

Examples of actions that improve partnering cooperation among the participants of construction projects

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Abstract. The aim of the article is to present examples of actions that can be undertaken in order to improve partnering cooperation in construction projects. These actions are a practical supplementation to the previously developed fuzzy system of controlling partnering relations in construction projects. The actions relate to 18 parameters of partnering relations that describe cooperation between a general contractor or a company that manages the project and four other participants: the contractors (subcontractors), the designer, the material and equipment suppliers and the real estate developer. The actions have been listed based on a review of subject literature, self-analysis, as well as interviews with participants of construction projects. They can provide examples of good practices that maintain partnering cooperation at a high level. Good cooperation, in turn, translates into a better performance of the project.

1. Introduction

During the last couple of years, the possibility of increasing the chances of a successful ending of construction projects through developing partnering relations between the participants of these projects has been recognised more and more often. In publication [1] the authors state that "partnering is a management approach used by two or more organisations to achieve specific business objectives by maximising the effectiveness of each participant's resources. The approach is based on mutual objectives, an agreed method of problem resolution and an active search for continuous measurable improvements". Partnering cooperation can include the carrying out of a single project (project partnering) or stretch over numerous projects and take on the form of strategic partnering. Numerous publications [2,3,4,5,6,7,8] point both to the measurable, as well as the non-measurable benefits derived from the use of a partnering approach. These benefits include: a reduction of the duration and the cost of the completion of projects, increasing the quality of the work, reducing the duration of the design process, smaller supervision costs, a reduction in the amount of disputes, an improvement of the communication between project participants, a reduced exposure to risk, or increased client satisfaction.

Taking into account the benefits derived from the development of partnering relations in construction projects, the authors presented a proposition of a fuzzy system of controlling partnering relations in construction projects in [9]. Its aim is supporting partnering relations management from the perspective of a project manager - a role that can be played by a general contractor or a management firm.



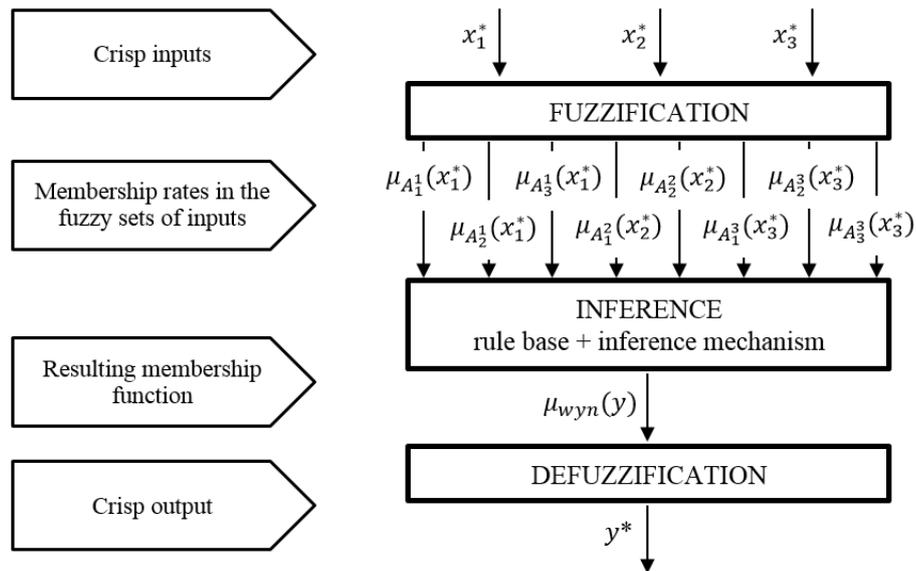


Figure 1. Scheme of the functioning of the system.

The scheme of the functioning of the system has been presented in figure 1. The system is based on Mamdani's fuzzy inference system and allows, on the basis of the value of an output variable (y^*), to point out whether the partnering relations in the context of each of the parameters should be kept on their current level, whether they should be improved, or improved immediately. In order to accomplish this, the following elements are used: the evaluation of the partnering relation parameter (x_1), the weight of the influence of the partnering relation parameter on a criterion of the project's evaluation (duration, cost, quality or safety) (x_2), as well as the weight of the analysed project evaluation criterion (x_3). The output recommendations for each of the partnering relation parameters, however, require supplementing with examples of actions that can be taken in order to improve them. Thus, the final conclusion is going to gain a more practical form and it will be easier to implement the resultant recommendations. The purpose of this article is listing the examples of such actions. In order to achieve this, methods of literature review, self-analysis and interviews with experts have been used.

2. Parameters describing partnering relations

Examples of actions that can be undertaken to improve partnering cooperation between the participants of a construction project have been listed in reference to 18 partnering relation parameters that describe the cooperation of a project's manager (the general contractor or a management firm) with four other participants: contractors (subcontractors), the designer, material and equipment suppliers and the real estate developer. These parameters were presented by the authors in [9], along with a proposition of a fuzzy system of controlling partnering relations in construction projects. The parameters of partnering relations, understood as a part of the cooperation between a project manager and construction contractors (subcontractors), include: participation in organising construction work, the sharing of non-material resources, the sharing of material and human resources, effective communication, the maintaining of established standards and following the rules of behaviour, keeping the agreed payment deadlines and amounts, frequency of the occurrence of disputes and the time needed to solve them, as well as adaptability to changes. The parameters of partnering relations understood as a part of the cooperation between the project manager and the designer include: time needed to reply to propositions of changes to the project, time needed to address problems within a project, adaptation of design solutions (additional construction work, changes to construction work) to the capability of the contractor. The parameters of partnering relations, understood as a part of the cooperation between the project manager and the suppliers: providing quality materials and

equipment, timely delivery of shipments, current technical support. The parameters of partnering relations, understood as a part of the cooperation between the project manager and the real estate developer: negotiating the establishment of the site, keeping the agreed payment deadlines and amounts, presence of the real estate developer's representatives during the approval of finished construction, frequency of the occurrence of disputes and the time needed to solve them.

The examples of actions that can be taken in order to improve partnering cooperation in the context of each of the parameters were listed primarily on the basis of a review of subject literature. They have also been appended on the basis of the authors' own analysis, as well as on the basis of interviews with experts (a selection of specialists with many years of experience in managerial positions in construction companies).

3. Results and discussion

The examples of the actions that can be undertaken to improve partnering cooperation in the context of each parameter have been provided below, in tables 1-4. These tables contain partnering relation parameters regarding the cooperation of a project's manager with contractors (subcontractors), the designer, construction material and equipment suppliers, as well as the real estate developer, respectively.

Table 1. Examples of actions that can be undertaken in order to improve partnering cooperation of a project's manager with contractors (subcontractors) in the context of each parameter.

Partnering relation parameter	Example of an action that can be undertaken in order to improve partnering cooperation in the context of a given parameter.
Participation in organising construction work	Consulting the organisation of the construction site and of the construction process with contractors (subcontractors) more often. Taking into account opinions regarding, for instance, the amount of machinery or structures at the construction site, as well as their layout, determining the sequence of performing work in the event of atypical solutions, the manner of the transport of materials or the necessity of changing the organisation of the construction site due to previously unforeseen situations.
Sharing of material and human resources	Stressing that the common goal of all of the project's participants is its successful completion [10]. A more willing sharing of resources between a project's manager and the contractors in the event of unforeseen events, for instance equipment failures or the threat of not meeting a deadline. The sharing of employees can also include the performing of small assistance work that is not listed as additional work, such as, for instance, the righting of a fence that was flipped by the wind, help in transporting materials or equipment or the securing of the worksite from atmospheric conditions.
Sharing of non-material resources	A greater willingness to exchange knowledge on the topic of the technologies that are being implemented, possible difficulties and the manners of dealing with these difficulties [11]. In case of doubt in this are from either side, a willingness to forward the above questions to other participants of a project.
Effective communication	The introduction of new forms of verbal and written communication, ensuring a sufficient frequency of contact [12,13,14]. Paying attention to the clarity and legibility of messages. Paying attention to the factuality of messages. The organisation of coordination meetings. Stressing direct, personal contact [15]. The organisation of team building workshops. The organisation of integration meetings facilitating the development of interpersonal communication and trust [15,16]. The use of common and mild language [4]. Basing communication on sincerity and openness [13,14]. The use of communication methods that are appropriate to the character of a message (e-mail is the quickest manner of sending messages, but in the case of complex messages, a face-to-face conversation is usually more appropriate)[13].

Maintaining of established standards and following the rules of behaviour	Spreading knowledge about established rules. Taking care so that all workers (also those newly hired) are familiar with arrangements regarding the manner of entering the construction site, passes, working hours and breaks, or the enforcement of health and safety regulations, such as possessing safety goggles, vests or helmets. The ongoing enforcement of decisions.
Keeping the agreed payment deadlines and amounts	Taking care that payments are transferred on time and in full after the satisfactory performing of work. Ensuring the availability of sufficient funds to cover payments for construction work. The planning of expenditures in advance.
Frequency of the occurrence of disputes and the time needed to solve them	Respecting the work of other participants of a project and taking care so as to not damage it (for instance damaging freshly made concrete floors, plasters, floors or windows). Ensuring the quality of performed work. Ensuring that work is performed in a realistically planned period of time. Paying attention to a properly planned sequence of work, communication between the participants and the provision of sufficient safety measures. A systematic approach to solving problems [17]. Stressing the pursuit of solutions, instead of the guilty [17]. Enacting the principle of equal rights of all sides [17]. Understanding the motivations of the other side [5]. An earnest exchange of bad news at the appropriate time, which makes it possible to undertake mutual action in order to avoid or minimise the impact of a problem [5]. Striving to solve disputes at the lowest possible level, without the need to mediate or enter a legal dispute [2,4].
Adaptability to changes	The factual presentation of the justification of changes and a precise presentation of what they entail. Devoting more time to planning, in order to minimise the extent of the occurrence of changes. Presenting the necessity of introducing technological changes early enough so that contractors will be able to prepare for them. Avoiding introducing changes in the case when preparations have already been made to perform work in accordance with previous decisions, for instance the purchase of materials.

Table 2. Examples of actions that can be undertaken to improve cooperation within a partnership of a project's manager with the designer in the context of each parameter.

Partnering relation parameter	Example of an action that can be undertaken in order to improve cooperation within a partnership in the context of a given parameter.
Time needed to reply to propositions of changes to the project	The factual justification of proposed changes regarding materials, structure or architecture. Propositions regarding these changes can result from: the limited availability of a given material, the desire to reduce the cost of or simplify the performing of certain construction work. A situation is also possible, in which a project's manager, possessing a larger degree of practical knowledge, will be able to propose solutions that are better suited to given conditions.
Time needed to address problems within a project	Concentrating on solving a problem, instead of finding the guilty party. A factual and precise communication of problems. Cooperation in the pursuit of solutions to emergent problems.
Adaptation of design solutions (additional construction work, changes to construction work) to the capability of the contractor	Presenting the benefits of the proposed solutions to the project as a whole. Pointing the designer's attention to the resources that are at the manager's and contractor's disposal and their experience in the use of a given technology.

Table 3. Examples of actions that can be undertaken to improve cooperation within a partnership of a project's manager with suppliers in the context of each parameter.

Partnering parameter	relation	Example of an action that can be undertaken in order to improve cooperation within a partnership in the context of a given parameter.
Providing materials and equipment	quality	Pointing to the possibility of establishing long-term cooperation with suppliers should the quality of the materials and equipment be sufficient. Underlining that a high failure rate of construction equipment can be the cause of pauses in work and cause delays (for instance the malfunction of a crane). Similarly, delays can result from the delivery of materials that do not meet appropriate parameters, materials that will require the filing of a complaint and will cause the necessity of waiting for another delivery, which can impact the success of a project.
Timely shipments	delivery of	Pointing to the possibility of establishing long-term cooperation with suppliers should the punctuality of deliveries be satisfactory. Underlining that delayed deliveries can cause pauses in work and lead to delays in the performing of work (for instance the delivery of concrete mixtures should provide a continuity of concrete pouring work, with even minor delays resulting in halting the pouring due to the setting of the mixture during transport). Stressing that performing work in a timely manner is key to the success of a project [6].
Current technical support		Pointing to the possibility of establishing long-term cooperation with suppliers providing satisfactory technical support. A willingness to direct questions and queries for advice from suppliers, as suppliers who know their materials well are able to provide advice regarding which of them will be best in given conditions. The clear presentation of one's expectation regarding technical support [11].

Table 4. Examples of actions that can be undertaken to improve cooperation within a partnership of a project's manager with the real estate developer in the context of each parameter.

Partnering parameter	relation	Example of an action that can be undertaken in order to improve cooperation within a partnership in the context of a given parameter.
Negotiating the establishment of the site	the	Pointing to the real estate developer that it is possible to reduce the overall costs of carrying out a project through such things like leasing rooms in existing buildings for social or equipment storage purposes, making it possible to use water and energy sources, using parking spaces, etc.. Getting the real estate developer to participate in planning the establishment of the construction site.
Keeping payment deadlines and amounts	the agreed	Ensuring the timely and full payment by the real estate developer after the satisfactory completion of work. Ensuring the provision of appropriate funds for payments for performed work. Underlining that good cooperation brings mutual benefits and could be continued in the future.
Presence of the real estate developer's representatives during the approval of finished construction		Constant contact with the real estate developer's construction site supervisor. Informing of planned construction work approvals in advance. Paying more attention to the proper and timely preparation of the performed work to be approved by the real estate developer's construction site supervisor.
Frequency of the occurrence of disputes and the time needed to solve them	the	Ensuring that high quality work is being performed. Ensuring that work is performed within a realistically planned timeframe. A systematic approach to problem solving [17]. Stressing the pursuit of solutions, not guilty parties [17]. Adopting the principle of equal rights of all sides [17]. Understanding the motivations of the other side [5]. An earnest exchange of bad news in an appropriate time, which makes it possible to work together in order to avoid or minimise the impact of a problem [5]. Striving to solve disputes at the lowest possible level, without the necessity of mediation or entering into a legal dispute [2,4].

4. Calculation example

Presented example of fuzzy system of controlling partnering relations operation is related to the cooperation between project manager and contractors in the context of effective communication and cost of project implementation.

Example values of input variables: evaluation of the partnering relation parameter (effective communication) $x_1^* = 1$ (very poor), weight of the influence of the partnering relation parameter on a criterion of the project's evaluation (cost) $x_2^* = 0.787$ (the slope of regression function presented in the article [18]), weight of the analysed project evaluation criterion $x_3^* = 5$ (very important).

In figure 2 fuzzification process for crisp values of input variables has been presented.

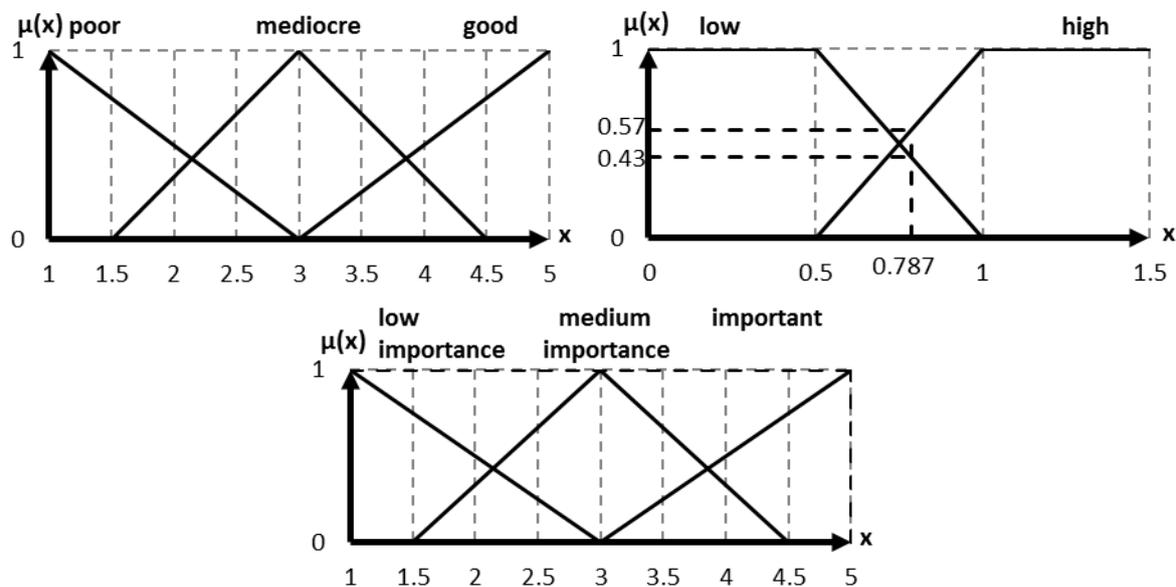


Figure 2. Illustration of fuzzification process for crisp values of input variables.

The degree of meeting the conditions of each activated rules:

If x_1 =poor and x_2 =low and x_3 =important then y =improve

$$h = \min(\mu_{A_1}(x_1^*), \mu_{A_2}(x_2^*), \mu_{A_3}(x_3^*)) = \min(1, 0.43, 1) = 0.43$$

If x_1 =poor and x_2 =high and x_3 =important then y =improve immediately

$$h = \min(\mu_{A_1}(x_1^*), \mu_{A_2}(x_2^*), \mu_{A_3}(x_3^*)) = \min(1, 0.57, 1) = 0.57$$

Modified conclusion membership functions of particular rules are presented in figure 3.

$$\mu_{B_2^*}(y) = \min(0.43, \mu_{B_2}(y))$$

$$\mu_{B_3^*}(y) = \min(0.57, \mu_{B_3}(y))$$

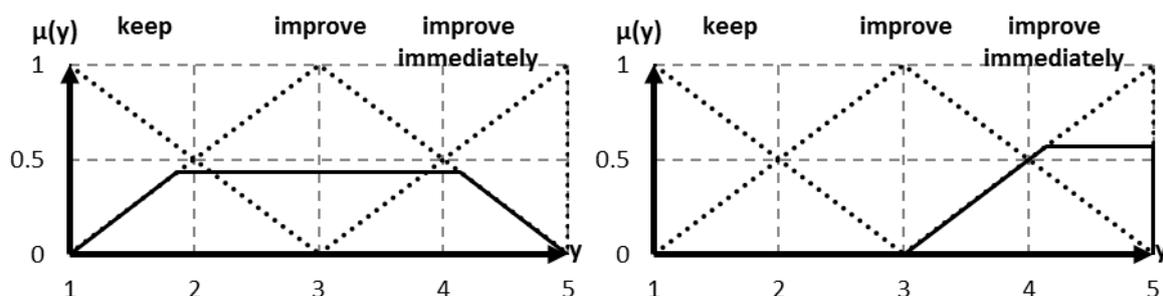


Figure 3. Modified conclusion membership functions of the activated rules.

Determining the resulting membership function through aggregations of modified membership functions of conclusions of specific rules are presented in figure 4.

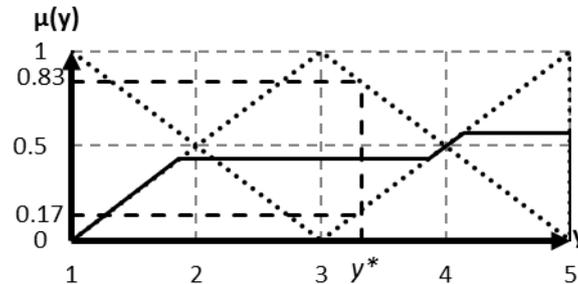


Figure 4. Resulting membership functions of the output value.

Defuzzification has been performed using center of gravity method and the crisp output $y^*=3.33$ has been obtained. The conclusion “improve” reaches the largest value (0.83) of membership function for this output. To improve partnering cooperation in the context of effective communication with contractors, the actions listed in table 1 can be undertaken.

5. Conclusions

The paper presents actions that can be undertaken in order to improve cooperation within a partnership between the participants of construction projects, in the context of each of the partnering relation parameters. The listed actions are only examples and guidelines, which can be expanded or tailored to a particular construction project. The system of the carrying out of a particular project - that conditions between which of the participants will the cooperation be developed and to what degree - needs to be taken into account. One must also remember that these actions should not be contrary to the clauses of a legal agreement, and are meant to make it possible to obtain added value through a synergic effect and cooperation in order to achieve a common goal. This goal, for each of the participant of a construction project, should be the successful completion of a project.

The actions presented in the article will be a practical appending to the fuzzy system of partnering relations controlling in construction projects presented by the authors in [9]. These actions are a presentation of specific cases of good practice that help to maintain cooperation within a partnership between a project's participants at a high level. Good cooperation, in turn, as it has been pointed out in the introduction, leads to numerous benefits over the course of the carrying out of a project, which are both measurable and non-measurable.

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