Three Original Methods for Minimizing Ambiguities in Global Project Communications

Stephen Fox

Author(s)
Fox, Stephen

Title

Three Original Methods for Minimizing Ambiguities in Global Project Communications

Abstract

Both the International Project Management Association (IPMA) and the Project Management Association (PMA) stress the importance of communication. For example, readers of the IPMA's Competence Baseline Version 3.0 (ICB3) are advised that, Effective communication is vital to the success of projects, programmes and portfolios. Yet, global projects can involve people who do not speak the same languages and/or who do not share the same cultures. This can lead to linguistic ambiguities in communications and/or conceptual ambiguities in communications. These ambiguities need to be minimized because they can threaten the reliability and validity of communications. The reliability of communications will be compromized if communications are understood differently by different recipients. The validity of communications will be compromized if communications do not address the issues which they are intended to address.

In this paper, findings are reported from a study investigating sources of ambiguities and methods for minimizing ambiguities. Existing methods for minimizing ambiguities which can threaten the reliability and validity of communications were found to be of limited usefulness for global project communications. In particular, exhaustive translation / interpretation methods are too time-consuming and expensive. However, more economical alternatives to exhaustive methods do little to counteract threats to reliability and validity. Three new methods for minimizing ambiguities are put forward. The first is a standardized template. This offers both immediate and long-term advantages. A preliminary template was developed during the study and is presented in this paper. Second, the formulation of a methodology for minimizing ambiguities is proposed. Third, the development of topic-specific global project languages comprising symbols, symbol sets and symbol systems is recommended.

Preface

The medieval picture on the front cover of this paper depicts the construction of the Tower of Babel. This legendary tower is associated with profound communication difficulties among people from different parts of the world. The picture below is The Confusion of Tongues by Gustave Doré (source: http://en.wikipedia.org/wiki/Image:Confusion_of_Tongues.png). This picture represents Doré's conceptualization of the chaos and anxiety which would have arisen when the people working on the construction of the Tower were unable to communicate with each other.

Today, both the International Project Management Association (IPMA) and the Project Management Association (PMA) stress the importance of communication. For example, readers of the IPMA's Competence Baseline Version 3.0 (ICB3) are advised that, "Communication may take many forms: – oral, written, text, or graphic, static or dynamic, formal or informal, volunteered or requested – and may use a variety of media such as paper or electronic means. Communication may take place in conversations, meetings, workshops and conferences, or by exchanging reports or meeting minutes".

Moreover, ICB3 states, "Communication covers the effective exchange and understanding of information between parties. Effective communication is vital to the success of projects, programmes and portfolios; the right information has to be transmitted to the relevant parties, accurately and consistently to meet their expectations. Communication should be useful, clear and timely".

In this working paper, findings are reported from a study investigating sources of ambiguities, and methods for minimizing ambiguities, in global project communications.This working paper is a VTT (Technical Research Centre of Finland) contribution to the Global Project Strategies 1 research project. The Global Project Strategies 1 (GPS1) research project began on 1st January 2005 and ended on 31st December 2006. Other participants in the GPS1 project have been Helsinki University of Technology; Helsinki School of Economics; Tekes – Finnish Funding Agency for Technology and Innovation and the following companies: Active Inspire, Foster Wheeler, LT Consultants, Kone, Metso Automation, Posiva, Nokia Multimedia, Nokia Networks, and TVO.

Contents

List of Figures

List of Tables

1. Introduction

In this section, the background of the study is described. Further, the research goal and the research method are outlined. Subsequently, the overall structure of the working paper is set out.

1.1 Background

Global projects can involve people who do not speak the same languages and/or who do not share the same cultures. This can lead to linguistic ambiguities in communications and/or conceptual ambiguities in communications. The term, linguistic ambiguities, encompasses the different characters, sentence structures etc., which can be drawn upon by speakers of different languages. The term, conceptual ambiguity, encompasses the different frames of reference which can be drawn upon by people from different cultures. These ambiguities need to be addressed because they can threaten the reliability and validity of communications.

The reliability of communications will be compromised if communications are understood differently by different recipients. The validity of communications will be compromised if communications do not address the issues which they are intended to address. Marketing blunders provide some powerful examples of reliability and validity problems (Ricks, 1999). Consider the example shown in Figure 1. The Scandinavian vacuum cleaner maker Electrolux did not recognize that the word, "sucks", in its marketing slogan is a slang disparagement in the United States of America. Hence, the reliability of their marketing communication was compromised because, at least at first sight, this slogan has a different meaning to different recipients.

Nothing sucks like an Electrolux

Figure 1. Reliability compromised.

Figure 2 shows an example of a slogan which did not address the issue that it was intended to address when it was translated into Chinese.

Come alive with the Pepsi Generation   English original   ***Pepsi brings your ancestors back from the grave***   Chinese translation

Figure 2. Validity compromised.

Figure 3 shows an example of both reliability and validity being compromised. When rendered phonetically in Chinese, the name Coca-Cola can sound like the words for "bite the wax tadpole" or "female horse stuffed with wax". In this case, the communication can have a different meaning to different recipients (reliability compromised) and the communication does not address the issue which it is intended to address (validity compromised).

Coca-Cola
English original

bite the wax tadpole
Chinese translation

OR

female horse stuffed with wax
Chinese translation

Figure 3. Reliability and validity compromised.

Together the three examples above illustrate that the reliability and validity of communications can be compromised even when global organizations, such as Coca-Cola, have plenty of time and expertise at their disposal to perfect one communication that will be used repeatedly. By contrast, global project participants may have far less time and/or far less expertise available to prepare communications. Consider, for example, a principal contractor's construction supervisor who has to deal with a dilemma such as the collapse of a tower crane.

Figure 4. A global project dilemma. (Source:
http://images.google.fi/imgres?imgurl=http://www.cranestodaymagazine.com/Pictures/th
umb/e/k/d/crane_crash___1.jpg&imgrefurl=http://www.cranestodaymagazine.com/story.
asp%3FsectionCode%3D135%26storyCode%3D2036950&h=96&w=100&sz=5&hl=fi
&start=5&tbnid=XJI4BkXIciMQcM:&tbnh=79&tbnw=82&prev=/images%3Fq%3DTo
wer%2BCrane%2Bcollapse%26svnum%3D10%26hl%3Dfi%26lr%3D%26sa%3DG)

This construction supervisor has to take the lead in establishing the whereabouts and condition of the crane operator and any operatives who have been working in the vaccinty of the crane. S/he has to make sure that any injured persons receive emergency treatment as soon as possible. Further, the construction supervisor has to make sure that the accident is contained, for example, by ensuring that stores for hazardous materials have not been damaged. Also, s/he has to make sure that clues to the cause of the collapse are not lost, and that the necessary statutory authorities are informed immediately. Accordingly, the construction supervisor has to communicate very quickly with a diverse range of project participants. As shown in Figure 5, the global dissemination of a brand slogan involves the repeated use of one communication, whereas dealing with a global project dilemma involves single use many diverse communications.
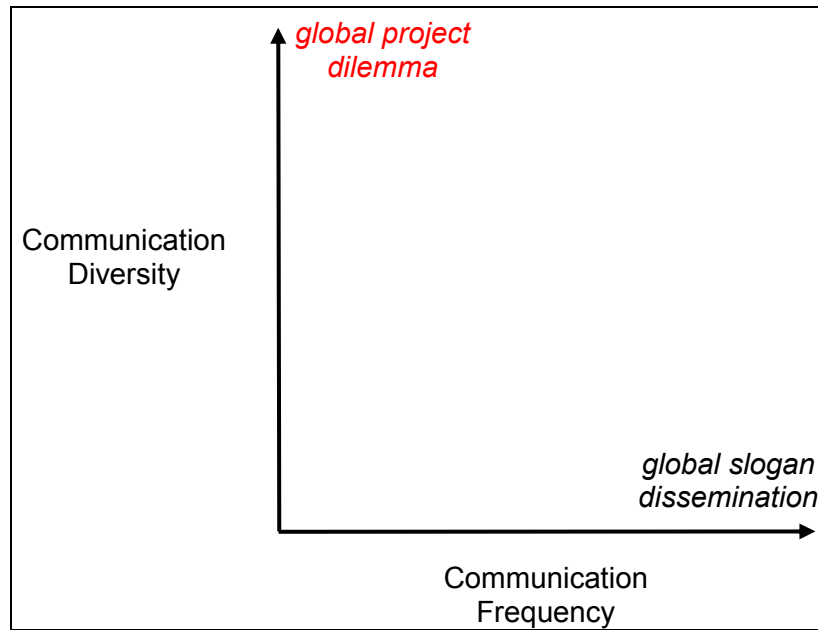
Figure 5. Diversity versus frequency.

Such communications are not limited to dilemmas during global projects. Often, project participants from different parts of the world have to communicate with each other extemporaneously. Project participants will seldom have the time or money available to spend on the preparation of their communications. Moreover, communications are often highly individual with little potential for refinement through reuse. Thus, as shown in Figure 6, global project participants can face formidable communication challenges but may have relatively few resources to help them deal with those challenges.
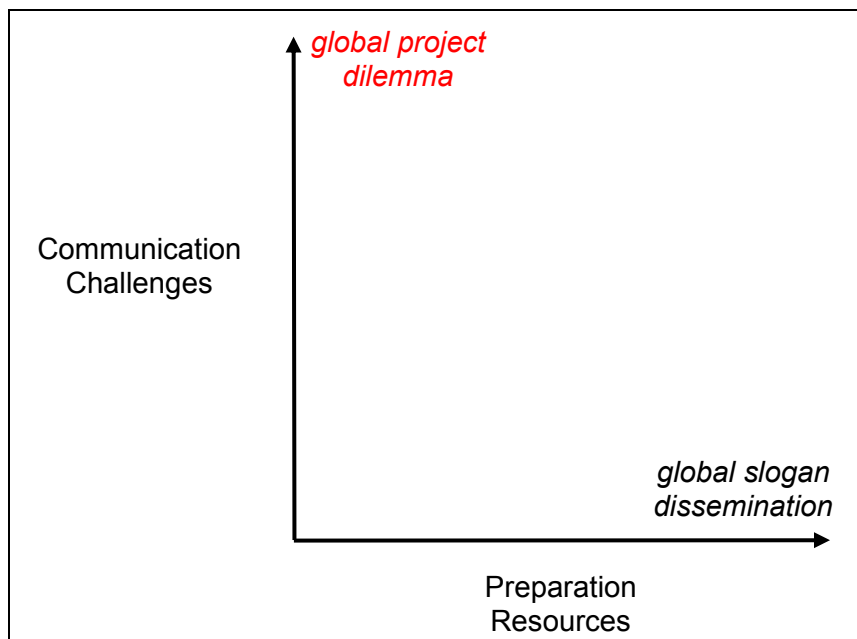
Figure 6. Challenges versus resources.

1.2 Research goal

The goal of the study reported in this VTT working paper was to identify existing methods, and/or propose new methods, which could be used by global project participants to counteract threats to the reliability and validity of their communications.

1.3 Research method

The research comprised four stages. Each stage included literature review and discussions with translation experts. First, sources of ambiguity which can compromize reliability and/or validity were investigated. Second, existing methods of counteracting these threats were assessed. Third, the most effective method of counteracting threats was investigated in more detail. Fourth, potential new methods were defined. This last stage included a workshop involving translation scholars and translation practitioners.

1.4 Research reporting

The remainder of this working paper comprises five sections. In the next section, an assessment of existing methods is presented. Subsequently, proposals for three new methods are put forward in sections 3, 4 and 5. In the final section, conclusions from the research and directions for future research are presented.

2. Existing Methods

A brief overview of existing methods is provided in this section. These are defined as being exhaustive translation / interpretation procedures; amateur translation / interpretation; amateur translation / interpretation using aids; professional translation / interpretation; and use of one language. Subsequently, an assessment of these methods is presented.

2.1 Exhaustive translation / interpretation procedures

Exhaustive translation procedures involve at least two native speakers independently translating from their native language to their second language. This preliminary forward translation can be reviewed by at least two other translators. The preliminary forward translation can be improved until all the translators agree that it is fit for backward translation. Then, backward translation can be carried out independently by at least two other translators. Subsequently, translations can be pilot tested and amended (e.g. Bullinger et al., 1998; Harkness & Schoua-Glusberg, 1998; Wild et al., 2005). The time required to carry out these exhaustive procedures can multiply when one language has significant internal diversity. For example, there is considerable variation between different spoken dialects of prevalent languages such as Chinese and less prevalent languages such as Tamil (David & Naji, 2000). Such exhaustive translation procedures can counteract threats to reliability and validity. However, they are time-consuming to establish and costly to operate.

Translation is written communication whereas interpretation is oral communication. Translation and interpretation involve different training, skills, and talents. The most exhaustive form of interpretations may be so called United Nations style interpretation. This involves an interpreter, who uses interpreting equipment and works with another interpreter in a soundproof booth, listening to the speaker's speech in one language and simultaneously converting it into another language, without waiting for the speaker to finish his or her statement. Such exhaustive interpretation procedures can counteract threats to reliability and validity. However, they are time-consuming to establish and costly to operate.

2.2 Amateur translation / interpretation

One alternative to the use of exhaustive translation procedures is for amateur translation / interpretation to be carried out by individual project participants who have skills in more than one language. However, having skills in more than one language is clearly not the same a being a skilled translator / interpreter who has the benefits of years of

study and practice. An example of the limitations of individuals' languages skills is provided by a study of workplace accidents in Finland. By its constitution, and through its education system, Finland is a bilingual country where both Finnish and Swedish are written, read and spoken. Yet, there is evidence that accident frequency is significantly higher in bilingual Finnish companies, than in companies which operate in either only the Finnish language or only the Swedish language. This finding suggests that even where bilingual interactions are routine there can be communication problems (Salminen & Seppälä, 2005). In particular, amateur translators / interpreters do not have professional skills which can help them to avoid intrusions of source-language words and structures into the target language (Gile, 2003).

2.3 Amateurs using translation / interpretation aids

Software-enabled aids include multilingual dictionaries and thesauri, terminology management databases, translation memories, text alignment tools and terminology elaboration tools. Such aids are not based on fundamental principles for minimizing ambiguities. They are intended to increase the productivity of skilled translators / interpretors. Reliability and validity still depend upon the skill of the human translator / interpretor (Höge, 2002). Moreover, if an aid is only used occasionally, it may be difficult to recover the time and money spent on procurement and training. So called, machine translation, takes place when no human input is required to the translation process. Machine translation works best on large volumes of well written text from narrow subject areas. Hence, it is not well suited to the preparation of many project communications. Further, it has been reported that machine translation can be inaccurate (Barbalace, 2006).

2.4 Professional translation / interpretation

The employment of a professional translator / interpreter is a more costly alternative to amateur translation / interpretation. However, it has long been recognized that even this alternative will not necessarily ensure the reliability and validity of communications (Phillips, 1960). In particular, the accuracy and productivity of professional translators can arise from their specialization in a particular field. When a global project involves technological and/or organizational innovations, there may be no translators with relevant specialist knowledge. Further, there can be a lack of professionals who are able to translate or interprete between some languages. This proved to be a major problem in the enlargement of the European Union (EU). In particular, finding professionals who could interprete between languages such as Lativian, Portuguese, Hungarian and Danish prove to be extremely difficult (Farnam, 2002).

Another problem is that professional translators and interpreters are best employed when people have already written or said what they want to communicate or at least know exactly what it is that they wish to communicate. However, global project participants may not always have a pre-defined communications ready for translation or interpretation. Consider, for example, open ended questions which may occur to a project manager during negotiations with potential project participants during an initial meeting. The main function of such open ended questions may be to explore attitudes towards possibilities. By contrast, in the translation of text or the interpretation of speech, the author's or speaker's message is a final product which is intended only to provide information. Hence, fidelity to the source text or speech is given much weight with almost no margin for adaptation to the target receiver. Accordingly, typical translation techniques may be of limited usefulness in the preparation of many project communications.

2.5 Use of one language only

Another alternative to rigorous translation procedures is to make use of just one language which is used throughout many different countries. Such languages include Arabic, English, Russian and Spanish. However, the use of one language can result in project participants been selected on the basis of their skill in a language. Rather, than on the basis of their skill in their trade or profession. Further, determining the different skills level of different participants in a shared language is difficult. Furthermore, attempting to address such uncertainties by reading communications to project participants with a relatively low literacy level could compromise reliability and validity (Ortega & Richey, 1998). In particular, there is research which suggests that the use of one language when asking questions to people with different first languages can affect responses (Bennett, 1977; Harzing, 2005).

2.6 Assessment of existing methods

As show in Table 1, literature review and discussions with experts revealed exhaustive translation / interpretation procedures are seldom viable, but existing alternatives to exhaustive procedures do little to counteract threats to reliability and validity.

Table 1. Assessment of existing methods.

Method	Strength	Weakness
Exhaustive procedures	counteract threats	slow and expensive
Amateur	economy	intrusion of source language and culture
Amateur + aids	some economy	intrusion of source language and culture
Professional	some economy	lack of knowledge and flexibility
One language	economy	can limit selection of project participants

In the opinion of the author, existing methods have two further limitations. Those are existing alternatives do not provide a basis for improving the dissemination of best practice, or for improving the economy of best practice. This is because much of the work done is not explained. Hence, project participants could employ professional translators / interpreters many times but not develop an understanding of threats to reliability and validity, or how to counteract those threats (Temple, 1997). Furthermore, it remains difficult to determine whether, or not, other potential ambiguities have been introduced at the same time that recognized ambiguities have been counteracted. Consideration of these limitations led to the conclusion that new methods for counteracting threats to reliability and validity should be developed. In the next section, the first of three new methods is described.

3. New Method 1: Communication Plan Template

Both the International Project Management Association and the Project Management Institute recommend that a communication plan is set up at the start of a project. Further, the management of project communications is identified as being a key competence for project managers. In this section, a template which could be introduced into project communication plans is presented. Further, it is argued that repeated use of this template by project managers could increase their competence in managing global project communications.

3.1 Structure of template

Literature review and discussions with translations experts led to the identification of two principal categories of ambiguity. These can be described as conceptual ambiguity and linguistic ambiguity. The term conceptual ambiguity encompasses the different conceptual frames of references used by speakers of different languages. The term linguistic ambiguity refers to the different symbols, characters, sentence structures etc., which are used by speakers of different languages. Each of these categories can encompass a number of sources of ambiguity. Eight sources of ambiguity are included in the preliminary template. This are listed below and described in the next sub-section.

- conceptual ambiguity: all languages (Ca);
- conceptual ambiguity: language families (Cf);
- conceptual ambiguity: more than one language (Cm);
- conceptual ambiguity: one language (Co);
- linguistic ambiguity: lexical (Ll);
- linguistic ambiguity: phonological (Lp);
- linguistic ambiguity: syntactic (Lsy);
- linguistic ambiguity: semantic (Lse).

One page of the preliminary template is presented in Figure 7 overleaf.

Actions for minimizing ambiguities in global project communications			
Project:		Author:	Date:
Preparation (Y/N)		Reporting (Y/N)	
Focus	Record of Actions Taken to Identify / Eliminate Ambiguities		Y?
Ca	Identified by	reference to papers / articles	
		discussions with authors of papers / articles	
	Eliminated by	definition of similarities and differences	
		specific examples relevant to participants' experience	
Cf	Identified by	reference to literature	
		discussions with relevant scholars	
	Eliminated by	definition of links between language families	
		provide specific examples	
Cm	Identified by	initial cross referencing using specialist dictionaries	
		discussions with bilinguals	
	Eliminated by	use of alternative words / phrases that are more descriptive	
		provide specific examples	
Co	Identified by	initial cross referencing to specialist dictionaries	
		relating word meanings specific to geographical areas	
	Eliminated by	following advice of native speakers with expert knowledge	
		not using words with different meanings in different places	
Ll	Identified by	discussions with native speakers with expert knowledge	
		checking for homonym, heteronyms, Capitonyms	
	Eliminated by	not using colloquialisms	
		not using homonyms, heteronyms, Capitonyms	
Lp	Identified by	discussions with native speakers with expert knowledge	
		checking for homophones, Capitonyms	
	Eliminated by	not using words which could be blurred together in speech	
		not using of homophones, Capitonyms	
Lp is only relevant to spoken communications			
Lsy	Identified by	discussions with language scholars	
		discussions with native speakers with expert knowledge	
	Eliminated by	not having complicated sentences	
		use of Plain Language	
Lse	Identified by	checking for idiomatic phrases, sociolects	
		checking for different attitudes towards the same words	
	Eliminated by	cutting idiomatic phrases, sociolects	
		use of balanced piloting sample	

Figure 7. One page of preliminary template.

Sources of ambiguity listed above are presented as the eight main rows of the template. It is important to note that the terms used to describe ambiguities in this working paper are not the only possible terms which could be used. Following discussion of each source of ambiguity, reference is made to any alternative terms identified by the author. Further, it is could be argued that the template should be structured around types of culture. This is because the need for translation to take account of cultural factors has been widely recognized for some years (Hui & Triandis, 1985; Robert et al., 2006; Valero-Garces, 2006). However, using culture as a starting point has at least two major limitations. The first limitation is that different disciplines have fundamentally different understandings of the meaning and influence of culture. For example, there are deeply rooted disagreements about the meaning of culture even between cross-cultural psychologists and cultural psychologists (Peng et al., 2001). Further, different disciplines have different understandings of the relationships between different types of culture, such as national, professional, and/or organizational (Cray & Mallory, 1998).

One objective for the preliminary template is to provide a basis for improving the dissemination of best practice. Another objective for the preliminary template is to provide a basis for improving the economy of implementing best practice. Such improvements will require a working consensus across different disciplines. If culture is a starting point, improvement could be stymied at the outset by existing disagreements which are deeply rooted. A second major limitation of using culture as a starting point is that some categories of ambiguity, in particular, Ca and Cf, are extremely difficult to attribute to culture. The structure put forward in the preliminary template allows reference to be made to culture where relevant, but does not make culture the starting point.

Another page of the preliminary template is presented in Figure 8 overleaf, and covers the mediation of ambiguities which cannot be eliminated through simple actions. For example, eliminated simply by avoiding words such as too and two, which have different meanings but similar pronunciations. The second page of the template has the same structure as the first page, but has spaces for entries relevant to mediation.

Actions for minimizing ambiguities in global project communications		
Project:	Author:	Date:
Preparation? (Y/N)	Reporting? (Y/N)	

Focus	Record of Actions Taken to Mediate Ambiguities	
Ca	Ambiguities	
	Actions	
	Participants	
	Revisions	
Cf	Ambiguities	
	Actions	
	Participants	
	Revisions	
Cm	Ambiguities	
	Actions	
	Participants	
	Revisions	
Co	Ambiguities	
	Actions	
	Participants	
	Revisions	
Ll	Ambiguities	
	Actions	
	Participants	
	Revisions	
Lp	Ambiguities	
	Actions	
	Participants	
	Revisions	
Lsy	Ambiguities	
	Actions	
	Participants	
	Revisions	
Lse	Ambiguities	
	Actions	
	Participants	
	Revisions	

Figure 8. Another page of preliminary template.

3.2 Scope of use

The template has been developed to provide a preliminary basis for tackling three important challenges.

The first challenge is identifying different types of ambiguity. At the time of this study, different types of ambiguity are described in scholarly texts and journal papers. However, no texts or papers were found during literature review which provides a comprehensive listing of different types of ambiguity. Rather, different texts and papers focus on particular types of ambiguity. Hence, identifying different types of ambiguity is time-consuming.

The second challenge is counteracting threats to reliability and validity during the preparation of communications. In order to facilitate this, users are directed towards actions for counteracting threats arising from different types of ambiguities. These are discussed in the next sub-sections of this working paper.

The third challenge is providing a comprehensive, but succinct, record of which threats have been counteracted, and how they have been counteracted, during the preparation of particular communications. For example, in an accident report which must be issued in several languages.

These challenges can be found in many different types of communications. Most obvious are discrete messages such as advertisements, letters, emails, memos, minutes and instructions. However, there are many other types of communications which can contain ambiguities. These include: job descriptions; operating procedures; narratives such as tales about a company's origins; report graphics such as diagrams and charts; verbal exchanges during workshops, meetings etc.

It is unlikely that template could be applied to the preparation of every communication. However, it is possible that this template could be used to minimize ambiguities in symbols, words, phrase etc., that will be used repeatedly as key components in many of the communications during a global project.

3.3 Identification and elimination of ambiguities

The first page of the preliminary template covers the identification and elimination of ambiguities. The contents of the first page of the template are discussed in the following paragraphs. Discussion includes consideration of the following phrase *"the net benefits from 4D analyses of Building Information Models"*. This phrase is concerned an information and communication technology (ICT) which has been spreading rapidly in construction projects.

22

Conceptual ambiguity across all languages (Ca) The term, Building Information Models, is an example of concepts which are ambiguous across all languages (CAa). In one article, for example, the terms Building Information Models and Product Modelling are used to describe the same technology (Anteroinen, 2005). The term Building Information Models is a noun, while the term, Product Modelling can be a verb. Building Information Models (BIMs) are computer-interpretable information models of buildings and/or built environments (Goldberg, 2004). A computer-interpretable model can be described as digital objects and their relationships. A digital object being, a single "container" of computer code that combines data (properties) and behaviour (methods). The introduction of BIMs is intended to make it much easier to repeatedly create, simulate and analyse alternative solutions for the design, construction and operation of buildings. No existing term such as conceptual ambiguity across all languages was identified during literature review.

Ca can be identified by making reference to papers and/or articles. If a concept is referred to by more than one term in papers and/or articles published in the same one year period, Ca may exist. The existence of Ca can be further investigated by making enquiries with the authors of papers and/or articles. Such authors may be able provide insights into a concept's origin which is equivalent across all languages and/or point to an emerging pattern of terminology. For example, a Glossary on Building Product Modelling (Karstila, 2004) includes the statement, "Note: Recently, also the term Building Information Model (BIM) has been used as a synonym for building product model". Discussions with Karstila and other experts, revealed agreement that the term building product model was becoming less widely used. Discussions also revealed agreement that the term product model describes a concept which underlies Building Information Models.

In an effort to eliminate Ca, communications should include specific examples which are relevant to project participants own particular experience. For example, the term, Building Information Model, can be replaced by the names of each specific software product which individual participants have used. If project participants do not have prior experience they should be shown explanatory images such as screen shots of relevant software packages in use.

Conceptual ambiguity across language families (Cf) The term, 4D, introduces an example of concepts which are ambiguous across language families (Cf). Visual 4D models are intended to communicate the spatial and temporal, (four dimensional) aspects of construction schedules more effectively than traditional planning tools such as bar charts and network diagrams. A review is provided by Heesom and Mahdjoubi (2004). The conceptualization of time and space is an important example of conceptual ambiguity across different language families (Whorf, 1939; Nunez & Sweetser, 2006).

In particular, past, present and future actions are clearly distinguished by speakers of the English language. For example, when saying, "I will see the person", "I see the person", "I saw the person". By contrast, the present and future tenses are seldom so clearly distinguished by speakers of the Finnish language. In particular, a question using the present tense in Finnish may be interpreted as covering also the future tense. Such differences can be specific to families of languages, rather than specific to individual languages. For example, the English language is a member of the Indo-European family of languages. Finnish is a member of the Ural-Altaic family of languages. Studies suggest that the spatio-temporal mental models formed by native Finnish speakers differ from those formed by native speakers of Indo-European languages (Stromnes, 1974). The conceptualization of time can become important when research questions concern the evaluation of processes where time is a critical factor. No existing term such as conceptual ambiguity across language families was identified during literature review.

Cf can be identified by finding out what language families project participants' languages belong to. Then, by finding out what are the reported differences between those language families. Next, by assessing the relevance of those differences to the communication to be prepared. Information about language families is readily available and widely reported (e.g. Davies, 2006; Highfield, 2006). Preparation time can be reduced and understanding can be increased by seeking advice from relevant scholars before delving into the scientific literature. Also, input should be sought from native speakers who are experts in the thing to be evaluated. However, it is important to note that experts in, for example, 4D analyses, may be unaware that their native languages belong to a language family which conceptualizes time in a different way to the language families of project participants. Accordingly, those preparing communications should obtain background information before such seeking input from experts who are not language scholars.

In an effort to eliminate Cf, concepts should be broken down into elements. For example, rather than making broad statements about 4D analyses of Building Information Models, specific statements should be made about particular types of analyses. Different conceptual links between different statements and different language families should be defined before communications are prepared. For example, speakers of different language families might have different analyses priorities, such as how far into the future analyses should be carried out.

Conceptual ambiguity across more than one language (Cm) Mistranslations can happen when one word represents several concepts in the source language, while in the target language each of the same concepts is symbolized by a different word. This difficulty led to Michelangelo carving little horns on the head of his statute of Moses. The Latin translator of the Bible encountered the phrase which in Hebrew means "and

rays glowed from Moses' face". Since in Hebrew "rays" and "horns" are referred to by the same word ("karnayim"), the translator selected the Latin word for "horns" and mistranslated the sentence as "horns grew on Moses' head" (Fram-Cohen, 1985). As shown in Figure 9, Michelangelo's statue was regarded as an authoritative image and led to similar depictions of Moses by other artists.

Figure 9. Classic Cm.
(Source:http://www.wga.hu/frames-e.html?/html/m/michelan/1sculptu/giulio_2/moses.html)

The word, benefit, provides an example of conceptual ambiguity across more than one language (Cm). The one English language word, benefit, has two translations in the Finnish language. These are "hyöty" and "etu". The corresponding adjectives, "hyödyllinen" and "edullinen" correspond to the English language words, useful and advantageous. The exact terminology, conceptual ambiguity across more than one language, was not found during literature review. However, literature review revealed interest in the extent of conceptual ambiguity across languages (Lucy, 1997; Nisbett, 2003) Further, the emic-etic issue is a topic of interest in cross-cultural research (Brislin, 1980). Researchers with an emic perspective seek to develop an understanding of how concepts are understood in one specific culture. That culture may, or may not, be defined by geographical boundaries of one specific country. Researchers with an etic perspective are concerned with developing an understanding of how concepts are

understood across cultures. It has been suggested that concepts can be unique to one culture, comparable across cultures, or overlapping (Church & Katibak, 1988).

Cm can be identified by seeking advice from bilinguals. Prior to this reference could be made to dictionaries. For example, in one English to Finnish dictionary the Finnish words, "vahinko", "haitta" and "tappio" are listed for the English word, disbenefit (Hurme et al., 2000a). Making reference to the same publisher's Finnish to English dictionary (Hurme et al., 2000b) the word, disbenefit is not listed for any of the three Finnish words. Thus, reference to the Finnish to English dictionary suggests that the word, disbenefit, does not have a Finnish language equivalent. In this way, ambiguity across more than one language can be identified. However, it is important to note that reference to dictionaries is at best a starting point. Dictionaries are not adequate tools to determine the actual usage of terms (Gile, 1995).

In an effort to eliminate Cm, communications should be made as specific as possible, in this case, about particular types of disbenefits which might arise from 4D analyses of Building Information Models. For example, one disbenefit might be personnel losing their own visualization capabilities if they are continually provided with computer visualizations. Also, alternative words or phrases to disbenefit could be considered. These could be "negative side effects" or "negative unintended consequences".

Conceptual ambiguity across one language (Co) The word, net, introduces an example of conceptual ambiguity across one language (CAo). This is because the Finnish word, "nettohyöty" may refer either to benefits minus costs or to the benefits in comparison to the baseline situation. Again the exact terminology, conceptual ambiguity across one language, was not found during literature review. However, this type of conceptual ambiguity is widely recognized. In particular, conceptual ambiguity across one language can increase when one language is the native language of speakers in many different geographical areas. The Spanish language, for example, is the native language of speakers in several South American countries. It has been argued that questionnaires written in Spanish of Spain would need to be adapted for use in Argentina (Wild et al., 2005). Similarly, French is the native language of many people in living in Belgium, Canada, Switzerland and some parts of Africa. Examples of conceptual ambiguity across British English and American English are widely reported (BBC, 2003).

Conceptual ambiguity across one language can be identified by seeking advice from relevant experts who are native speakers of participants' and/or researchers' native languages. These experts need not be bilingual. Again, dictionaries may be referred to but only as starting point before discussions with relevant experts. For example, when considering the Finnish word, "nettohyöty", a Finnish financial dictionary could be

referred to before seeking clarification from Finnish accountants or economists. If research is to be carried in different countries where the same language is the native language (e.g. UK and USA), alternative dictionaries such as Oxford and Webster could be referred to before seeking advice from relevant experts who can be monolingual. In an effort to eliminate Co, words which have recognized ambiguities should not be used.

Linguistic ambiguity due to lexical issues (Ll) Lexical ambiguity can arise when a lexical entry allows a word more than one possible meaning. It is important to distinguish between conceptual ambiguity across one language and linguistic ambiguity due to lexical issues. The word, net, has the potential to introduce both. As described above, the Finnish word, "nettohyöty" introduces ambiguity within a concept across one language. However, "nettohyöty" is not a homonym. By contrast, one colloquialism for the Internet is, the net. For example, in phrases such as, "surfing the net". Hence, some readers of and/or listeners to the phrase, *"the net benefits from 4D analyses of Building Information Models",* could understand that benefits from collaborative 4D analyses which have been enabled by the Internet are being referred to. Thus, the word, net, is a homonym. No alternative terms to lexical ambiguity were identified during literature review.

In an effort to eliminate Ll, lexical issues can be dealt with in every language separately by native speakers. Potential ambiguities from homonyms, heteronyms and Capitonyms should be investigated and eliminated. It is important to note that it is possible for homonyms to have quite opposite meanings. For example, the word, sanction, can mean to approve and can also mean to punish. Heteronyms (sometimes called heterophones) can be described as words which are spelt the same but have different meanings. For example, desert (abandon) and desert (arid region). Capitonyms are words that are spelt the same but have different meanings when capitalized. For example, polish (to make shiny) and Polish (from Poland). Again, dictionaries could be referred to before seeking advice from relevant experts who can be monolingual.

Linguistic ambiguity due to phonological issues (Lp) Phonological ambiguity can arise when a set of sounds can be interpreted in more than one way. As described above, phonological ambiguity can be introduced by homophones. Phonological ambiguity is important in oral communication (Frost et al., 1990). In an effort to eliminate Lp, phonological issues can be dealt with in every language separately by native speakers. Potential ambiguities from heteronyms, homophones and Capitonyms should be investigated and eliminated. Capitonyms have different meanings and may, or may not, have different spellings. Potential ambiguities from the blurring of words should also be identified and eliminated. For example, if the two words, a parent, are blurred they could sound like the one word, apparent.

Linguistic ambiguity due to syntactic issues (Lsy) Syntactic ambiguity can arise from sentences which may be parsed in more than one way. Parsing may involve different readers and/or listeners breaking up a question into different chunks and attributing different meanings to those individual chunks and, as a result, the whole question. Consider, for example, *the net benefits,* as one possible chunk of the phrase, *"the net benefits from 4D analyses of Building Information Models"*. Another reader or listener might break up communications into other chunks including, *net benefits*. Associations with the Internet could be less likely without the word, *the*, in a chunk including *net benefits*. During literature review, structural ambiguity was identified as an alternative term to syntactic ambiguity. Further, punctuation ambiguity was identified as a factor which contributes to syntactic ambiguity.

In an effort to eliminate Lsy, syntactic issues can be dealt with in every language separately by native speakers. In addition, advice may be sought from language scholars who have knowledge of how readers and/or listeners tend to break up questions into chunks. Also, reference should be made to Plain Language guides (e.g. http://www.plainlanguage.gov; http://www.clearest.co.uk). Generally, long sentences which require the stringing together of several chunks should be avoided.

Linguistic ambiguity due to semantic issues (Lse) No alternative to the term, semantic ambiguity, was identified during literature review. Semantic ambiguity can arise if the same words in the same communications elicit either different cognitive states or different emotional states (Schaffer & Riordan, 2003). For example, the word, benefit, in the phrase *"the net benefits from 4D analyses of Building Information Models"* can be regarded as introducing bias. Consider, for example, a person whose continued employment depends on the continued use of Building Information Models may have an attitude that benefits should be emphasized. On the other hand, the overstatement of benefits from ICT investments is widely recognized (Hempell, 2003; Irani & Love, 2002; OECD, 2003). Thus, a company director may regard negatively communications including words such as benefits. However, possible alternative words such as, consequences, impacts, and affects may have slightly negative connotations. Accordingly, different cognitive states or different emotional states should be considered during the piloting of important communications. For example, in this case, by seeking a balanced piloting sample of people with different interests in a technology. Such a sample could include a people whose careers could be advanced in connection to the thing which will be evaluated and people whose careers could be thwarted.

Further, semantic ambiguity can arise when the meaning of a sentence could be determined only with the help of greater knowledge sources (Baker et al., 2001). In particular, idiomatic phrases which are in every day use in one language may be difficult to translate into other languages (Small et al., 1999). Furthermore, idiomatic

phrases may be specific to the sociolect of just one company or even different parts of the same company. For example, the directors of a company may have only occasional need to speak about Building Information Models, and may refer to them as, Building Information Models. By contrast, site personnel in the same company who use Building Information Models every day may refer to them as BIMs. When the terms, *Building Information Model* and *4D*, are used the meaning of the phrase, *"the net benefits from 4D analyses of Building Information Models"* must be determined with the help of greater knowledge sources. In an effort to eliminate Lse, idiomatic phrases which are in every day use in only one language should be avoided. The identification of such phrases could be accelerated through input from bilinguals. Further, the extent of sociolects should be given careful consideration. For example, the everyday word, opportunity, has a quite special meaning in the sociolect of risk management consultants. In that sociolect, opportunity can mean "a risk with a positive outcome" (Lesrisk, 2006). The identification of such meanings is difficult without input from specialists. There is no need for such specialist to be bilingual.

3.4 Mediation of remaining ambiguities

The first page of the preliminary template covers the identification and elimination of ambiguities. Those ambiguities which can not be eliminated by following the actions suggested above, need to be mediated.

Mediation importance Mediation is a widely recognized as being an essential part of translation (Heij et al., 1996; Dufour & Kroll, 1995; Duyck & Brysbaert, 2004; Kroll & de Groot, 1997; Kroll & Stewart, 1994; Lam et al. 1998; McNamara, 2005; Salamoura & Williams, 2001). Mediation of concepts can establish conceptual equivalence (Potter et al.. 1984; Francis & Gallard, 2005). Further, conceptual equivalence features in a variety of fields including cognitive science (e.g. French & Jacquet, 2004), communication (e.g. Singh & Baack, 2004), and computer science (e.g. Boyd, 2004). The mediation of ambiguities through informed discussions is a key aspect of exhaustive translation procedures. Bullinger and colleagues (1998), for example, report that any item deemed not to be conceptually equivalent is discussed in order to streamline the translations cross-culturally. Streamlining is based on the opinions of people with in-depth understanding of the languages and of the cultures involved. Wild and colleagues (2005) describe an exhaustive translation procedure comprising ten steps. Conceptual equivalence is an explicit concern during five of these ten steps. For example, one of the stated rationales for the Preparation step is to strengthen the conceptual equivalence of the forward translations, and to help to avoid any ambiguities. In order to achieve this, explanations of the research question concepts are prepared before any translation takes place. The subsequent Harmonization step is

intended to ensure conceptual equivalence between source and target language versions and between all translations.

Mediation actions Literature review revealed a lack of commonly accepted procedures for how mediations should be carried out. However, informed discussions involving a range of participants are common theme. Triandis (1992), for example, has recommended that researchers from different cultures should work together in the sharing of ideas. The best time to begin addressing conceptual ambiguities may be during the development of research questions. At this stage, concept ambiguity across all languages (Ca) and across one language (Co) can be addressed. Subsequently in the formulation of question for research participants, all eight types of concept ambiguity could be addressed concurrently. Once those ambiguities which are most obvious have been eliminated, draft questions could be prepared in one language. That language could be the native language of the majority of the research participants. Then, initial forward translations into the other languages could be carried out. Forward translation should be followed by discussion and correction of the resulting communications with native speakers of the target language who have good knowledge of the thing to be researched or at least of the relevant field. The subsequent piloting of communications should be considered as part of the mediation process. Interestingly, discussions with translation experts revealed that backward translation was considered to unnecessary. Backward translation has been included in exhaustive translation procedures for many years in order to identify semantic errors in forward translations (Deutscher, 1968). However, it was argued that back translation is of limited usefulness because translation is not a reversible process like addition or multiplication. Similar opinions were found in the literature (Acquadro et al., 1996; Sechrest et al., 1972).

Mediation Participants The involvement of people with different types of expertise is a key aspect of exhaustive translation procedures. For example, in the procedure described by Wild et al. (2005) include a project manager, a key in-country consultant, forward translators, an independent translator, back translators, an in-country consultant and proof readers. Similarly, others (Acquadro et al., 1996; Guillemin et al., 1993; McKay et al., 1996) have involved a broad range of expertise including monolinguals from the target population, bilinguals, survey design experts, interviewers and translation experts. The inclusion of monolinguals is important because, compared to bilinguals, their speech patterns are less likely to be influenced by other languages. Accordingly, they are suited to assessing the lucidity of translated questions. Table 2 provides a summary of the different types of expertise needed.

Table 2. Mediation participants.

Type of ambiguity and range of expertise needed	
Ca	Topic experts e.g. authors of papers – can be monolingual
Cf	Language scholars and experts in thing to be researched – can be monolingual
Cm	Bilinguals
Co	Monolinguals
Ll	Monolinguals
Lp	Monolinguals
Lsy	Language scholars – can be monolingual
Lse	Bilinguals and monolinguals

These include monolinguals, bilinguals, language scholars and subject experts. Skills may be provided by people who are prepared to contribute without expecting any financial payment. For example, language scholars may be prepared to contribute to the preparation of communications if doing so provides them with some new raw material for teaching and/or their own research. A further option is to consider input from professional translators / interpreters. As discussed earlier in this paper, professional translators / interpreters may have a weak grasp of an emerging field and its terminology. Nonetheless, they have to be good detectors of ambiguity (Gile, 1995). Accordingly, translation academics with experience as professional translators could make a positive contribution to the fine tuning of important communications.

Establishing a network people with different types of expertise could appear to be a formidable challenge. However, during the research underlying this paper, establishing contact with necessary experts was found to be quite straightforward. Emails and telephone calls to the authors of papers and books led to discussions about the key aspects of translation procedures. These were followed by discussions about the challenges of disseminating best practice. Subsequently, a workshop involving scholars and practitioners was convened by a professor of translation studies. In this way a network was established at the cost of some phone calls and emails.

3.5 Advantages and limitations

When compared to existing options, the use of a template offers both immediate advantages and long-term advantages. These advantages arise from the usefulness of templates in externalizing the activities in a process which need to be undertaken in order to achieve an objective. One immediate advantage is that templates provide

people with easy access use knowledge of requirements that have been found to be relevant in similar situations (Jones, 1992). This is particularly important when only limited resources are available because time is saved in determining what should be done. Another immediate advantage is that a template can facilitate the sub-division of a process such as the allocation of activities where several project participants could contribute (Cross, 1994). This is also important when only limited resources are available. For example, a template can provide a common basis for agreeing the allocation of activities among different project participants in different countries.

The keeping of records is a feature of exhaustive translation procedures (Aycan et al., 1999; Bullinger et al., 1998; Casimir & Keats, 1996; Wild et al., 2005), and another immediate advantage of templates is that they can enable a standardized process for keeping records. For example, a template can be useful in enabling the checking-off of activities after they have been carried out. Equally, a template can provide a record of what ideally should have been done, but what was actually not done. This is very important when only limited resources are available as it can provide a structured summary for others who have an interest how a communication was prepared.

The long-term advantage of a standardized template is that repeated use could lead to users become more and more familiar with sources of ambiguities and how they can threaten the reliability and validity of communications. Moreover, users could become more and more familiar with the types actions which can be taken to minimize ambiguities, and in doing so counteract threats to reliability and validity. As a result, users can learn to counteract threats more and more quickly.

Although a standardized template offers advantages, it does have limitations. In particular, use of the template could be quite time consuming when it is used for the first time. Moreover, use of the template requires considerable diligence in following through numerous inter-related actions. Accordingly, it may be that the best use of the template is in minimizing ambiguities in symbols, words, phrases etc., which will be used repeatedly as "components" in many of the communications in a global project. For example, the template could not be used to prepare every word of every discussion about 4D analyses of Building Information Models during a global project. However, the template could be used to minimizing ambiguities in the key terms, 4D and Building Information Models. Another important use of the template could be to minimize ambiguities in a few very important project documents. For example, documents which define different parties scope of work. This could be an important step in preventing conflicts during global projects (Cheney et al., 2004).

4. New Method 2: Global Communication Wizard

In this section, it is argued that some of the limitations of a standardized template could be reduced by developing a software-enabled methodology with a user-friendly interface. Product design methodologies offer positive examples of how underlying principles defined in a standardized template can provide the foundation for user-friendly tools which improve the dissemination and the economy of best practice.

4.1 Methodology content

At the time of the study, best practice could be found in scholarly texts and journal papers. These can be difficult to access and time consuming to review. A similar situation existed in product design prior to the introduction of methodologies developed from templates. Best practice existed but its use was limited (Peck, 1973). Subsequently, methodologies have been developed through the use of templates. These methodologies include the full scope of best practice (Leaney & Wittenberg, 1992). As a result, resources do not have to be spent reviewing potential sources of best practice and comparing their contents.

Further, standardized templates have provided the basis for continually improving the economy of implementing best practice. Methodologies developed from templates comprise easy-to-follow workbooks which lead users through the underlying principles of best practice. A possible workbook page is shown in Figure 10. Thus, methodologies can provide inexperienced individuals with an easy-to-follow route to the application of best practice. In particular, suggestions for action are expressed as short and simple sentences. Further, methodologies can comprise a knowledge base which includes examples of previous work. These examples can be linked to suggestions for action. In this way, product design methodologies have led to radical improvements in the productivity of the design process and in the quality of outputs from the design process (Ulrich & Eppinger, 1995).

The content of product design methodologies is continuously developed through rigorous scientific research. However, it is important to note that even the earliest uses of these methodologies led to improved product designs (Boothroyd et al., 1983).

Actions for minimizing ambiguities in global project communications			
Project:			
Preparation of questions? (Y/N)		Reporting of research? (Y/N)	
Record of Actions Taken to Identify, Eliminate and Mediate Ambiguities			
Focus		Conceptual Ambiguity across all languages (Ca)	

Identify Ca's by making reference to papers and/or articles in the relevant domain. If a concept is referred to by more than one term in papers and/or articles published in the same one year period, Ca may exist. The existence of Ca can be further investigated by making enquiries with the authors of papers and/or articles. Such authors may be able provide insights into a concept's origin which is equivalent across all languages and/or point to an emerging pattern of terminology.

Ca's identified:

Eliminate Ca's by including specific examples which are relevant to research participants' own particular experience. For example, instead of referring to an information and communication technology by a generic term, refer to the specific software and/or hardware which participants have used. Make sure to determine and document similarities and differences between specific example and generic term.

Ca's eliminated:

Mediate remaining Ca's by making initial forward translations of questions into other languages. Forward translation should be followed by discussion and correction of the resulting questions with native speakers of the target language who have good knowledge of the thing to be researched or at least of the relevant field. These native speakers do not need to be bilingual.

Ca's mediated:

Author:	Date:

Figure 10. Possible workbook page.

A methodology for minimizing ambiguities in global project communications could also include the full scope of best practice. As a result, it would not be necessary to spend time reviewing potential sources of best practice and comparing their contents. Further, a methodology for minimizing ambiguities could comprise easy-to-follow workbooks which lead users through underlying principles and provide inexperienced individuals with an easy-to-follow route to the application of best practice. Further, such a methodology could include a knowledge base of words and phrases which have been prepared and used previously. Figure 11 illustrates the necessary scope of an initial methodology for minimizing ambiguities in global project communications.
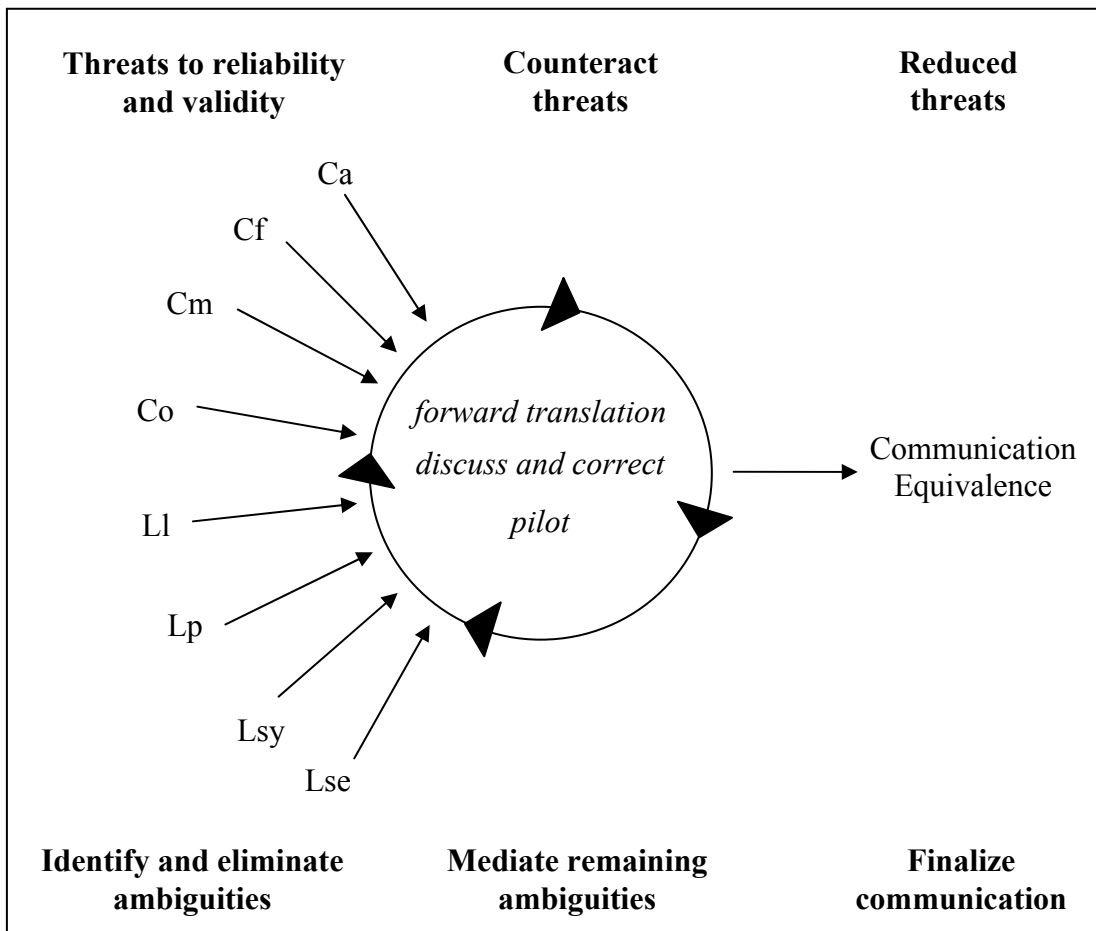

Figure 11. Initial methodology scope.

4.2 Methodology interface

The most effective interface for the type of methodology described above could be a "wizard". This is a term used to describe interactive computer programs which act as interfaces to lead users through complicated tasks, using step-by-step dialog boxes.

Figure 12. Example of wizard.

Microsoft's Windows 95 was the first operating system to make use of wizards. By the time of this study, wizards had become commonplace in consumer-orientated systems and have a variety of names including "Assistants", "Druids" and "Genies". Web applications such as an airline booking site make use of the wizard paradigm to complete lengthy interactive processes. An example is shown in Figure 12.

4.3 Advantages and limitations

A methodology with a wizard interface could improve upon a standardized template by reducing the time and diligence required to minimize ambiguities in key components of global project communications. Nonetheless, there could be many communication situations during a global project in which there would be insufficient preparation time available to use a methodology.

5. New Method 3: Global Project Languages

In this section, it is argued that some of the limitations of a template or methodology for minimizing ambiguities could be overcome by developing topic-specific languages comprising intuitively understandable graphic symbols. Augmentative and Alternative Communication (ACC) provides positive examples of how symbols, symbol sets, and symbol systems can be used minimize ambiguities in the most formidable communication environments.

5.1 Need for global project languages

There can be a huge variety and volume of communications during projects. Also, there can be participants from many different countries and cultures participating in global projects. As a result, there is massive potential for ambiguity in global project communications. Consider, for example, the possible communications involved in the global project dilemma described in sub-section 1.1 of this working paper. In such a dilemma, a construction manager would have speak, listen, write and read communications involving a wide range of people including site operatives and government officials. If the people involved had only four different native languages there would be twelve "ambiguity combinations". If one of those native languages was English and some of participants' native language was American English but some participants' native language was British English, there would then be twenty "ambiguity combinations". If one of those native languages was Chinese, and some participants spoke one dialect of Chinese and other participants spoke another dialect of Chinese, there would be thirty "ambiguity combinations". This "ambiguity growth" is summarized in Figure 13 below.

> 4 native language = 12 ambiguity combinations
>
> 4 native languages (incl. 1 language with 2 variations) = 20 ambiguity combinations
>
> 4 native languages (incl. 2 languages with 2 variations) = 30 ambiguity combinations

Figure 13. Ambiguity growth.

As discussed above, a template could be very useful in minimizing ambiguities in key components of global project communications such as recurring words and phrases. Further, a methodology could reduce the time and diligence required to minimize ambiguities in key components. Nonetheless, the more "ambiguity combinations" there are in global project, the more resources will be required to minimize ambiguities using even the most user-friendly methodology.

Also, it is possible that the use of a template or methodology by a project manager could lead to only simplex communications being reliable and valid. The term "simplex" refers to one-way communication from a sender to a recipient. In a global project, for example, the project management team could send out communications comprising key component words and phrases which are unambiguous to all project participants irrespective of their country or culture of origin. However, the recipients of those messages would not be able to reply using unambiguous words and phrases unless they had participated fully in the use of the template or methodology. There are at least two reasons why this might not be feasible. Firstly, the template or methodology itself would have to be presented in a format which is unambiguous to all project participants. Secondly, some participants would join the project in its later stages long after the template or methodology had been used.

IPMA's Competence Baseline Version 3.0 states that, "Communication covers the effective exchange and understanding of information between parties". Clearly, simplex communication is not sufficient for effective exchange and understanding of information between parties. Rather, at least half-duplex communication is needed. The term half-duplex refers to two-way communication, but only in one direction at a time. Thus, two parties must take turns in sending and receiving. Full-duplex communication is more effective because it allows two parties to send and receive communications simultaneously. In some situations, multiplex communications could be most effective because they allow more than two parties to send and receive communications simultaneously. Accordingly, the best use of a template or methodology may be to facilitate development of graphic symbols which can be used in duplex or multiplex communications by all project participants irrespective of their countries or cultures of origin.

5.2 Examples of global symbols

There are many examples of symbols which are used globally. Some of these can be used in isolation. Figure 14 shows some self-explanatory harzard symbols.

Figure 14. Symbols used in isolation.

Graphic symbols can also be used to augment communications. Galileo, for example, used simple drawings as sentence elements when he published the first telescopic observations of Saturn (Tuft, 1990). At the time of this study, the face symbols shown in Figure 15 were being widely used as sentence elements in Email messages. These symbols are used within Email messages to clarify the feeling of the sender. Figure 16 shows symbols which are used with email messages to indicate priority.
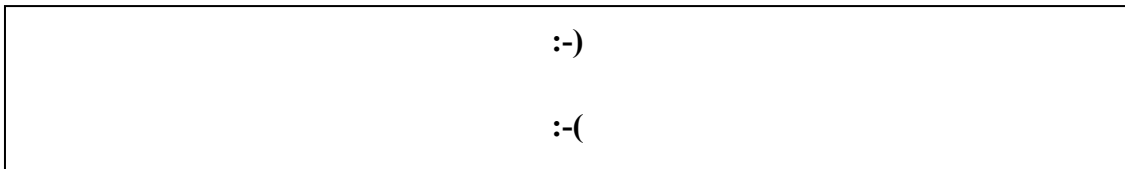

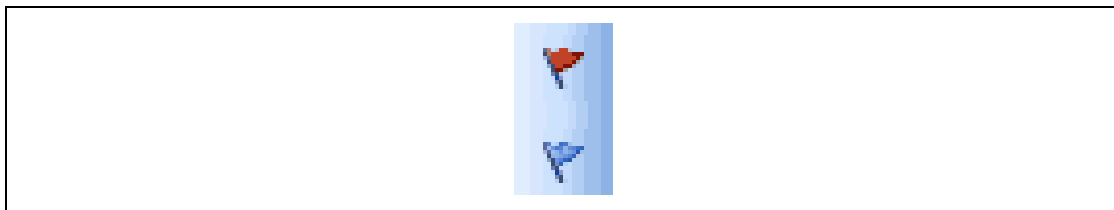*Figure 15. Symbols used within email messages.*

Figure 16. Symbols used with email messages.

In Augmentative and Alternative Communication (AAC) symbols, symbol sets and symbol systems are used to minimize ambiguities in communications. ACC is used by people with severe communication disorders and for whom gestural, speech, and/or written communication is temporarily or permanently inadequate to meet all of their communication needs. ACC involves the use of symbols, symbol sets and symbol systems. In ACC, a symbol is defined as something used to represent another thing or concept. For example, a picture or line drawing of a dog to represent dog. A symbol set is defined as set of symbols that is closed in nature. A symbol set can be expanded, but it does not have clearly defined rules for expansion (e.g. Picture communication symbols). A symbol system is defined as a set of symbols which includes rules or a logic for the development of symbols (e.g. Blissymbols). Figure 17 shows an example of Blissymbols. Unlike Picture communication symbols, Blissymbols are not intuitively understandable. However, it is important to note that Blissymbols are not topic-specific.

Figure 17. Blissymbols.

Figure 18 shows a topic-specific symbol system developed by the author (Fox, 2006). In this case, the topic is the inter-organizational use of building information models. The testing of this symbol system is being carried out using magnetic versions of the symbols. These magnetic symbols can be placed and positioned on standard magnetic boards which are already in use in many offices and meeting rooms. The development of symbols has followed a simple procedure. First, the scope of the symbol system was defined: building information models and analyses / simulation options. Second, the types of building information models and analyses / simulation options to be included within the symbols system were defined. Third, a metaphor was defined for each type of building information model and analyses / simulation option. Four, a symbol was defined for each metaphor. Initially, symbols were drawn as pencil sketches. Subsequently, the pencil sketches were recreated as the graphic symbols shown in Figure 18.
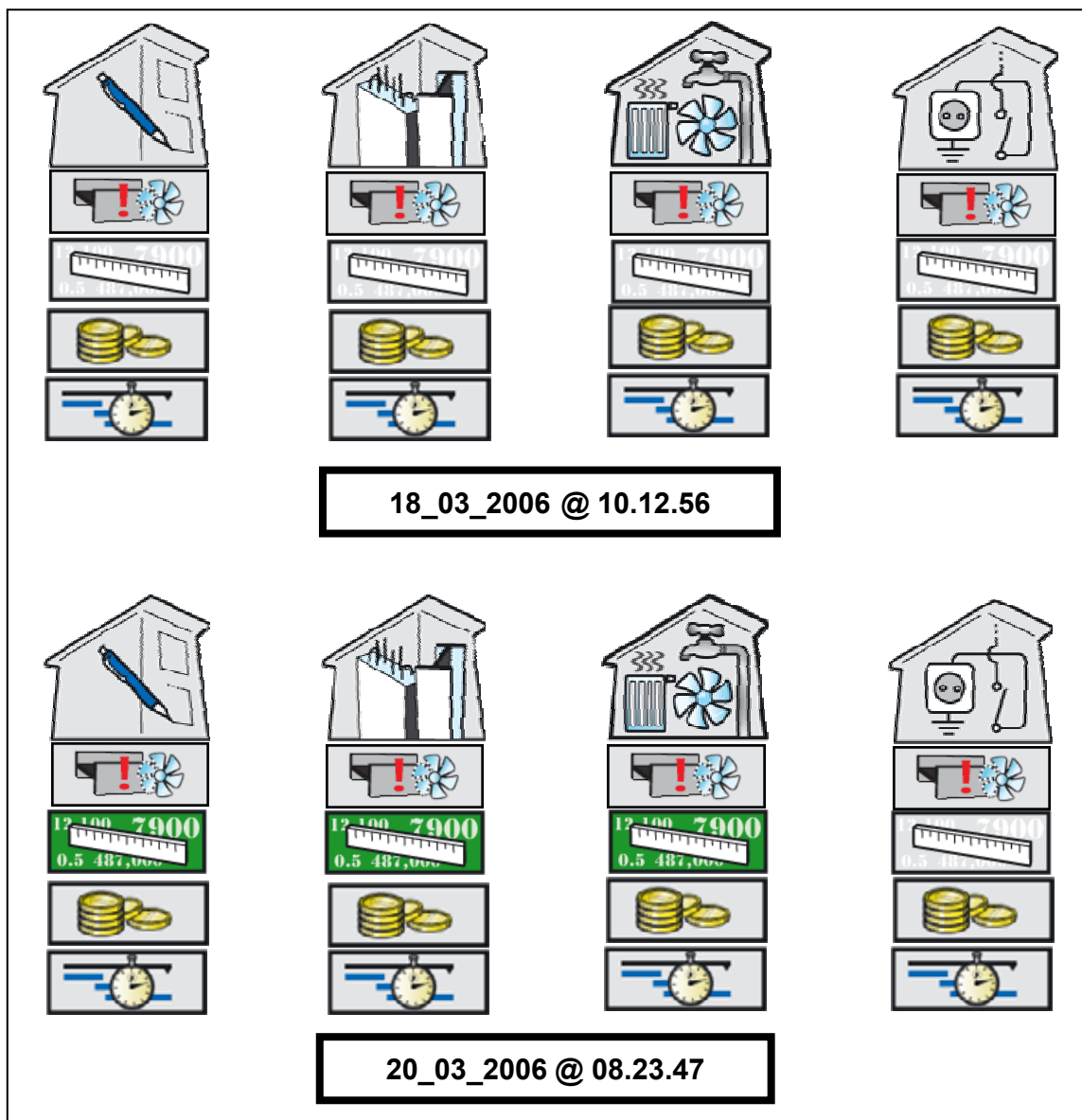

Figure 18. A new symbol system.

Possible topics for global project languages include health and safety; contractual negotiations and agreements; and procurement. Whenever possible, existing global symbols should be incorporated into these languages.

5.3 Advantages and limitations

Topic-specific graphic symbol languages may have more potential for enabling full duplex and multiplex communications than using a template or methodology to minimizing ambiguities in key words and phrases. However, developing graphic symbol languages is a more formidable challenge than minimizing ambiguities across existing languages. Firstly, formulating the rules for such languages would be difficult. Subsequently, these rules would have to be maintained. On the other hand, the more graphic symbols are used, the less need there would be to minimize ambiguities across existing languages. A summary of the relative strengths and weaknesses of the new methods proposed in this working paper is provided in Table 3.

Table 3. Assessment of new methods.

Method	Strengths	Weaknesses
Template	immediately available and provides base for development of methodology and symbols	limited to simplex communication of a few key components and documents
Wizard	less time and diligence needed in use	requires more development time and still limited to simplex communication
Global Project Languages	not limited to simplex communications	difficult to formulate and to maintain rules

6. Conclusions

The principal findings are listed below. Subsequently, possible directions for future research are discussed.

6.1 Principal Findings

- The reliability of communications will be compromised if communications are understood differently by different recipients. The validity of communications will be compromised if communications do not address the issues which they are intended to address. The reliability and validity of communications can be threatened by conceptual ambiguities and linguistic ambiguities.

- Compared to the global dissemination of a marketing slogan, global projects involve a high volume of diverse communications which often have little potential for refinement through reuse. Yet, compared to the global dissemination of a marketing slogan, there are few resources available for the preparation of communications during global projects.

- Existing methods for minimizing ambiguities which can threaten the reliability and validity of communications are of limited usefulness for global project communications. In particular, exhaustive translation / interpretation procedures are too time-consuming to establish and too expensive to operate. However, more economical alternatives to exhaustive translation procedures do little to counteract threats to reliability and validity.

- Compared to existing methods, the use of a standardized template offers both immediate and long-term advantages. These advantages arise from the usefulness of templates in externalizing activities in a process which need to be undertaken in order to achieve an objective. In particular, templates provide easy access to knowledge of requirements; templates can facilitate the sub-division of a process; templates can enable a standardized process for keeping records. Further, knowledge of underlying principles can be developed through repeated use of a template.

- Both the IPMA and PMA recommend that a communication plan is set up at the start of a project. A template to support the identification, elimination and mediation of remaining ambiguities could be incorporated in communication plans for global projects. Such a template could be structured around types of ambiguity. Suggestions for action could be linked to a listing of types of ambiguity. A preliminary template has been developed and introduced.

- Product design methodologies offer positive examples of how underlying principles defined in standardized templates can provide the foundation for user-friendly tools which improve the dissemination and the economy of best practice. Such a methodology could be developed for minimizing ambiguities in global project communications. The most effective interface for such a methodology could be a wizard which guides the actions of users through step-by-step dialog boxes.

- A standardized template could be very useful in minimizing ambiguities within key components of global project communications such as recurring words and phrases. Further, a methodology could reduce the time and diligence needed to minimize ambiguities. However, use of a template or methodology could lead to only simplex communications being reliable and valid. By contrast, topic-specific graphic symbol languages may have more potential to facilitate full duplex communications.

- There are many examples of global use of graphic symbols. Some of these are used within messages as sentence elements. Others are used with messages. In Augmentative and Alternative Communication symbols, symbol sets and symbol systems are used. Developing topic-specific symbol languages is a more formidable challenge than minimizing ambiguities across languages. On the other hand, the more graphic symbols are developed, the less need there would be to minimize ambiguities across existing languages.

6.2 Future Research

Identification of ambiguities which can threaten the reliability and validity of communication is the basis for a standardized template, a user-friendly methodology and for topic-specific symbol languages. Accordingly, more survey research should be carried out into types of ambiguities.

Further, action research should be carried out to test the preliminary template introduced in this working paper. This could lead to refinements or to the formulation of a substantially different template. Development of a user-friendly methodology could begin after test of the template.

However, development of topic-specific languages of graphic symbols need not wait until a methodology has been established. Rather, symbols, symbol sets and symbol systems could be developed using the template as a guide for minimizing ambiguities. Extensive piloting will be essential to the development of global project languages.

References

Acquadro, C., Jambon, B., Ellis, D. & Marquis, P. (1996). Language and translation issues. In: Spilker, B. (ed.). *Quality of Life and Pharmacoeconomics in Clinical Trials*, 2nd ed., Philadelphia: Lippincott-Raven. Pp. 575–585.

Anteroinen, S. (2005). Product Modelling is here to stay. *Nordicum*, November, pp. 54–55.

Aycan, Z., Kanungo, R.N. & Sinha, J.B.P. (1999). Organizational culture and human resource management practices: The Model of Culture Fit. *Journal of Cross-Cultural Psychology*, 30(4), pp. 501–527.

Baker, K.L., Franz, A.M. & Jordan, P.W. (2001). Coping with Ambiguity in Knowledge-based Natural Language Analysis, Center for Machine Translation and Department of Philosophy, Carnegie Mellon University.

Barbalace, J.K. (2006). Glossary of Translation and Interpretation Terms. Available on line: http://englishrussiantranslations.com/resources/glossary.html. (Accessed 16 June 2006).

BBC (2003). Separated by language. British Broadcasting Corporation News. Available on line: http://news.bbc.co.uk/1/hi/programmes/letter_from_america/ 3208004.stm. (Accessed 16 June 2006).

Bennett, M. (1977). Response characteristics of bilingual managers to organizational questionnaires. *Personnel Psychology*, 30, pp. 29–36.

Boothroyd, G., Dewhurst, P. & Knight, W. (1983). Product Design for Assembly, Wakefield, RI: Boothroyd Dewhurst, Inc.

Boyd, N. (2004). EDUCE: A pattern language of language patterns. Available on line: http://www.educery.com/papers/patterns/educe. (Accessed 16 June 2006).

Brislin, R.W. (1980). Translation and content analysis of oral and written materials. In: Triandis, H.C. & Berry, J.W. (eds.). *Handbook of Cross-Cultural Psychology*, Vol. 2, Boston: Allyn and Bacon. Pp. 389–445.

Bullinger, M., Alonso, J., Apolone, G., Leplège, A., Sullivan, M., Wood-Dauphinee, S., Gandek, B., Wagner, A., Aaronson, N., Bech, P., Fukuhara, S., Kaasa, S. & Ware, J. (1998). Translating health status questionnaires and evaluating their quality: The International Quality of Life Assessment Project approach. *Journal of Clinical Epidemiology*, 51, 1998, pp. 913–924.

Casimir, G. & Keats, D. (1996). The effects of work environment and in-group membership on the leadership preferences of Anglo-Australians and Chinese-Australians. *Journal of Cross-Cultural Psychology*, 27 (4), pp. 436–457.

Cheney, G., Christensen, L.T., Zorn, T.E. & Ganesh, S. (2004). *Organizational Communication in an age of globalization: issues, reflections and practices*. Long Grove, IL: Waveland Press.

Church, A.T. & Katibak, M.S. (1988). The emic strategy in the identification and assessment of personality dimensions in a non-Western culture. *Journal of Cross-Cultural Psychology*, 19 (2), pp. 140–163.

Cray, D. & Mallory, G. (1998). *Making Sense of Managing Culture*. Boston, MA: International Thomson Business Press.

Cross, N. (1994). *Engineering Design Methods: strategies for product design*, 2nd ed. Chichester, UK: John Wiley & Sons.

David, M.K. & Naji, I.M.H. (2000). Do minorities have to abandon their languages? *The International Scope Review*, 2(3), pp. 1–17.

Davies, E. (2006). Unlocking the secret sounds of language: life without time or numbers. The Independent, London, 6 May.

Deutscher, I. (1968). Asking Questions Cross-Culturally: Some Problems of Linguistic Comparability. In: Becker, H.S., Geer, B., Riesman, D. & Weiss, R.S. (eds.). *Institutions and the Person*. Papers presented to Everett C. Hughes. Chicago: Aldine Publishing Company.

Dufour, R. & Kroll, J.F. (1995). Matching words to concepts in two languages: a test of the concept mediation model of bilingual representation. *Memory & Cognition*, 23 (2), pp. 166–180.

Duyck, W. & Brysbaert, M. (2004). Forward and backward number translation requires conceptual mediation in both balanced and unbalanced bilinguals. Journal of Experimental Psychology: *Human Perception and Performance*, 30(5), pp. 889–906.

Farnam, A. (2002). Europe's expansion sparks fear of linguistic domination. *The Christian Science Monitor*, 8 February.

Fox, S. (2006). VBE Traffic Control System: a web-enabled system for managing virtual building environments. VTT. P.O. Box 1000, FI-02044 VTT, Finland.

Fram-Cohen, M. (1985). *Reality, Language, Translation*: what makes translation possible? Paper presented in the American Translators Conference, Miami.

Francis, W.S. & Gallard, S.L.K. (2005). Concept mediation in trilingual translation: evidence from response time and repetition priming patterns. *Psychonomic Bulletin & Review*, 12, pp. 1082–1088.

French, R.M. & Jacquet, M. (2004). Understanding bilingual memory: models and data. *Trends in Cognitive Science*, 8, pp. 87–93.

Frost, R., Feldman, L.B. & Katz, L. (1990). Phonological ambiguity and Lexical ambiguity: Effects on visual and auditory word recognition. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 16, pp. 569–580.

Gile, D. (1995). Basic concepts and models for interpreter and translator training. John Benjamins, Philadelphia.

Gile, D. (2003). Justifying the deverbalization approach in the interpreting and translation classroom. *Forum*, 1, pp. 47–63.

Goldberg, H.E. (2004). AEC from the ground up: the building information model. *Cadalyst*, November 1.

Guillemin, F., Bombardier, C. & Beaton, D. (1993). Cross-cultural adaptation of health-related quality of life measures: Literature review and proposed guidelines. *Journal of Clinical Epidemiology*, 46, pp. 1417–1432.

Harkness, J.A. & Schoua-Glusberg, A. (1998). Questionnaires in Translation. *ZUMA-Nachrichten Spezial*, January.

Harzing, A.-W. (2005). Does the use of English-language questionnaires in cross-cultural research obscure national differences? *International Journal of Cross-Cultural Management*, 5 (2), pp. 213–224.

Heesom, D. & Mahdjoubi, L. (2004). Trends of 4D CAD applications for construction planning. *Construction Management and Economics*, 22(4), pp. 171–182.

Heij, W.L., Hooglander, A., Kerling, R. & van der Velden, E. (1996). Nonverbal context effects in forward and backward word translation: evidence for concept mediation. *Journal of Memory and Language*, 35 (5), pp. 648–665.

Hempell, T. (2003). *What's Spurious, What's Real? Measuring the Productivity Impacts of ICT at the Firm-Level*. Mannheim: Centre for European Economic Research.

Highfield, R. (2006). Andes people look back to the future. *The Telegraph*, London, 13 June.

Hui, C.H. & Triandis, H.C. (1985). Measurement in cross-cultural psychology: a review and comparison of strategies. *Journal of Cross Cultural Psychology*, 16, pp. 131–152.

Hurme, R., Pesonen, M. & Syväoja, O. (2000). *Englanti-suomi suursanakirja*. Helsinki: WSOY.

Hurme, R., Malin, R-L. & Syväoja, O. (2000). *Suomi-englanti suursanakirja*. Helsinki: WSOY.

Höge, M. (2002). *Towards a Framework for the Evaluation of Translations' Aid Systems*. Department of Translation Studies, University of Helsinki.

Irani, Z. & Love, P. (2002). Developing a frame of reference for ex-ante IT/IS investment evaluation. *European Journal of Information Systems*, 11, pp. 74–82.

Jones, J. (1992). *Design Methods*. New York: Van Nostrand Reinhold.

Karstila, K. (2004). *Glossary of building product modeling*, Helsinki: Rakennus-teollisuus Ry.

Kecskes, I. & Papp, T. (2000). *Foreign Language and Mother Tongue*. Mahwah, NJ: Lawrence Erlbaum Associates.

Kroll, J.F. & De Groot, A.M.B. (1997). Lexical and conceptual memory in the bilingual: Mapping Form to Meaning in Two Languages. In: de Groot, A.M.B. & Kroll, J.F. (eds.). Tutorials in bilingualism: Psycholinguistic perspectives Mahwah, NJ: Lawrence Erlbaum Publishers. Pp. 169–199.

Kroll, J.F. & Stewart, E. (1994). Category interference in translation and picture naming: evidence for asymmetric connections between bilingual memory representations. *Journal of Memory and Language*, 33, pp. 149–174.

Lam, C.L., Gandek, B., Ren, X.S. & Chan, M.S. (1998). Tests of scaling assumptions and construct validity of Chinese (HK) version of the SF-36 Health Survey. *Journal of Clinical Epidemiology*, 51, pp. 1139–1147.

Leaney, P. & Wittenberg, G. (1992). Design for assembling, *Assembly Automation*, 12 (2), pp. 8–17.

Lesrisk (2006). Glossary. Lesrisk Debt and Risk Management Inc. Available on line: http://www.lesrisk.com/glossary.htm. (Accessed 16 June 2006).

Lucy, J. (1997). Linguistic Relativity. *Annual Review of Anthropology*, 26, pp. 291–312.

McKay, R.B., Breslow, M.J., Sangster, R.L., Gabbard, S.M., Reynolds, R.W., Nakamoto, J.M. & Tarnai, J. (1996). Translating survey questionnaires: Lessons learned. *New Directions for Evaluation*, 70, pp. 93–105.

McNamara, J. (2005). Bilingual lexical organization. *Elements*, Spring, pp. 80–89.

Nunez, R.E. & Sweetser, E. (2006). With the future behind them: convergent evidence from Aymara language and gesture in the crosslinguistic comparison of spatial construals of time. *Cognitive Science*, 30, pp. 1–49.

Nisbett, R. (2003). *The geography of thought: how Asians and Westerners think differently .... and why*. New York: Free Press.

Organization for Economic Cooperation and Development (2003). *Seizing the benefits of ICT in a digital economy*. Organization for Economic Co-operation and Development, Paris.

Ortega, D.M. & Richey, C.A. (1998). Methodological issues in social work research with depressed women of colour. *Journal of Social Service Research*, 23(3–4), pp. 47–70.

Peck, H. (1973). *Designing for Manufacture*. London: Pitman.

Peng, K., Ames, D. & Knowles, E. (2001). Culture and human inference: Perspectives from three traditions. In: Masumoto, D. (ed.). *Handbook of culture and psychology.* New York: Oxford University Press. Pp. 243–263.

Phillips, H.P. (1960). Problems of translation and meaning in field work. In: Adams, R.N. & Preiss, J.J. (eds.). *Human Organisation Research: Field Relations and Techniques*. Homewood, ILL: Dorsey Press Inc.

Potter, M.C., So, K., Eckardt, V. & Feldman, L. (1984). Lexical and conceptual representation in beginning and proficient bilinguals. *Journal of Verbal Learning and Verbal Behavior*, 23, pp. 23–38.

Ricks, D.A. (1999). *Blunders in International Business*. Malden, MA: Blackwell Publishing.

Riordan, C.M. & Vandenberg, R.J. (1994). A central question in cross-cultural research: Do employees of different cultures interpret work-related measures in a equivalent manner? *Journal of Management*, 20, pp. 643–671.

Robert, C., Lee, W.C. & Chan, K.Y. (2006). An empirical analysis of measurement equivalence with the INDCOL measure of individualism and collectivism: Implications for valid cross-cultural inference. *Personnel Psychology*, 59, pp. 65–69.

Salamoura, A. & Williams, J.N. (2001). Backward Word Translation: Lexical vs. Conceptual Mediation or "Concept Activation" vs. "Word Retrieval"? Working Paper, Research Centre for English and Applied Linguistics, University of Cambridge.

Salminen, S. & Seppälä, A. (2005). Safety climate in Finnish- and Swedish-speaking companies. *International Journal of Occupational Safety and Ergonomics*, 11(4), pp. 389–397.

Schaffer, B.S. & Riordan, C.M. (2003). A review of cross-cultural methodologies for organizational research: a best practice approach. *Organizational Research Methods*, 6 (2), pp. 169–215.

Sechrest, L., Fay, T.L. & Zaidi, S.M.H. (1972). Problems of Translation in Cross-cultural research. *Journal of Cross-Cultural Psychology*, 3(1), pp. 41–56.

Singh, N. & Baack, D.W. (2004). Web site adaptation: a cross-cultural comparison of U.S. and Mexican web sites. *Journal of Computer-Mediated Communication*, 9 (4).

Small, R., Yelland, J., Lumley, J., Rice, P.L., Cotronei, V. & Warren, R. (1999). Cross-cultural research: trying to do it better. 2: Enhancing data quality. *Australian and New Zealand Journal of Public Health*, 23 (4), pp. 390–395.

Stromnes, F.J. (1974). No universality of cognitive structures? Two experiments with almost-perfect one trial learning of translatable operators in Ural-Altaic and an Indo-European language. *Scandinavian Journal of Psychology*, 15, 300–309.

Temple, B. (1997). Watch your tongue: issues in translation and cross-cultural research. *Sociology*, 31 (3), pp. 607–618.

Triandis, H.C. (1992). Cross-cultural research in social psychology. In: Granberg, D. & Sarup, G. (eds.). *Social judgment and intergroup relations: Essays in honor of Muzafer Sherif,* New York: Springer Verlag. Pp. 229–244.

Tuft, E.R. (1990). *Envisioning Information*. Cheshire, Connecticut: Graphics Press.

Ulrich, K.T. & Eppinger, S.D. (1995). *Product Design and Development*. New York: McGraw-Hill.

Valero-Garces, C. (2006). *Mediation as translation or translation as mediation? Widening the translator's role in a new multicultural society*. University of Alcala, Madrid. Available on line: http://www.translationdirectory.com/article324.htm. (Accessed 16 June 2006).

Whorf, B.L. (1939). The relation of habitual thought and behaviour to language. In: Carroll, J.B. (ed.). (1956). *Language, Thought and Reality*, Massachusetts: MIT Press.

Wild, D., Grove, A., Martin, M, Eremenco, S., McElroy, S. Verjee-Lorenz, A. & Erikson, P. (2005). Principles for good practice for the translation and cultural adaptation process for patient-reported outcomes (PRO) Measures: Report of the ISPOR Task Force for Translation and Cultural Adaptation. *Value in Health*, 8, pp. 94–104.

VTT Working papers

43 Tsupari, Eemeli, Tormonen, Kauko, Monni, Suvi, Vahlman, Tuula, Kolsi, Aimo & Linna, Veli. Dityppioksidin (N_2O) ja metaanin (CH_4) päästökertoimia Suomen voimalaitoksille, lämpökeskuksille ja pienpoltolle. 2006. 94 s. + liitt. 7 s.

44 Saarinen, Jani, Rilla, Nina, Loikkanen, Torsti, Oksanen, Juha & Alasaarela, Jaakko. Innovaatioympäristö tänään ja huomenna. 2006. 32 s.

45 Heinonen, Jaakko. Preliminary Study of Modelling Dynamic Properties of Magnetorheological Fluid Damper. 2006. 36 p.

46 Häkkinen, Kai & Salmela, Erno. Logistiikkapalveluyhtiömalleja Suomen metalliteollisuudessa. Havaintoja vuonna 2005. SERVIISI-projektin osaraportti. 2006. 17 s.

47 Kurtti, Reetta & Reiman, Teemu. Organisaatiokulttuuri logistiikkapalveluorganisaatiossa. Tutkimus viidessä palveluvarastossa. 2006. 30 s.

48 Soimakallio, Sampo, Perrels, Adriaan, Honkatukia, Juha, Moltmann, Sara & Höhne, Niklas. Analysis and Evaluation of Triptych 6. Case Finland. 2006. 70 p. + app. 8 p.

49 Saarinen, Jani, Rilla, Nina, Loikkanen, Torsti, Oksanen, Juha & Alasaarela, Jaakko. Innovation environment today and tomorrow. 2006. 32 p.

50 Törnqvist, Jouko & Talja, Asko. Suositus liikennetärinän arvioimiseksi maankäytön suunnittelussa. 2006. 46 s. + liitt. 33 s.

51 Aikio, Sanna, Grönqvist, Stina, Hakola, Liisa, Hurme, Eero, Jussila, Salme, Kaukoniemi, Otto-Ville, Kopola, Harri, Känsäkoski, Markku, Leinonen, Marika, Lippo, Sari, Mahlberg, Riitta, Peltonen, Soili, Qvintus-Leino, Pia, Rajamäki, Tiina, Ritschkoff, Anne-Christine, Smolander, Maria, Vartiainen, Jari, Viikari, Liisa & Vilkman, Marja. Bioactive paper and fibre products. Patent and literary survey. 2006. 83 p.

52 Alanen, Raili & Hätönen, Hannu. Sähkön laadun ja jakelun luotettavuuden hallinta. State of art -selvitys. 2006. 84 s.

53 Pasonen, Markku & Hakkarainen, Toni. Kaukolämpölinjojen elinikä ja NDT. 2006. 27 s.

54 Hietaniemi, Jukka, Toratti, Tomi, Schnabl, Simon & Turk, Goran. Application of reliability analysis and fire simulation to probabilistic assessment of fire endurance of wooden structures. 2006. 97 p. + app. 23 p.

55 Holttinen, Hannele. Tuulivoiman tuotantotilastot. Vuosiraportti 2005. 2006. 38 s. + liitt. 7 s.

56 Häkkinen, Kai, Hemilä, Jukka, Salmela, Erno & Happonen, Ari. Logistiikka Belgiassa. Vierailukokemuksia keväältä 2006. 2006. 33 s.

57 Kulmala, Risto. Tiehallinto ja liikenteen tietopalvelut. Selvitysmiehen muistio. 2006. 29 s. + liitt. 3 s.

59 Graczykowski, Cezary & Heinonen, Jaakko. Adaptive Inflatable Structures for protecting wind turbines against ship collisions. 2006. 86 p. + app. 39 p.

60 Känsäkoski, Markku, Kurkinen, Marika, von Weymarn, Niklas, Niemelä, Pentti, Neubauer, Peter, Juuso, Esko, Eerikäinen, Tero, Turunen, Seppo, Aho, Sirkka & Suhonen, Pirkko. Process analytical technology (PAT) needs and applications in the bioprocess industry. Review. 2006. 99 p.

61 Välisalo, Tero, Räikkönen, Minna & Lehtinen, Erkki. Asset Management vesihuollossa. Kirjallisuustutkimus. 2006. 79 s. + liitt. 8 s.

62 Holt, Erika. Current trends in USA building research. 2006. 26 p. + app. 7 p.

64 Forsström, Juha. Ydinjätehuollon kustannusriskianalyysi. Esitutkimus. 2006. 51 p.

65 Talja, Asko, Törnqvist, Jouko, Kivikoski, Harri, Carpén, Leena & Nippala, Eero. Ruostumaton teräs maa- ja vesirakentamisessa. 2006. 32 s. + liitt. 5 s.

66 Rinne, Tuomo, Hietaniemi, Jukka & Hostikka, Simo. Experimental Validation of the FDS Simulations of Smoke and Toxic Gas Concentrations. 2007. 37 p. + app. 9 p.

67 Fox, Stephen. Three Original Methods for Minimizing Ambiguities in Global Project Communications. 2007. 50 p.