

# A TOOL FOR A CRITICAL EVALUATION OF TECHNICAL COMMUNICATION ABILITIES IN INTERNATIONAL CONSTRUCTION PROJECTS

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Current information quality management, whose purpose is to produce advanced approaches to the management of the quality of information which should help to reduce costs related to communication, tries to solve the problem of how to evaluate the quality of different texts. It tries to solve the problem of how its different quality dimensions of data in databases can be applied on written technical texts in different companies. This paper advances the current state of the research by proposing the tool with which mainly text's understandability can be evaluated while evaluating the quality of information-receivers' interpretations of written technical texts.

The tool developed with several preliminary studies with students was applied in one construction project, and results from this application are presented here including theoretical information about the proposed tool. The proposed tool enables to compare information-receivers' self-perceptions of different communication abilities with the results of the critical evaluation of the same abilities. It also enables to identify possibly existing relations among self-evaluations of different communication abilities and also among different critically evaluated communication abilities. For example, the test identified that the higher the self-evaluation of technical knowledge (or knowledge related to contractual issues) is, the higher the number of satisfied criteria evaluating critically the same knowledge exists. Another finding is that all respondents with the longest working experience have an incorrect belief about understanding which was critically evaluated while specifying whether each respondent who said that understands the meaning of the main message of the analyzed passage and simultaneously all of its words was really able to explain this message or all the key terms which were required from them to be explained.

**Key words:** *critical evaluation, communication abilities, written text, classification of interpretations*

## 1. INTRODUCTION

The main issue in information quality management is to evaluate different quality aspects (dimensions) of information<sup>1), 2), 3)</sup>. The examples of these information

quality dimensions are: understandability, readability, semantic consistency, accuracy, or relevancy.

The purpose of these evaluations is to specify which aspects and how much of the same information are differently non-quality, how much this low non-quality

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or, on the other hand, inappropriately too high quality aspects of the same information affect costs and time of communication. Thus, information quality management then tends to produce recommendations for how much quality of different aspects of information should be while communicating it for different purposes or in different environments<sup>4), 5)</sup>.

To evaluate a specific quality dimension of information requires to specify a metric which is represented by one number in the interval  $<0;1>$  and is counted as the number of criteria which were applied on a specific text and satisfied by the same text divided by the number of all the criteria applied on the same text<sup>1), 6)</sup>. Nevertheless, current information quality proposes this application of different metrics only or mainly on data in different databases, thus it (almost) ignores, e.g., written technical texts in construction companies.

Due to this current limitation, the same discipline also does not strongly consider in its development current research of linguistics or psychology, despite these two disciplines are also focused on communication and can be considered as beneficial for the development of information quality management (IQM) in the case that IQM really aims to propose methods with which the quality of written texts will be managed in the future.

The reason of why IQM should also consider more research from linguistics is that linguistics produces, e.g., different recommendations for communication or results from its studies dealing with how and why different information-receivers or producers have specific troubles in communication (e.g., a lack of knowledge for communication, insufficient skill in analytical thinking)<sup>7), 8)</sup>.

Psychology can be beneficial for IQM just because this discipline emphasizes the difference between different self-perceptions and real people's abilities (i.e., skills), e.g., to communicate accurately or to understand sufficiently interpreted information<sup>9)</sup>. Moreover, current psychology does not propose a tool with which incorrect beliefs about interpretation (communication) abilities could be evaluated. It means in other words that there is no tool which could enable to classify the same incorrect beliefs about communication abilities. But to have such

the tool, it could be possible to decide whether the quality of information can be evaluated, at least in some cases, only through the evaluation of people's self-perceptions about the same information or whether these self-perceptions cannot be always used and the evaluation is only possible with other data from critical tests of the same people.

Written communication is more important in international projects than national ones because before each work will be performed in the 1<sup>st</sup> type of projects (international), it must be described and submitted to the supervising engineer's representative for a written approval<sup>21)</sup>. The same international projects consist of people of different nationalities which can know and prefer different communication standards and styles. This approach, however, may not be appropriate for the project and may cause troubles not occurring in national projects. To eliminate maximally these possible troubles, communication must be in international projects more understood, evaluated than in other projects (including the critical evaluation of information-receivers' different communication abilities).

The objective of this paper is to propose one tool with which information-receivers' interpretations of written technical text or other communication abilities can be evaluated and to demonstrate that it produces beneficial results while applying it in international project's communication. This tool is firstly described theoretically, another chapter then describes the application of the proposed tool, including its results.

While the proposed tool can be used in different environments (e.g., projects, business communication, universities) or communication situations, our focus (while testing it) is on international construction projects because these projects have many communication troubles (e.g., troubles to communicate contractual issues or related to differences in opinions, incorrect presentations) requiring more attention and more advanced approaches to their elimination than currently existing<sup>10)-12)</sup>.

The proposed tool cannot be probably used by different construction projects or their companies for its time requirements, but it can be used by different

researchers or also by different consulting companies (focused on communication quality management) to help these projects to reduce their communication troubles.

## 2. LITERATURE REVIEW

Most of literature when presenting empirical results from different studies related to communication in international projects presents these results with the emphasis on that they were obtained in one or several projects located in a specific country or only in a few countries. When the test or other empirical study is not described in the paper, its recommendations are often more general.

For example, there is an emphasis on more research in intercultural communication occurring in international projects because this communication is considered as causing many problems<sup>10)</sup>. While dealing with these or other communication issues, it should be considered that different communication systems in different environments may affect the quality of communication differently. Thus it is recommended to map with a model communication problems and to learn from this model to improve the quality of project's communication<sup>11), 12)</sup>. Also models are available which tend to produce recommendations for general communication strategies<sup>13)</sup>.

Because written communication is often produced after oral agreements are achieved, there are also theoretical recommendations how these discussions should be performed or what kind of variables should be considered as affecting these discussions<sup>14)</sup>.

When we focus on written communication, and particularly on its evaluation, it can be firstly said that there are, e.g., studies evaluating "the co-construction of oral and written texts" while focusing on children or students or studies in linguistics focused on different aspects of written discourse<sup>15), 16)</sup>. James Barlow considers a projects' performance as requiring more attention and better approaches than currently used, and not only when we focus on written communication<sup>17)</sup>. All the previous here reviewed sources are not, however, focused on the evaluation of the quality of project's written communication. That is, they do not produce results of at

least one such critical evaluation. This is also valid for the paper of other authors which present several recommendations regarding project's communication, but these recommendations are not based on the empirical test<sup>18)</sup>. Generally speaking, the authors did not find a paper which would critically evaluate with a test the quality of written communication in (international or also construction) projects, at least in one quality dimension of the same information. The similar conclusion can be said when research papers are being searched which should present a critical evaluation of construction workers' technical knowledge or expertise.

There is, e.g., the study which emphasizes that the same people should more deeply develop 4 basic types of skills (leading, communication, problem solving, and negotiating), but this study does not critically test at least one of these skills<sup>19)</sup>. Another found study emphasizes the importance of several skills which are classified as human, conceptual and organizational, or technical, but the same study does not again evaluate them critically in workers as presented in our paper<sup>20)</sup>.

## 3. THE PROPOSED TOOL

Because psychology emphasizes the importance of the evaluation of possibly incorrect self-perceptions (self-evaluations) of different communication abilities, the tool which was constructed for the evaluation of information-receivers' ability to understand text was constructed in such a way that it enables to compare these self-evaluations with respondents' critical results from the test.

Before more will be said about the proposed tool, it should be said that the first purpose of its construction was to enable to classify respondents according to their differently quality interpretations (i.e., explanations) of the same text and to classify different parts of the interpreted text according to their different difficulties to be correctly understood (Tab.1). Having a group of respondents (e.g., 3) which produced required group of interpretations of the same text (it was required by that all of them had to answer the same group of questions about the interpreted text), respondents' interpretations

can be evaluated with a group of criteria (e.g., 4), and it can be then estimated how many criteria were satisfied by each respondent. Then the respondents can be ordered with the assumption that the higher the number of criteria satisfied by each respondent is, the higher s/he has the specific critically evaluated communication ability.

Because it can be also estimated how many respondents satisfied each criterion, it is possible to order all the criteria applied on respondents' explanations according to their increasing/decreasing difficulty to be satisfied. This approach is beneficial, e.g., when each part of one text which should be tested for its understandability (such as a connector of two specific sentences) should be explained by the respondents and their explanations of the same connector will be then evaluated with one or several criteria as accepted or not. After obtaining the order of these criteria, it is possible to go through the questions related to them to the initial text, which was tested, and to identify the most problematic parts of the tested text.

After the two scores are available (as presented in **Tab.1** of the respondents and the criteria used for the test), two types of recommendations are possible. The first group of them can describe which parts of the tested text should be mainly improved because they were the most difficult for the respondents. The second one can describe what and how much should be improved in each respondent according to their different final scores (i.e., with which parts of the text they had the highest troubles – they did not satisfy the criteria related to these parts).

Not only each answer for each question required to be answered by each respondent can be classified with only one criterion. It depends on the author of the test whether it is preferable to classify each answer for each question by only 1 criterion, or whether, on the other hand, it is preferable to define more criteria.

Returning to the proposed tool (**Fig.1**), it firstly enables to compare how much respondents change their self-evaluations of understanding in different times of a dealing with the same text. The first self-evaluation can be required after the text will be submitted firstly to

them with asking them to read it and to evaluate their understanding.

**Tab.1 An example of respondents' scores vs. the most difficult criteria.**

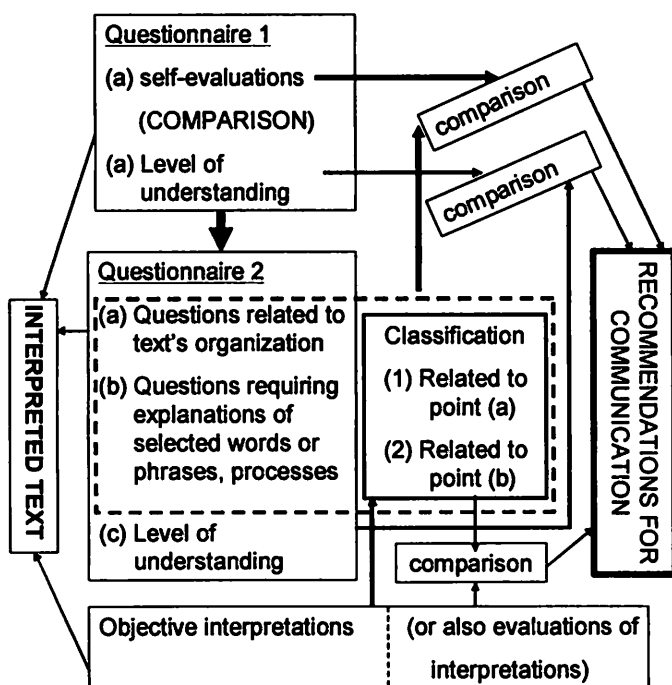
		No. of the respondent			SUM	ORDER OF CRITERIA
		1	2	3		
No. of a criterion	1		X		1	1-2
	2	X			1	1-2
	3		X	X	2	3-4
	4		X	X	2	3-4
SUM		1	3	2		
ORDER OF THE RESPONDENTS		3	1	2		

This evaluation will be performed by selecting only one of the following five choices: (1) I understand the main message and also the meaning of all of the words, (2) I understand the main message, but I do not understand the meaning of some of the words, (3) I do not understand the main message, but I understand the meaning of all of the words, (4) I don't understand the main message, and I do not understand the meaning of some of the words, (5) other choice. After these self-evaluations are collected, the respondents will be asked to explain several points related to the text's organization (e.g., to explain purposes of different connectors, why sentences are ordered as they are) and to explain several text's key terms. Then, they are asked again for the same self-evaluations which at least in some cases causes that their 2<sup>nd</sup> self-evaluations are corrected and become having worse scores (e.g., from (1) to (2) or to (3)).

The second comparison, which the proposed tool enables, is to compare respondents' self-evaluations of different communication- or other abilities. For instance, Kusayanagi proposed a questionnaire in which respondents had to evaluate their ability to read or write in English by selecting always only one from more prepared answers<sup>21</sup>). Bud he did not propose empirical results of its application. Other abilities which can be self-evaluated and are related to communication are, e.g., analytical thinking, conceptual thinking, interpersonal understanding.

The proposed tool also enables to deal with technical expertise, contractual or commercial knowledge and so on. These prepared choices related to each question can be, e.g., represented by the scale Excellent, Good, Fair, Poor and transformed into numbers from 1 to 4 or vice versa. Then not only an average score related to each question and one group of respondents can be estimated, it is also possible to compare how an average respondent which selected one choice related to one question scored while answering another question.

Nevertheless, these self-evaluations cannot guarantee their reliability because they are connected with respondents' perceptions which may be incorrect. To evaluate the correctness of these self-evaluations, it is necessary to evaluate critically the same respondents' abilities and to compare their self-evaluations of the same abilities with their critical testing.



**Fig.1 The proposed tool enables several types of comparisons.**

It means that it is possible to compare, for instance, self-evaluations of an ability to understand text's organization with its critical evaluation, self-evaluations of levels of technical knowledge with its critical evaluation, self-evaluations of knowledge related to commercial issues with its critical evaluation. For this purpose, respondents' interpretations related to specific

text are classified with a group of classification criteria distinguishing mainly, e.g., between their ability to understand correctly text's organization or argumentation structure and their ability to explain precisely different words, phrases, or processes mentioned in the interpreted text.

When we assume that the same text is highly relevant to their profession, they can for instance communicate similar documents daily, it is possible after classifying their explanations of the selected key terms, phrases, or processes to measure levels of their expertise. The higher the number of criteria satisfied by each respondent evaluating their technical expertise is identified, the higher the real level or size of this expertise exists.

What can be also compared is to specify how much their critically determined final score produced with a group of criteria evaluating their ability to understand text's organization is related to their final score produced with another group of criteria evaluating levels of their technical expertise. This technical expertise is highly important in international projects because mainly technical information is communicated with the SEO; other types of information (e.g., financial or economical) are produced only for inner purposes of the project or for its companies of the joint venture.

Moreover, after obtaining respondents' critical evaluations and final scores of these evaluations, they can be compared with their self-evaluations. In the case that the number of criteria critically evaluating a specific respondents' ability is sufficiently high, it can be considered as producing more accurate results than the self-evaluations, which can be thus rejected as reliable. Other cases of the same comparison may identify interesting relationships between some self-evaluation of a group of respondents and their critical evaluation of the same ability.

While evaluating respondents' interpretations of text (which can consist of only one or several paragraphs), it is necessary to guarantee that these criteria will be appropriately selected (and also questions of the 2<sup>nd</sup> questionnaire to which they relate). To satisfy this requirement, the main manager of the project which can

select text for the test can offer an “ideal” interpretation of the text with which a group of requirements for respondents’ interpretations will be constructed (i.e., by defining a group of evaluation criteria). Another possibility is to answer for this interpretation not only the main manager of the project, but also to ask more people of the management department of the project to interpret the same text. Then, their interpretations will be compared. Finally, the group of requirements for interpretations based on this comparison of “ideal interpretations” will be constructed.

As identified in the project where the tool was applied, its management department consisted of 3 highly experienced project managers and each having a total working experience higher than 25 years. Assuming that these managers are the only people which can satisfactorily specify the requirement how different texts communicated in their projects should be understood, all the participants of the test can be then evaluated how much their interpretations of the text are different from the “ideal” one.

This “ideal” one can be then considered as a standard interpretation of the text preferable in the project for its quality communication, which should be required from each person who must deal daily with similar types of information to the tested one – s/he should satisfy all the defined criteria or most of them.

After obtaining respondents’ interpretations of specific text, another possibility what can be performed with them is to ask one or several managers of the management department to evaluate each interpretation, explanation of each respondent as Excellent, Good, or Poor.

Because each respondent had to answer the same number of questions, thus s/he will be evaluated by the same number of scores (Excellent, Good, or Poor). When we transform Excellent into 3, Good into 2, and Poor into 1, a sum of these evaluations produced by each manager can be then estimated for each respondent. After these summations are available for each respondent, they can be ordered and the best one will be connected with the highest sum value.

As already said, the same evaluations can be produced

by more than one manager. If so, it is then possible to compare respondents’ final orders obtained through the evaluations of different managers and to specify correlation dependencies between total managers’ perceptions of how the high quality interpretation of the same text should be produced (the first possibility). These managers can evaluate respondents’ interpretations with a previously defined group of evaluation criteria. In this case, they will only read all the interpretations and specify whether each of them satisfied each relevant criterion constructed to them (the first approach).

The second approach is that they will evaluate all the explanations (with the scale Excellent, Good, or Poor; or another one) only intuitively. While the first approach can be more precise and can use more criteria, thus it may also require more time, the second approach is generally faster, but may not be only less precise, it can also produce more incorrect evaluations. When the second approach is selected, the intuitive evaluation, respondents’ explanations can be still critically evaluated with a group of criteria, and this classification will be produced, e.g., by the researcher visiting the site office. Such approach then enables to compare how much and why managers’ intuitive evaluations of interpretations are different from their evaluations with the group of criteria.

The last benefit of the tool, which will be described here, is that respondents’ self-evaluations of understanding available at the end of the second questionnaire can be again critically evaluated. For this purpose, incorrect beliefs about understanding type 1 and 2 will be defined.

Respondents’ self-evaluations of understanding at the end of the second questionnaire could be also the 1<sup>st</sup> or the 2<sup>nd</sup> choice stating that they understand the meaning of the main message of the whole interpreted passage. To explain this message by them can be asked in one question of the second questionnaire, and their explanations can be then classified with several criteria. Those who selected that understand the main message of the whole passage and satisfied no criterion, have an incorrect belief about understanding type 1.

Respondents’ self-evaluations of understanding at the

end of the second questionnaire could be also the 1<sup>st</sup> or the 3<sup>rd</sup> choice stating that they understand the meaning of all of the words. The second questionnaire will ask them to explain the meaning of key terms of the analyzed passage. Then respondents' explanations of each of these terms will be evaluated with always at least one criterion. In order to the respondent would satisfy his choice at the end of the 2<sup>nd</sup> questionnaire, it is necessary that s/he will explain each required term at least with one satisfied criterion. On the other hand, s/he has an incorrect conscious (self-aware) belief about an understanding of all of the words.

#### **4. APPLICATION OF THE PROPOSED TOOL**

##### **(1) Preliminary steps and the used text**

Before the here proposed tool was tested in the construction project, it was developed with 3 preliminary studies performed with three groups of university students. Nevertheless, the results from these studies will not be presented here and also the way how the tool was developed. The first project was selected from the 3 ones offered by one company for the test of the developed version of the tool because the 2<sup>nd</sup> project will be soon finished and its main manager was not open to our research *ibid* (he was interviewed about it). The last project was not also selected for the test because its office consists of an insufficient number of people which were required for the test (about 20 people). This information was also identified in the project during its short visit.

After discussing all the proposed steps of the test with the main manager of the 1<sup>st</sup> project, he selected 21 people for the test and mainly head persons of different project's departments. He also recommended to use for the test one passage from one appendix of the Employers' Requirements dealing with project's works which he was trying to interpret in that time in order that more instructions could be given to his workers.

This requirement was important for him to be understood sufficiently by his workers because they had to help him to specify (control and other) works which are necessary to be practically performed on the project.

Its passage which was selected for the test is presented here. It consisted totally of 5 sentences in 4 points and was taken from the beginning of the section titled Control of Water related to dewatering. The main part of the project was a construction of a tunnel.

#### **CONTROL OF WATER**

##### **General requirements - dewatering**

##### **27.75**

*(1) Dewatering of any excavation will not be permitted without approval<sup>1</sup>. Approval shall be subject to the satisfactory submission by the Contractor of his intended methods for dewatering, ground treatment, groundwater control, recharge wells, monitoring instrumentations and all necessary Temporary Works<sup>2</sup>.*

*(2) All dewatering methods used in the design and construction of the Works shall include for adequate groundwater cut off in order to minimize the change in the piezometric pressure head and/or groundwater table at all existing building structures<sup>3</sup>.*

*(3) Changes in piezometric pressure head and/or groundwater table during construction shall not be greater than an equivalence to one metre head of water over the undrained sections of tunnel and 5 metre head of water over the drained sections of tunnel reducing in proportion within a transition length of 200m beyond the drained/undrained interface, unless the Contractor can clearly demonstrate that all existing building structures and parts of the Works within the influence of the dewatering will not be affected by the proposed dewatering<sup>4</sup>.*

*(4) The groundwater level in the excavated area shall be held to within one metre below excavation level except where specifically directed or approved by the Supervising Officer<sup>5</sup>.*

*(Source: Contract No. DC/2007/12 – Design and Construction of Tsuen Wan Drainage Tunnel, Employer's Requirements – Appendix ER.B27)*

##### **(2) Content of the 1<sup>st</sup> questionnaire and its results**

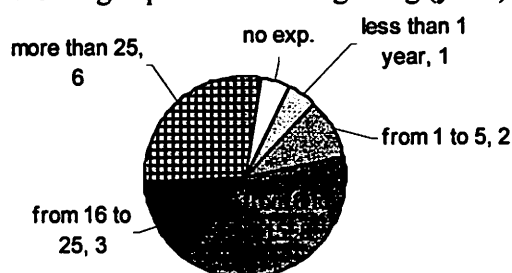
The first questionnaire was distributed to the people in which they mainly in its first part self-evaluated different communication skills and informed about their

nationality, department (Tab.2), total working experience in Japan, in Hong Kong, and in other countries (Fig.2). Seventeen respondents have no working experience in Japan (3 respondents between 6 and 15 years, 1 respondent between 1 and 5 years), and all the people with working experience in Japan are Japanese nationality. Seventeen people from 21 tested have working experience in Hong Kong higher than 6 years. All the participants of the test were males. The first questionnaire also identified that the test was participated by 12 Chinese men, 4 Japanese, 4 Chinese/English, and 1 Nepali.

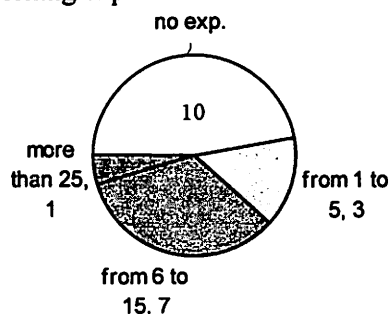
**Tab.2 People participated in the test.**

DEPARTMENT	No. of people
Financial and Administration	1
Commercial	1
Construction	7
Survey	1
Engineering	5
Safety	2
Quality and Environment	2
Management	2

**Working experience in Hong Kong (years)**



**Working experience in other countries**



**Fig.2 Numbers of people with differently long experience in Hong Kong and in other countries (excluding Japan).**

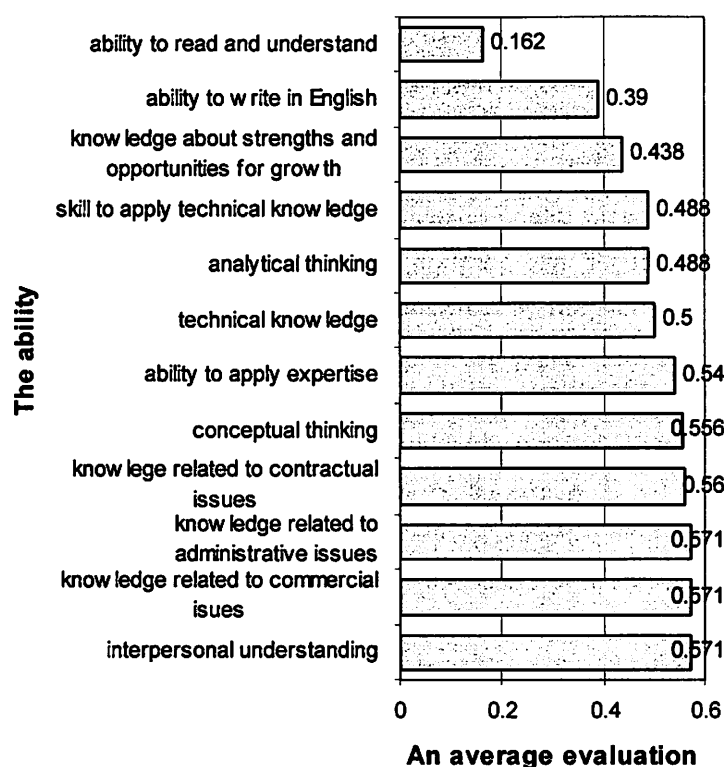
The first questionnaire, as already said, asked all the respondents to self-evaluate their different skills/abilities ((1) knowledge about strengths and opportunities for growth, (2) ability to write in English, (3) ability to read and understand, (4) analytical thinking, (5) ability to apply expertise, (6) conceptual thinking, (7) interpersonal understanding, (8) technical knowledge, (9) skill to apply technical knowledge, (10) knowledge related to commercial issues, (11) knowledge related to contractual issues, (12) knowledge related to administrative issues).

Each evaluation required to select one choice from 3, 4 or 5 such as Excellent, Good, Fair, Poor; or Excellent, Good, Adequate, Inadequate, Not acceptable.

There can be overlaps among some of these 12 abilities. The reason of it is that our study has not evaluated each of them (e.g., interpersonal understanding) critically with a group of criteria different from all the other criteria related to all the other 11 abilities. Moreover, there can be missing points among them. These abilities have been taken from other resources<sup>21)-23)</sup> and combined into one group.

While replacing always the first choice with 1 and the last one with by a number representing the total number of choices related to each question, it can be estimated how an average respondent satisfied each question. Moreover, the order of an average respondent's different abilities or skills can be obtained in the case that all the average values related to each question will be reestimated as values from the interval  $<0;1>$  where Excellent or other the best choice represents no. 0 and the worst possible choice is related to no. 1 (Fig.3). For example, the same figure identified that an ability to read and understand and an ability to write in English are the strongest ones for an average respondent. On the other hand, knowledge related to administrative issues, commercial issues, or to interpersonal understanding is the poorest one for an average respondent.



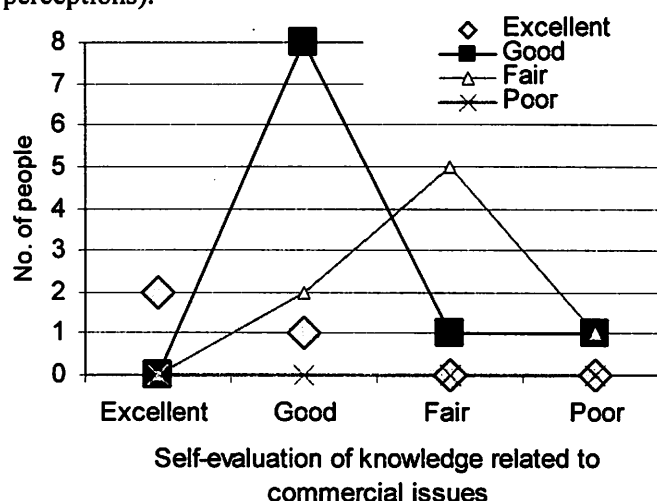


**Fig.3 Order of self-evaluations of different abilities or skills according how much an average respondent evaluated each of them.**

Fig.3 presents 12 abilities which can be mutually compared, that is, which choice a typical respondent selecting one choice related to one ability most often selected while evaluating another ability. Moreover, the same comparison can be performed while comparing their self-evaluations of different abilities with their working experience in Japan, Hong Kong, or in other countries; or with their nationality or department. Each comparison can theoretically identify some relationship of how respondents answered always only two selected questions, and it can be represented with one chart.

Nevertheless, only one example of the results of these comparisons will be presented in this paper because despite in some case these comparisons identified some relations, they cannot be accepted without critical tests. And while some of them could be evaluated critically in the test, it was impossible to evaluate most of them only with one here presented test. Secondly, the paper tends mainly to describe the proposed tool theoretically and to show several examples of results which can be obtained with the same tool; its main purpose is not, on the other

hand, to present as much results from the test as possible. Another reason for this choice is that different relationships obtained in the series of data related to Fig.4 require more studies to be validated (better said to justify these connections related to respondents' self-perceptions).

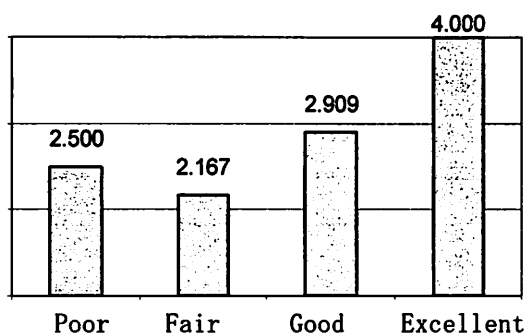


**Fig.4 Self-evaluations of knowledge related to commercial issues vs. self-evaluation of knowledge related to administrative issues (the legend is related to the knowledge related to administrative issues).**

For instance, each respondent had to evaluate his knowledge related to commercial issues by only selecting 1 from 4 choices. The same is valid for their evaluation of knowledge related to administrative issues. Then Fig.5 can be constructed stating how many respondents which selected always only one choice evaluating their knowledge related to commercial issues selected a specific choice dealing with their evaluation of knowledge regarding administrative issues.

Fig.5, e.g., shows that most respondents considering their 1<sup>st</sup> knowledge as excellent evaluated the 2<sup>nd</sup> knowledge also as excellent, or that most respondents evaluating their 1<sup>st</sup> knowledge as good evaluated the 2<sup>nd</sup> knowledge as good. The same is valid for their fair evaluations.

While Fig.4 also shows the number of people which selected each choice, such information is not presented in Fig.5, which, however, in contrast to Fig.4 is able to present an average relationship (i.e., how an average respondent which selected a specific choice related to the first knowledge selected another choice related to the second knowledge).



**Fig.5 Self-evaluations of 21 respondents of knowledge related to commercial (horizontal axis) and to administrative issues (vertical a.).**

To be able to perform the transformation of data from Fig.4 to Fig.5 requires that choices Excellent, Good, Fair, and Poor will be weighted by 4, 3, 2, and 1. Then, e.g., the third value of the later figure can be estimated as  $(3 \times 8 + 2 \times 2 + 4 \times 1) / 11 = 2.909$ . The weighted summation is always divided by a specific number of respondents which selected only one from 4 choices while evaluating their first type of knowledge here discussed.

### (3) Content of the 2<sup>nd</sup> questionnaire and criteria related to its questions

Instead of presenting more results obtained in the 1<sup>st</sup> questionnaire, the structure and content of the 2<sup>nd</sup> questionnaire will be presented, including basic results obtained with this 2<sup>nd</sup> questionnaire. This questionnaire contained 5 basic types of groups of questions and consisted of 19 questions totally.

The first several questions (totally 6 questions) tested respondents' ability to understand precisely text's organization, logical structure. They asked, e.g., to explain why information in point (2) is not presented after information in point (3), or whether information in points (3) and (4) are related. These questions required no technical expertise to be correctly answered, as assumed before the test was performed.

The second group of questions (totally 9 questions) asked to explain several key terms or processes named in the analyzed passage. Some of these questions asked, e.g., to explain the main difference between "recharge wells" and "groundwater control", to explain the meaning of a "piezometric pressure head". To answer

these questions correctly, technical expertise was required.

One question asked to give an example of a commercial claim related to the whole interpreted passage. The next one wanted to give an example of a contractual claim related to the same interpreted passage. Moreover, one question available at the end of the 2<sup>nd</sup> questionnaire asked again to self-evaluate respondents' understanding. The last question asked them to decide whether they learned something during the 2 questionnaires how to better read technical documents. Now, questions of the 2<sup>nd</sup> questionnaire will be described in more details.

Before respondents' different explanations will be classified, it is necessary to explain what an ideal answer for each question of the 2<sup>nd</sup> questionnaire should be. This classification will not be presented here for the limited scope of the paper, but all the evaluation criteria related to each question will be described.

The first question asked to explain whether it is possible to write "requires approval" instead of "will not be permitted without approval." The first and also second manager in the interviews said that the first expression is preferable because it is a way in which a supervising officer communicates. The second reason is that the same supervising engineer's officer emphasizes in this way the requirement. Nevertheless, this second reason will not be accepted while classifying respondents' explanations because there is no empirical evidence that negative expressions in general always emphasize the requirement. Thus the only correct answer for the first question is that the expression is preferable by the supervising officer because his style is characterized more by negative than affirmative expressions. But this information cannot be verified from the interview with the SEO, thus this information cannot be used for the construction of an evaluation criterion.

Another correct answer for Question 1 is that this representative probably wants to write that after the approval is given it is not satisfactory until s/he will also send the permission to dewater to the constructor. Otherwise and when "be permitted" can be understood also, e.g., as "start" or "begin", the negative expression is not necessary. Assume that the only correct answer to

the first question is that “will not be permitted without approval” is important because after the approval is obtained, the permission must be delivered to the constructor. Thus, respondents’ answers can be evaluated as satisfactory (value 1) or not (value 0) and with one criterion: In order to accept the explanation, it should not only contain “an approval,” but it also must mean “a permission”.

Question 2 asked to explain the main difference between “recharge wells” and “groundwater control”. The second term can be understood as a process, as an action, or a group of methods, etc. whose part is also a recharge wells which can be considered as a tool, method with which water can be transported back into the higher level on the place out of the excavation. Thus, for the classification of respondents’ answers for question 2, at least 3 criteria can be defined. The first one will require that the groundwater control will be considered more generally, broadly than the recharge wells. The second one will require that the recharge wells will be described as a tool, method, process, etc. and the third one that also its purpose will be described such as to transport water behind the excavation into its initial or similar level.

While evaluating respondents’ answers for question 3, it is assumed that they know the meaning of a “pressure.” But because the term “piezometric pressure head” contains also the word “pressure”, it will be required that the explanation will contain this word or similar which will indicate that no, e.g., the height of water is measured but that the pressure is measured. What will be also checked is whether their explanations state that a piezometric pressure head means that it is measured with some tool, instrument – a piezometer. Because the term also contains “head” the 3<sup>rd</sup> criterion will require that an explanation (in order to be accepted) will contain at least one word such as level, surface, table, etc.

Question 4 of the second questionnaire asked to explain what will happen in the case that “changes in piezometric pressure head and/or groundwater table during construction will be greater than an equivalence to one meter of water over the undrained sections of

tunnel”. In some exceptional cases, nothing can happen which will cause problems, it depends on how much the equivalence will be high. But it will be assumed that this equivalence can be never higher than 1 meter or it will cause two problems: (a) a settlement of the existing ground can be caused (criterion 1), (b) existing building structures can be affected (criterion 2).

Question 5 asked whether the SEO used “clearly” purposefully or whether this term can be deleted. In the classification of respondents’ explanations, it is assumed that this word cannot be deleted and is important. The reason is that it emphasizes that a submission must be prepared for the SEO and this submission must be accepted, thus a permission will be awarded before the work will start which will not satisfy the initial construction criteria specified by the SEO. This assumption is based on the interpretation of the analyzed passage by the first and also second manager which was interviewed regarding this term.

In this submission, it must be explained that the proposed steps of the contractor which will not satisfy the criteria specified by the SOE will still not affect the existing building structures. “Clearly” can be probably also understood as in an appropriate, readable, sufficient, concrete way, but these terms are vague, therefore they will not be used for the construction of a criterion. The first criterion which will be constructed requires that the explanation mentions “a submission” or similar word, the second one which will be constructed requires that the explanation mentions “a permission” or similar word. The last criterion will require that the explanation will also state something about alternative methods, steps of the constructor whose influence on the existing structures must be clearly demonstrated.

Question 6 asked to explain how two passages available in points (3) and (4) of the analyzed passage are connected when we assume that they are connected. Our evaluation of the respondents’ explanations will assume that there exists at least one connection. With this assumption, also the same question was constructed. Point (3) of the analyzed passage is related to the drained and undrained sections of tunnel. Point (4), from

which the second passage was taken, is related to the excavated area, but this point does not mention the same tunnel. But both points specify general requirements for dewatering for different construction works of the project and are also available in the first 4 points of the section titled CONTROL OF WATER. Therefore, the considered passages are not absolutely independent. They are related with that they specify different general requirements for dewatering in the same project – which is a tunnel with drained/undrained sections and other excavated or non-excavated areas. That they are connected through a more general topic can be considered as a basis for the first criterion.

Moreover, explanations such as that both passages contain the same expression “1 meter” or the first one contains “ground water table” and the second one “ground water level” will be also accepted. Explanations containing these or similar reasons identify another type of connection (not general, but demonstrated by the group of similar or identical words in both passages, or explaining the main difference in them through some relations such as specific-more general). The second constructed criterion requires that at least one of these specific connections will be presented.

The first point which can be said about sentence no. 4 which should be explained with 15 words in maximum (required by question 7) is that it is about a tunnel (criterion 1). The second one is that specifies requirements (criterion 2) for water (levels) control or dewatering (criterion 3) in drained (criterion 4) and also undrained (criterion 5) sections, parts of the same tunnel. Moreover, it also names a transition or an interface which can be considered as another important key word of the passage (criterion 6). Finally, its final parts states that when the requirement is not satisfied, it must be demonstrated (criterion 7) that no structures will be affected.

Question 8 asked to explain the main purpose of the whole section titled CONTROL OF WATER and it can be said that its purpose is (a) to produce requirements for (b) construction works. Therefore, 2 criteria can be defined (related to points (a) and (b)) which will classify

respondents' answers.

Question 9 asked whether the sequence of points going from (1) to (4) can be changed from 1-2-3-4 into the sequence 1-2-4-3. A correct answer is considered as no because a project consists mainly of works related to the tunnel and point (3) specifies in a very long sentence several basic requirements for different works related to the tunnel. The last point no. (4) is more general, not related to the tunnel, and it is also much more shorter than point (3). Based on the assumption that these points (3) and (4) cannot be interchanged, two criteria can be applied on each explanation related to question 9. The first one will require that NO is presented and the second one that at least some appropriate reason is presented.

Question 10 asked to explain why “satisfactory submission” is presented instead of “submission”. The SEO tends by the “satisfactory” (probably) to emphasize that not all of the submissions which will be submitted to her/him must be approved. Only those which s/he considers as satisfactory can obtain an approval. Therefore, one criterion can be specified evaluating all of the explanations related to question 10 and asking whether the respondents are able to explain that only some submissions are accepted and then only approvals related to them are given.

Question 11 required in order to be answered acceptably to explain what the main manager will initiate after he will read the analyzed passage. The answer is that the manager should discuss the condition with a design engineer (whether it is appropriate or correct). The same manager (then) also consults the passage with an engineering manager which is responsible for an appropriate installation of piezometers. Therefore, two criteria can be defined while evaluating the answers related to question 11. The first one is that a design engineer is mentioned or a discussion with him, the second one that an engineering manager is presented or the installation of piezometers.

Question 12 asked to identify a sentence which states the most important message. It is assumed that this sentence is the first one in the whole analyzed passage because it explains as the most general main requirements

from the SEO for different types of dewatering and constructing. Those respondents which selected the first sentence, were evaluated by 1, all the others were evaluated by 0. Therefore, only one criterion has been specified while evaluation answers related to question 13.

Question 13 asked to explain why information in point (3) is not presented before information in point (2). The main reason is that information in point (2) is more general and mentions “piezometric pressure head and/or groundwater table” and also “existing building structures” about which both more details are presented in point (3). Moreover, point (2) emphasizes that all dewatering methods must be considered while reading information in point (3). Respondents’ answers for question 13 are evaluated firstly by one criterion and they will be accepted, if at least one satisfactory explanation is identified such as that information in point (2) is more general, related to all methods. The second considering criterion is satisfied when the explanation mentions that point (2) is related mainly to design stage or to the preparation of a method statement than (3) mainly related to construction processes on the site.

Question 14 wanted to explain why information in points (3) and (4) is related, if so. The first reason is that information in both these points is related to the general topic “general requirements – dewatering”. Thus this first reason is about their similarity. The second reason is about their difference while both points are still related to the same project. Point (3) is mainly related to a tunnel, point (4) is about dewatering of different excavations, but is not explicitly about the tunnel. Therefore, the first criterion defined can evaluate whether different explanations state that these points are related to the same more general topic, the second one can evaluate whether the main difference of them is emphasized. In order the first criterion would be satisfied, an explanation must state explicitly the similarity which is required.

Question 15 asked to explain who will take responsibility of damage, loss when some problems occur in the case that the ground water level in the

excavated area will not be held to within one meter below an excavation level. Assuming that the requirement from the SEO is appropriate and correct, then only the contractor is responsible for the damage or other loss or its subcontractor. Assuming further that the damage will really occur when the requirement is not satisfied, then the SEO is theoretically responsible instead of a contractor, but only in the case that the contract previously signed states so. This will be assumed. Thus explanations related to question 15 can be evaluated with 2 criteria.

The first one will check whether “contractor” is presented which is the only correct answer when no other explanation is produced. When this additional explanation is available, it is checked with the second criterion whether it explains the reason why a specific person should be responsible.

At least one commercial claim was required by question 16 and an explanation which will be accepted would at least state that someone from the commercial department must perform some task related to the analyzed passage or real works to which the passage is related. Those respondents who wrote any explanation, were evaluated by 1, in the case they did not produce absolute non-sense or irrelevant information to the question. The last question which required a written explanation asked to present steps which are necessary when the contractor needs to ask an insurance company to pay money for some damages occurred and related to the content of the analyzed passage.

The main manager explained that when some accident occurs related to the content of the interpreted passage, the steps which should follow are: (1) condition survey, (2) engineering analysis, (3) construction risk assessment (by their designer) – analyze the risk, analyze the risk to existing buildings or structures, (4) insurance policy (examine the terms – make sure that you are in a trouble, look at the excess), (5) receive the complain, (6) inform the insurance company, (7) provide records, (8) inform the SEO. He also said that points from (1) to (4) must be performed in the site office.

Nevertheless, despite having these basic steps, it

cannot be still easily decided which evaluation criteria should be applied on the explanations. For example, respondent no. 2 wrote “reports, photos, etc.” which can be understood as “to produce reports, photos, etc.”, but it still does not explain in which step or activity these reports and photos are created. The same is valid for explanation no. 13 containing only “investigation.” This expression is again too general and can contain more steps or only one, but it cannot be accurately specified. For this reason, two criteria were defined. The first one required that an acceptable explanation contained at least one example of an activity, which was satisfied by all of the available explanations. The second criterion required that at least one more activity or step will be presented.

#### **(4) Findings related to the 2<sup>nd</sup> questionnaire or its comparison with the 1<sup>st</sup> one**

The first finding which will be presented here relates to the difficulty of different criteria. After counting how many respondents satisfied each of them, these criteria can be ordered in **Tab.3**. In this table, e.g., only 3 respondents from 21 were able to explain why “will not be permitted without approval” is preferable instead of “requires approval”. Or only 8 respondents were able to correctly identify a sentence with the main message of the whole analyzed passage.

The 2<sup>nd</sup> finding which will be presented here as related to the 2<sup>nd</sup> questionnaire is that 52 % of respondents selected that they learned something about better reading during the test (19 % selected “no” and 29 % selected “I do not know”).

Another one is that when respondents’ self-evaluations of understanding are compared at the end of the 1<sup>st</sup> and 2<sup>nd</sup> questionnaire, 29 % of them reduced these self-evaluations at the end of the 2<sup>nd</sup> questionnaire (71 % had identical self-evaluations in both questionnaires). Moreover, there is no respondent which would increase his self-evaluation of understanding at the end of the 2<sup>nd</sup> questionnaire (e.g., from the 2<sup>nd</sup> choice to the 1<sup>st</sup> one that he understands everything).

**Tab.3 Rank of criteria based on the number of respondents satisfying each criterion.**

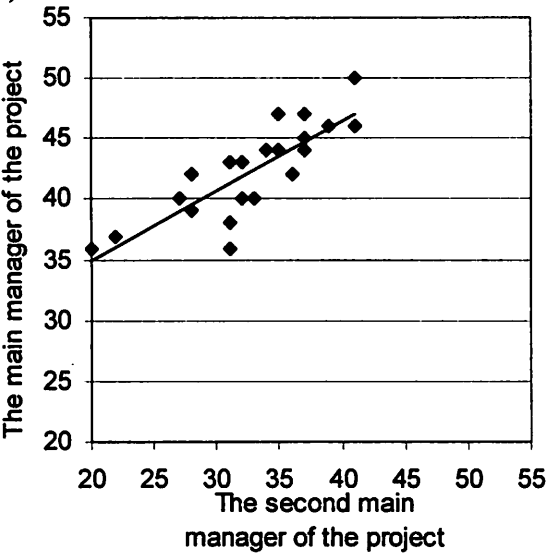
<b>Number of respondents satisfying a specific criterion</b>	<b>Name of the criterion (an abbreviation Q represents the no. of a question to which the criterion relates)</b>
0	Q7 – “transition” presented
0	Q7 – “demonstrate” presented
1	Q5 – “permission” presented
1	Q9 – appropriate reason presented
1	Q14 – general topic mentioned
2	Q3 – tool, instrument mentioned
2	Q6 – one general topic
3	Q1 – reason for negative expression
3	Q2 – water level sustained
3	Q5 – alternative methods, steps presented
3	Q7 – “tunnel” mentioned
3	Q14 – general topic mentioned
4	Q5 – “submission” presented
4	Q6 – specific example of connection
4	Q7 – “drained” presented
4	Q7 – “undrained” presented
5	Q2 – “groundwater control” general
5	Q3 – “pressure” presented
5	Q4 – “settlement of the ground” presented
5	Q8 – “to offer requirements” presented
5	Q11 – “design engineer” presented
5	Q13 – design and construction stages
6	Q2 – tool, method or process mentioned
6	Q4 – EBS affected
7	Q16 – commercial claim presented
8	Q11 – engineering manager or piezometers
8	Q12 – sentence with main message
9	Q13 – point (2) more general or more methods
10	Q7 – “requirements” presented
10	Q15 – reason for a responsible person presented
11	Q3 – level, surface, table, etc. presented
11	Q8 – requirements for “construction works”
12	Q7 – water control or dewatering presented
12	Q10 – the meaning of “satisfactory”
13	Q15 – “contractor” presented
13	Q17 – the second example of a step presented
14	Q9 – NO is presented
15	Q17 – one example of a step presented

After producing a transcript of all the respondents’ written explanations, they were submitted to the main manager of the project and also to the second manager from the management department which then evaluated each written answer for each question from the first 17 as Excellent, Good, or Poor (these words can be represented by numbers 3, 2, and 1).

After obtaining all these evaluations from both managers and transforming them into the numbers, a summation of all the numbers related to each respondent and related to the 1<sup>st</sup> or 2<sup>nd</sup> manager can be estimated. After estimating these summations for each respondent and for both questionnaires, two groups of data are

available which are correlated with the value equal to 0.863 (Fig.6). This number means that there is a strong dependency or similarity between the whole perception of both managers how a good interpretation of the analyzed passage should be formulated, despite they performed the evaluation of the respondents' interpretations independently. The main manager of the project systematically evaluated respondents' explanations with a worse score, but his general perceptions about how an ideal interpretation of the passage should be formulated are still close to the perceptions of the 2<sup>nd</sup> manager.

It should be repeated that all the evaluations of respondents' interpretations were performed by both managers intuitively. The classification of the same interpretations with a group of criteria (totally 38) was later performed with several reasons. The first one was that it enabled to compare how much the respondents' final scores will be different from those produced by 2 managers in the case that respondents' interpretations will be evaluated more precisely (not with intuitive or expert judgments which can be, at least in some rare cases, incorrectly performed, but with precisely defined criteria).



**Fig.6 Dependency between respondents' final orders produced through the evaluation of their interpretations by two managers.**

While considering each question of the 2<sup>nd</sup> questionnaire excluding the last 2 questions, one or several criteria were defined for each of them which had

to specify whether each answer to the specific question satisfies each criterion or not. In the case that a specific criterion was satisfied by a specific explanation, the explanation was evaluated by 1; on the other hand, it was evaluated by 0.

Thus, it is then possible to estimate how many criteria each respondent satisfied from 38 totally defined (16 evaluating their ability to understand text's organization, 19 evaluating their technical expertise, 2 evaluating their knowledge related to contractual issues, and 1 evaluating their knowledge related to commercial issues).

After counting how many criteria were totally satisfied by each respondent (from 21) in their explanations, the group of 21 final summations of their scores could be compared with their final scores produced by the evaluations of their explanations by the 1<sup>st</sup> and 2<sup>nd</sup> manager. This comparison identified that there are strong correlation dependencies between respondents' final score produced with the group of evaluation criteria and their final scored produced by the 2 managers, despite the first approach corrected some incorrect evaluations of the 1<sup>st</sup> or 2<sup>nd</sup> manager and also evaluated some questions with more criteria than those managers (which could always evaluate with only 3 choices – Excellent, Good, Fair).

The value of this dependency is equal to 0.894 when the order with the group of criteria is compared with the order produced by the main manager of the project. The value of this dependency is equal to 0.834 when the order of the 2<sup>nd</sup> main manager is considered. Both scatter plots related to these 2 correlation coefficients are similar to the data in Fig.6.

The second questionnaire distinguished among several respondents' abilities, which were tested: (a) to understand text's organization, (b) to explain precisely different technical terms, (c) to present knowledge related to commercial issues, (d) to present knowledge related to contractual issues. In the case that these abilities will be distinguished, it can be compared how one ability from (a) to (d) depends on another one from the same group of abilities. Each question of the 2<sup>nd</sup> questionnaire had to be answered with approximately up

to 15 words. The purpose of this limitation was to obtain explanations not too much long which would be difficult for the evaluations by the 2 managers.

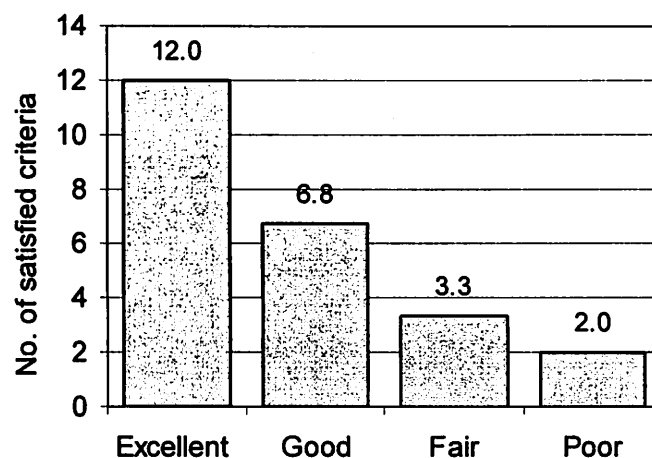
For example, the test demonstrated that there is a general linear dependency between how many criteria an average respondent satisfied while dealing with his ability to understand correctly text's organization and how many criteria the same respondent satisfied evaluating his technical knowledge. A more interesting finding from the critical classification of respondents' explanations of text's organization with totally 16 criteria is that the test identified 1 respondent satisfied no criterion, 3 respondents satisfied only 1 criterion, or 1 respondent satisfied only 2 criteria. An average respondent satisfied only totally 28.1 % of all of the defined criteria (38), and the best respondent satisfied 52.6 % from the same 38 totally used. A percentage of criteria satisfied by each respondent while evaluating their ability to understand text's organization is equal to 24.1 %.

An average percentage of criteria satisfied by each respondent while evaluating their technical knowledge is equal to 33.1 % which is not much higher than 24.1 %. This finding is surprising because our assumption at the beginning of the test was that more criteria will be satisfied in the worst cases while evaluating respondents' ability to understand text's organization, logical structure. The reason for this assumption was that to satisfy these criteria, no technical expertise is necessary. But the test demonstrated that those respondents having no technical expertise or very low (given by the number of criteria satisfied from all of the criteria evaluating their technical expertise) also in all the cases scored with the worst positions while evaluating their ability to understand text's organization.

Respondents' different scorings obtained through the 2<sup>nd</sup> questionnaire can be compared with their self-evaluations available in the 1<sup>st</sup> questionnaire. These comparisons identified, e.g., a strong relation between respondents' self-evaluations of levels of technical knowledge and their scores obtained while critically evaluating their technical expertise with totally 19

criteria (Fig.7).

Their technical knowledge and related to commercial and contractual issues was evaluated totally with 22 criteria. When their order is firstly produced as based on how many criteria from the 1<sup>st</sup> eleven criteria were satisfied by them and this order is compared with their order produced with the evaluation of their explanations with the last 11 criteria, the correlation dependency is identified between these two orders equal to 0.603. Probably the higher the total number of criteria than 22 dealing with their knowledge would produce a higher dependency, but it requires another research – to specify precisely this consistency in respondents' scoring which is not dependent on the criteria or questions they need to answer.



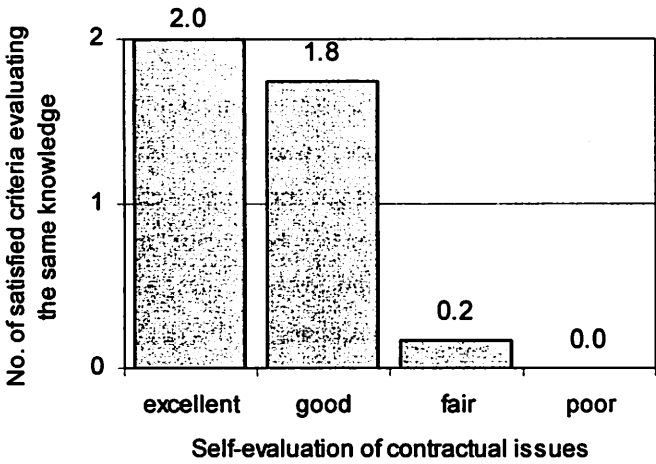
**Fig.7 Respondents' self-evaluations of technical knowledge vs. an average no. of criteria satisfied by them and evaluating critically their technical knowledge.**

The second here presented finding identified that there is a strong dependency between respondents' self-evaluations of knowledge related to contractual knowledge and the number of criteria satisfied by each of them from 2 totally and critically evaluating the same knowledge (Fig.8). While evaluating respondents' technical knowledge with totally 19 criteria, it should be also said that the best two respondents satisfied 13 criteria, and what is more important is that both these respondents were from the Management department.

The last result, related to the test and which will be presented here, is related to the critical evaluation of respondents' incorrect beliefs about understanding.



The basic process of this evaluation has been already presented in the previous chapter. Before 2 charts will be presented related to this evaluation, it should be firstly repeated that a respondent had an incorrect belief about understanding in the case that he selected at the end of the 2<sup>nd</sup> questionnaire that he understands the main message of the whole analyzed passage, but was not able at least with one satisfied criterion from 7 defined totally to explain this message. The second type of an incorrect belief was identified always in the case that a respondent said that he understand the meaning of all of the words at the end of the same questionnaire, but he was not able to explain all the required terms always at least with one satisfied criterion.



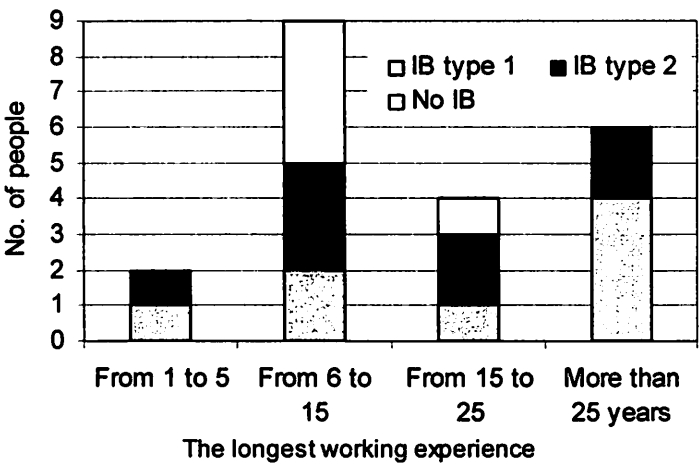
**Fig.8 Respondents' self-evaluations of knowledge related to contractual issues vs. an average no. of criteria satisfied by them and evaluating critically the same knowledge with totally 2 criteria.**

**Fig.9** compares respondents' the longest working experience vs. whether an incorrect belief (of type 1 or 2) was identified. The most interesting finding ibid is that all 6 respondents with the longest experience more than 25 year have this incorrect belief. Moreover, this group of people is the largest one having an incorrect belief of the 1<sup>st</sup> type. On the other hand, respondents with the lowest working experience have no incorrect beliefs. But this comment should be understood carefully because this group of respondents consists of only 2 people.

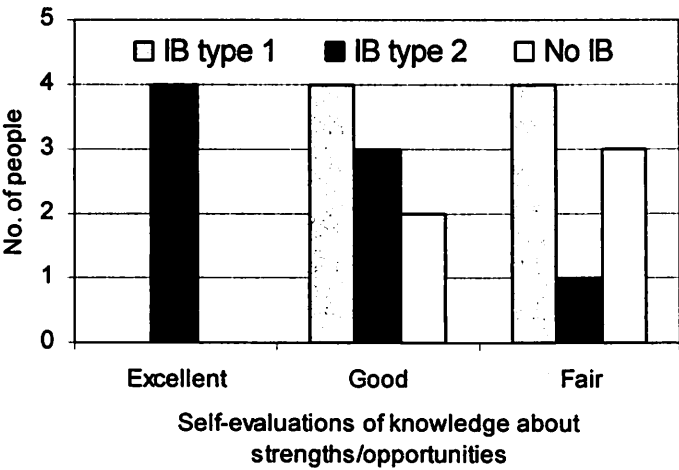
**Fig.10** compares how much respondents' self-evaluations of their self-aware knowledge about strengths

and opportunities are related to critically identified incorrect beliefs type 1 and 2 about understanding. The first interesting finding of this figure is that the number of people having the incorrect belief about understanding type 2 is decreasing with the decreasing self-evaluations.

The second finding of **Fig.10** is that with the decreasing of the self-evaluations, the number of people having no incorrect belief about understanding is increasing. In other words, the second finding means that the higher the self-evaluation of this expertise, the higher the possibility that at least one incorrect belief about understanding will be identified.



**Fig.9 Critically identified incorrect belief about understanding vs. the longest respondents' working experience.**



**Fig. 10 Respondents' self-evaluations of their strengths and opportunities vs. critically identified incorrect beliefs about understanding in their explanations.**

The last above presented finding is important because it describes a relationship which has not been reported until now by other authors – that there is a general possibility that the higher the respondents' self-perceptions about their strengths or expertise, the higher the expectation that these self-perceptions are incorrect and will be rejected with a critical test.

It should be emphasized at the end of this chapter that despite several doubts whether the tool can discover at least some incorrect self-perceptions in experienced workers or their other communication troubles, our test these findings produced. For example, about 30 % of people reduced their self-evaluations of understanding at the end of the 2<sup>nd</sup> questionnaire. Furthermore, more than 50 % of them reported that they learned something about reading despite no training was delivered to them, or the tool critically identified incorrect beliefs about understanding not previously reported by other researchers.

## **5. CONTRIBUTIONS AND LIMITATIONS OF THE PROPOSED TOOL**

The proposed tool, which has been developed by the authors of the paper for more than one and half years, cannot be probably used by different construction projects or their companies for its time requirements for the use, but it can be used by different researchers in information quality management or also by different consulting companies which can benefit from advanced approaches with which people's different communication abilities can be tested, mainly their real understandability. A metric of this dimension can be then constructed as a number dividing the total number of satisfied criteria and related to text's organization or argumentation structure by the total number of criteria applied on all of the respondents' explanations dealing with the same aspects of the text, or other more advanced approaches can be constructed which will not be presented here.

The tool advances current approaches of information quality management by demonstrating that text's understandability should be evaluated only with the critical evaluation of its interpretations. It enables to

evaluate critically different text's organizations while evaluating always its selected parts, or to evaluate how much different text's connectors are understood by different people. The most difficult ones can be always replaced by another ones and tested again whether they cause less misunderstandings. If so, they can be considered more appropriate for a specific group of information-receivers (e.g., construction engineers).

Based on these different future tests, different standards as requirements for international written project communication could be produced by the researchers or other consulting companies. These standards could also specify how highly different metrics must be satisfied while dealing with different texts and communicated in different environments, for different purposes.

The tool also enables to test an understandability of new grammatical structures which can be creatively produced and tested whether they are preferable than those currently known. But this benefit of the tool must be empirically demonstrated in the future. Moreover, to judge the quality of different texts, the paper aimed to demonstrate that current information quality management should also consider more research from psychology or linguistics in the case that it wants to focus more on written texts out of databases. Finally, the tool can be applied on each natural language and not only on the English language.

The first main limitation of the proposed tool is that its application is expensive (requires time of tested subjects and interviewed persons). The second one is that there is currently no software which could help to apply this tool on different groups of information-receivers (to help to construct questionnaires while considering possibly different texts), to evaluate quickly their interpretations, and to produce suggestions what and why should be improved.

One surprising finding of the test was that some people satisfied no criterion, despite not all the criteria required technical knowledge in order to be satisfied. But we still think that to understand an organization of technical texts does not necessarily require high relevant

knowledge to their contents, it should be probably more emphasized by the educators of a professional reading.

Several recommendations for future research will be now presented which also describe the main limitations of the current research. The first one is to perform another studies which will deeply understand main requirements for written communication of people working in international projects, including their main problems related to this communication. Secondly, a more critical focus on different types and structures of incorrect beliefs about different communication abilities can produce recommendations describing which self-perceptions are how much incorrect and that these self-perceptions should not be considered as reliable. Another problem which is now unsolved is to solve the question of which weights (including weights equal to 0) should be connected with different evaluating criteria. The here presented test assumed that all of them have the same weight. (The most important ones (or types of them) can be then probably considered as the most necessary to be satisfied according to the quality requirements of a specific communication.) Before this problem will be solved, it is probably necessary to deal firstly with the following two problems.

The first one is to specify a minimum number and type of criteria which will produce accurate predictions about respondents' future interpretations (including their limitations) of other texts. Such predictions should be possible because our test demonstrated that when respondents' interpretations are evaluated with the first and last 11 criteria from 22, there is a correlation dependency between their final orders produced with these 2 groups of criteria. The second one is to specify a minimum number and type of criteria which will guarantee that respondents dealing with similar texts will score highly similarly in these tests. When we assume that people working in one project for years deal for this time with similar topics in written communication, the second problem should have a solution. To know the solution to the 2<sup>nd</sup> problem means to produce reliable orders of respondents.

It would be also interesting to deal with how much

respondents' motivation affects their scorings in different tests. After all of the previous problems will be at least partly solved, it is probably possible to start to search for which trainings, educations of people working in international projects should be performed, about which topics.

## 6. CONCLUSIONS

The paper proposed the tool with which information-receivers' interpretations of written technical text can be critically evaluated. The tool enables not only to evaluate the quality of their understanding or other communication aspects, it also enables to identify the main non-quality parts of the tested text. This was not identified in the papers of other researchers.

The tool was not only described theoretically, it was also applied in one international construction project, which demonstrated that the tool enables to produce several types of results which were not possible to be obtained by other approaches or reported by other researchers. For example, the tool demonstrated that self-perceptions about understanding may be incorrect, thus they cannot be considered in the evaluation of the quality of written information. But the tool also demonstrated that critically obtained respondents' scoring focused on the evaluation of their technical knowledge is similar to their self-perceptions about the same knowledge.

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