of a BDC provisions system based on importance of provisions

One of the most important elements of a contract is its contents which include the system of contract provisions. One of the main principles of the civil law is followed in the formulation of contract provisions: contract freedom. On the basis of this principle, parties have a right to make contracts independently and to determine their provisions.

Provisions have different importance in a contract. Lithuanian legal doctrine divides all contract provisions into essential and non-essential. The model of the system of BDC provisions is formed on the basis of this classification; its principal scheme is showed in Figures 1-3.
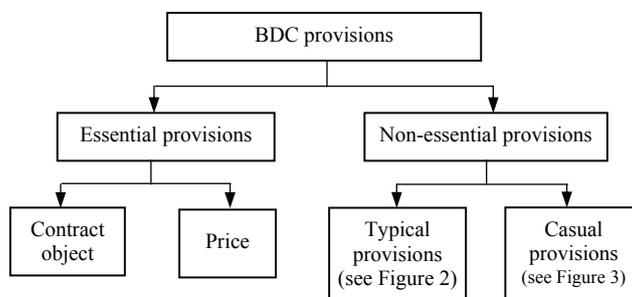

Figure 1. The principal scheme of the model of BDC provision system based on the importance of provisions

Essential contract provisions are those that are necessary and sufficient to formulate a contract which would create rights and liabilities to the parties after coming into force. Essential contract provisions have two features: necessity and sufficiency. Necessity is understood in the following way: the contract is not valid until the parties agree on all essential contract provisions. If an agreement is not achieved, it is considered that parties have pre-contract relations. Sufficiency is understood in the following way: when the parties agree on all essential contract provisions, the BDC is considered valid although adjustment of non-essential provisions is postponed. The analysis of the Civil Code shows that three essential contract provisions are distinguished in a BDC: the contract object, the contract price and the fulfilment terms. When these provisions are adjusted, the BDC is considered valid and creates rights and liabilities to its parties. It is not required that parties agree on all possible contract provisions in all cases. The parties may agree on non-essential contract provisions later at the request of the interested party; non-essential provisions may also be determined by the court in accordance with contract specifications, dispositive legal norms, traditions, legal principles, interrelations of the parties, etc.

It is important to note that essential contract provisions may be determined not only by law but also by the parties of the contract. Suppose that the parties agree that the term of intermediary completion must also be

considered an essential contract provision. In this case the term of intermediary completion becomes an essential provision and will have the same importance on contract validity as the essential provisions described in the law.

Non-essential contract provisions are all other provisions that are not essential. This means that non-essential contract provisions are neither necessary nor sufficient for the contract. Their presence or absence does not influence the validity of the contract. If all non-essential provisions are adjusted but at least one essential provision is not adjusted, then the contract is not valid. Two types of secondary contract provisions may be distinguished: typical and casual.

Typical provisions are the provisions set by laws, which become mandatory for parties due to the fact of contract making. They differ from essential provisions in that it is not necessary to adjust them: if the parties agree on all essential provisions, then upon making the contract they adjust the typical contract provisions as well. When a BDC is signed they are automatically included in the contents. Typical BDC provisions can be imperative and dispositive.

Imperative contract provisions are determined by imperative legal norms and are mandatory for contract parties whether included in the contract or not. Parties cannot neither change nor cancel these provisions. For example, the Civil Code, Chapter 6.702, Part 2 sets a typical imperative BDC provision: "The contractor shall have no right to transfer the result of the work to third persons without the consent of the customer".

BDC provisions may also be determined by dispositive legal norms; for example, the Civil Code, Chapter 6.703, Part 2 includes a dispositive norm which sets a typical BDC provision that the contractor shall be obliged at the demand of the client to correct without compensation the defects of the technical documentation if not specified otherwise in the BDC. This is a typical dispositive BDC provision and need not be adjusted by the parties; it will be valid ipso facto (due to the making of the contract). Dispositive legal norms may be changed by the parties in their contract upon agreement. In this case the provisions agreed by the parties will be superior over the provisions set by dispositive legal norms. If the parties have not changed the contents of dispositive legal norms upon agreement or have not discussed legal relations regulated by dispositive norms, then legal relations between the parties are regulated by dispositive legal norms. Thus dispositive legal norms are valid when contract parties do not specify otherwise.
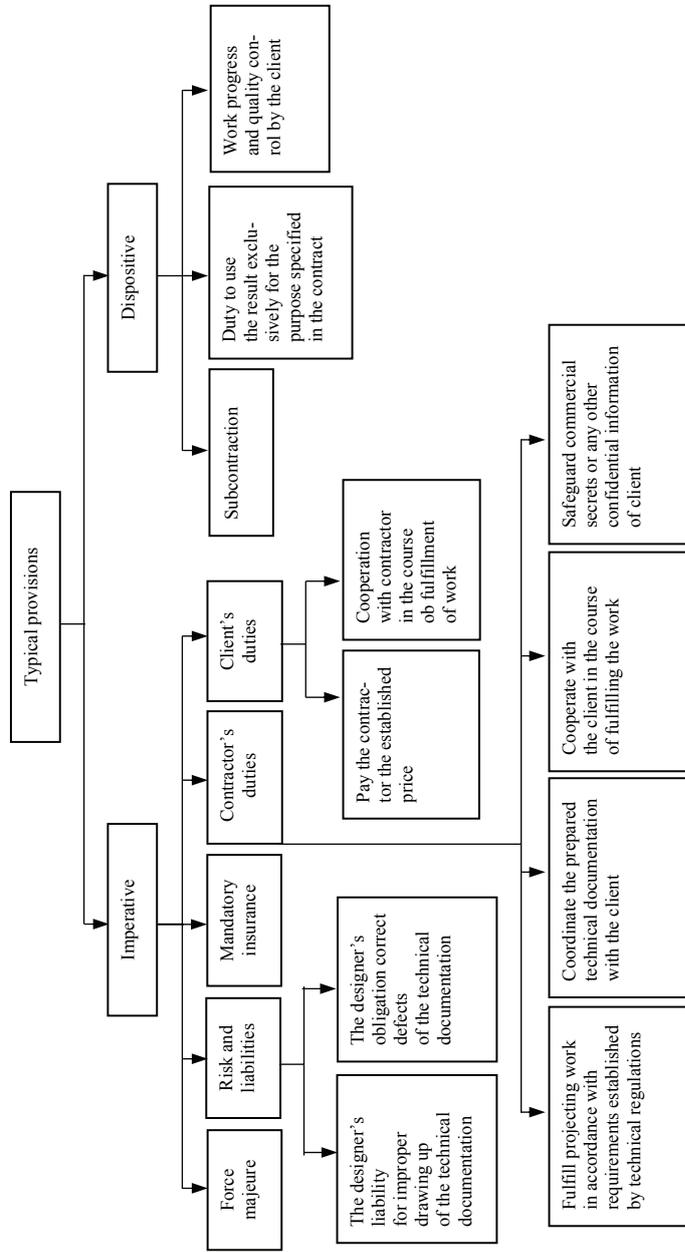
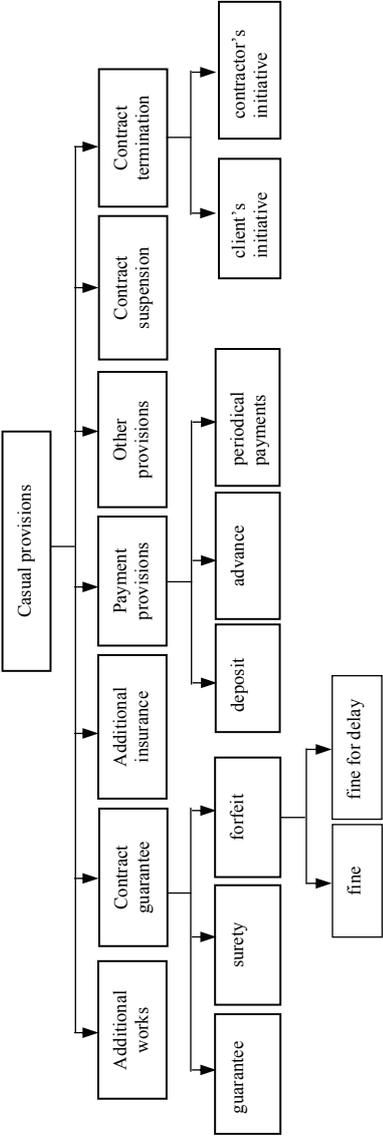Figure 2. The model of typical BDC provisions

Figure 3. The model of casual BDC provisions

Casual contract provisions are non-essential and determined by the parties and not by laws. They are not automatically included in a BDC as typical provisions. Absence of such provisions does not influence the validity of the contract, because they are determined upon mutual agreement between the contractor and the client. It is important to note that regardless of the group to which a certain contract provision is attributed according to the provided classification, all these provisions are equally obligatory when the BDC comes into force, and all contract provisions have legal power over the parties.

Such a classification of BDC provisions helps to determine the hierarchy of provisions, and even non-experts can see legal significance and importance of provisions. This way they can clearly see what legal outcomes will be when some contract provisions are not discussed, in which cases BDC provisions discussed in the Civil Code shall be applicable and in which cases BDC provisions will be valid.

2.2. The model of the BDC provision system based on grouping of provisions into general and special

BDC provisions may also be divided into two main groups according to types of contracts for which they are typical. One group includes contract provisions that are characteristic only of a BDC. The other group would include contract provisions that are characteristic of other types of contracts as well.

The model of the contract provision system based on this classification does not specify essential and non-essential provisions. The model of the BDC provision system based on grouping of provisions into general and special is shown in Figures 4-6.
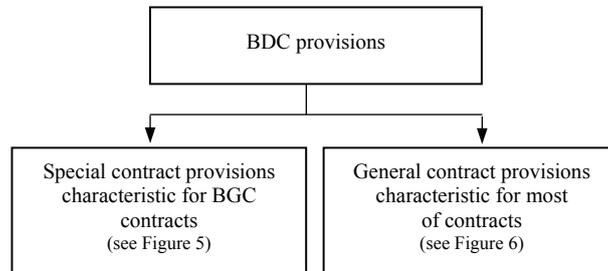
Figure 4. The principal scheme of the model of the BDC provision system based on grouping of provisions into general and special
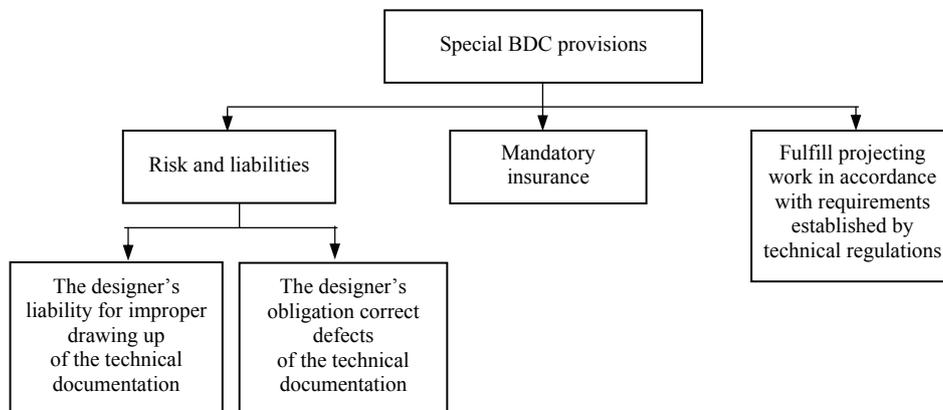
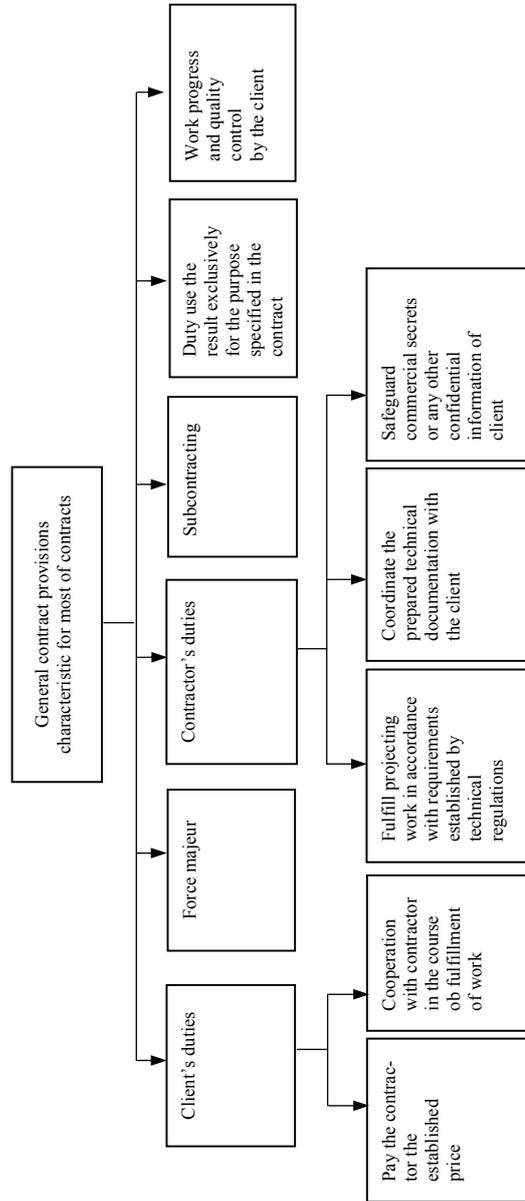Figure 5. The model of special BDC provisions

Figure 6. The model of general BDC provisions

2.3. The model of the system of BDC provisions based on functions of provisions

The system of BDC provisions may be also modelled with respect to functions of provisions. All BDC provisions have certain functions. For example, contract provisions regulating guarantees, surety and forfeit have liability guarantee function. All provisions regulating this function may be grouped into a separate subsystem. Other contract provisions may be similarly grouped into subsystems. The model of the system of BDC provisions formed on the basis of this principle is shown in Figure 7.

We think that this model is the most suitable for the creation of the multi-criteria evaluation technique for BDCs. This conclusion can be made due to the following reasons:

– experts can more easily evaluate the importance of contract provisions when the provisions are grouped according to their functions,

– legal power of all BDC provisions is equal regardless of the group they are attributed to according to any of classifications analysed; however, the latter classification shows best the actual operation and functions of a BDC.
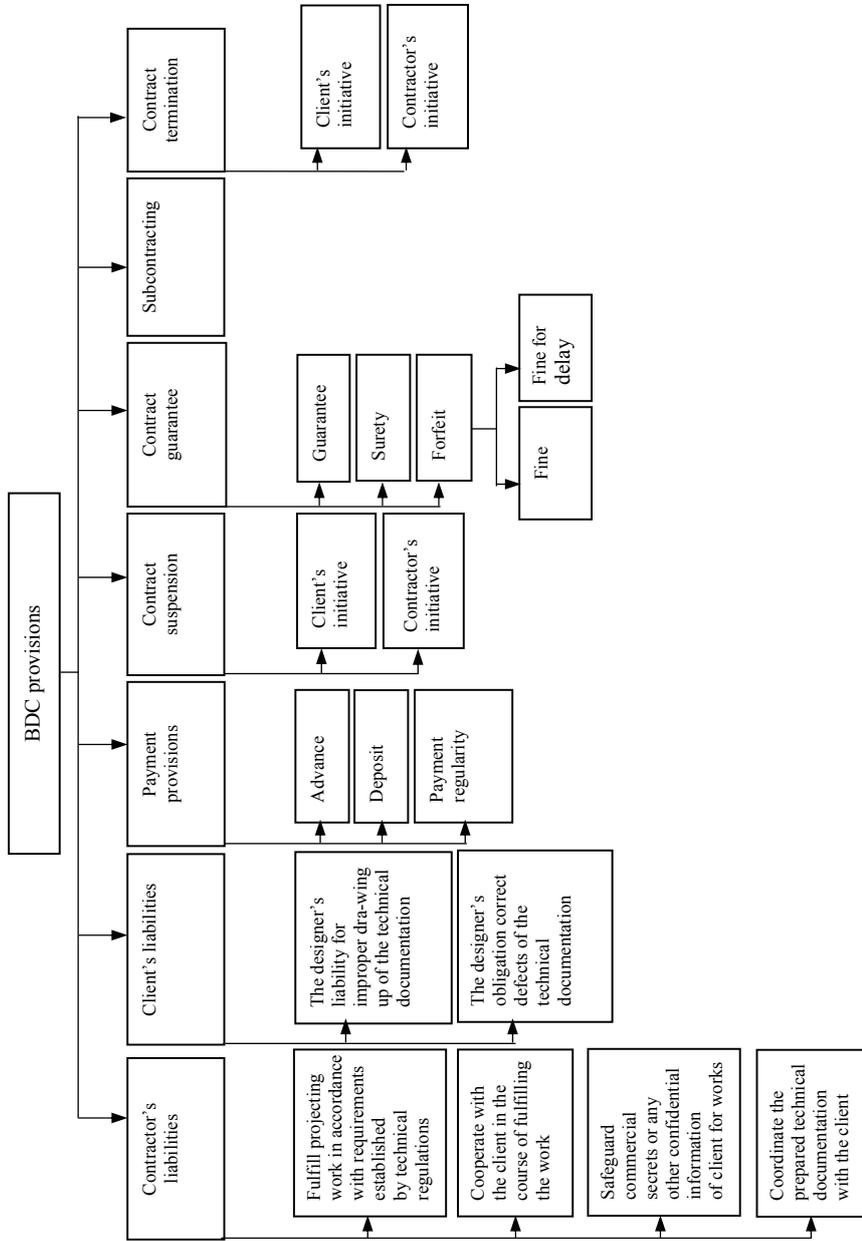
Figure 7. The model of BDC provisions based on functions

Conclusions

1. Construction is an expensive, long-term and complex process during which various problems occur and multicriteria decision making methods must be applied. Various authors offer different multicriteria decision making methods for problem solving at various stages of a construction investment process: selection of a contractor and architects, evaluation of priority for building reconstruction, evaluation of buildings from the point of view of sustainable development, making of decisions related to building maintenance, selection of construction materials, etc.

2. Problem solving in many systems analysed is made by determining criteria which influence the solution and by applying special multicriteria decision making methods. Criteria and their number usually depend on the nature of the problem being solved. This also influences the selection of mathematical methods.

3. Currently multicriteria methods and models are available to increase effectiveness of solutions of various issues related to construction; however, insufficient attention is still paid to making, evaluation and comparison of BDCs. For the construction process to be effective and well-run, the BDC must be well formulated. The model of the BDC provision system is created in order to successfully solve this problem.

4. Currently there are many systems facilitating contract making and legal issue solving; they help to determine precedents and civil law violations, to consult on tax structure, to solve disputes on inheritance, etc. Although these systems are created by various authors, at different time and for different tasks, it is possible to distinguish one common feature: information and the sequence of problem solutions are detailed on the basis of certain principles. In order to reveal peculiarities of contraction agreement making, it is expedient to make a scheme showing BDC provisions and their relationships in detail.

5. After the analysis of BDCs and laws regulating their making, three different models of BDC provision systems were created:

– The model of the BDC provision system based on the importance of provisions. This model is useful for persons who are not knowledgeable in civil law, because BDC provisions are divided according to their legal importance in this model, i.e. outcomes are shown when some provisions are not included in the contract. However, persons who are knowledgeable in law know this classification very well.

– The model of the BDC provision system based on grouping of provisions into general and special. Shows the differences of a BDC as compared with other contract types regulated by the CC. The model has one drawback: it is difficult to determine the importance of provisions and to apply it in decision making.

– The model of the BDC provision system based on functions of provisions. This model helps to determine the importance of contract provisions. Thus this model makes it possible to create an internet-based legal BDC multicriteria decision support system.

References

[1] Sik-Wah F.P., Kit-Yung C.S.: *Final Contractor Selection Using the Analytical Hierarchy Process*. "Construction Management and Economics" 2000, No. 18, pp. 547-577.

[2] Cheung F.K.T., Kuen J.L.F., Skitmore M.: *Multi-Criteria Evaluation Model for the Selection of Architectural Consultants*. "Construction Management and Economics" 2002, No. 20, p. 569-580.

[3] Zavadskas E.K., Ustinovičius L., Stasiulionis A.: *Multicriteria Valuation of Commercial Construction Projects for Investment Purposes*. "Journal of Civil Engineering and Management" 2004, Vol. X, No. 2, p. 151-166.

[4] Antuchevičienė J.: *Principles of Revitalisation of Derelict Rural Buildings*. "Journal of Civil Engineering and Management" 2003, Vol. IX, No. 4, pp. 225-233.

[5] Šaparauskas J.: *Multiple Criteria Evaluation of Buildings with Emphasis on Sustainability*. "Journal of Civil Engineering and Management" 2003, Vol. IX, No. 4, pp. 234-240.

[6] Trinkūnas V., Kaklauskas A., Zavadskas E.K.: *The Use of Computer Technologies in Sales of Construction Products*. "Journal of Civil Engineering and Management" 2003, Vol. IX, Supplement 1, pp. 25-31.

[7] Trinkūnas V., Kaklauskas A., Zavadskas E.K.: *Selection of Rational Construction Products Regarding Building Refurbichments*. "Strategic Property Management" 2002, Vol. VI, No. 2, pp. 74-82.

[8] Meldman J.A.: *A Structural Model for Computer-Aided Legal Analysis*. "Rutgers H Computers and Law" 1977, No. 6, pp. 27-71.

[9] Michaelsen R.H., Michie D.: *Expert Systems in Business*. "Datamation" 1983, No. 29 (11), pp. 240-246.

[10] Susskind R., Tindall C.: *VATIA: Ernst and Whinney's VAT Expert System*. Proceedings of the 4th International Conference on Expert Systems, 1988.

[11]   Capper P., Susskind R.: *Latent Damage Adviser – The Expert System*. Butter-worths, London 1988.

[12]   Swaffield G.: *An Expert System for Stamp Duty*. Proc 3rd Intl Conf Artificial Intelligence and Law, Oxford, UK, ACM Press, New York June 25-28, 1991, pp. 266-271.

[13]   Waterman D.A., Paul J., Peterson M.: *Expert Systems for Legal Decision Making*. "Expert Systems" 1986, No. 3 (4), pp. 212-226.

[14]   Douglas R., Toulson D.: *WIRE Intelligent Quantum (WIRE IQ) – Tort Evaluation by Precedent instead of 'Rules'*. Proceedings of Twelfth International Conference on Legal Knowledge Based Systems, GNI, Nijmegen, Netherlands 1999, pp. 127-128.