Cognitive load 2.6a

COMPLEXITY AND THE COGNITIVE LOAD OF R&D ALLIANCE CONTRACTS:

AN EXPERIMENTAL STUDY

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Abstract

In this paper we offer a new perspective on measuring the complexity of inter-firm contracts. We define complex contracts as those contracts that contain many elements (clauses, provisions, enforcement mechanisms) with a relatively large number of interdependencies that also impose a significant cognitive load upon contract parties. Previous studies on contractual complexity employ objective measures such as the number of pages, the amount of kilobytes or the number of provisions to measure this complexity. Following some suggestions in the literature, we argue that the degree to which a contract imposes a cognitive load upon contract parties should be taken as another important dimension of contractual complexity. We develop a model of the complexity of contracts using a multidimensional perspective where both objective and subjective dimensions are taken into account. Our empirical analysis combines a sample of nearly 400 R&D alliance contracts in the biopharmaceutical industry with an experiment, where we measure the perception and assessment of the cognitive load of these contracts. Our findings show that quantitative, objective measures of complexity, such as length, and objective as well as subjective elements of the cognitive load of contracts, i.e. the information processing effort that contractual parties have to make, do indeed measure different aspects of contractual complexity. (206 words)

INTRODUCTION

Inter-organizational contractual arrangements, such as those set up to govern inter-firm alliances, have become important mechanisms through which firms exchange products, services, and knowledge. Mayer and Argyres (2004) and Sampson (2004) argue that sophisticated contractual relationships are an increasingly important feature of the business landscape, particularly where high technology is involved. While previous research has focused predominantly on the manner in which firms govern these relationships, legal scholars, economists and business scholars have more recently attempted to study " … the actual formalized documents that we call contracts …" (Suchman 2003: 96). These studies have generally been based on transaction cost economics and property rights theory, which has led to an extensive examination of particular control rights (e.g. Lerner & Merges 1998, Robinson & Stuart forthcoming, Kaplan & Stromberg 2003, Elfenbein & Lerner 2003) and/or ownership rights (e.g. Elfenbein & Lerner 2003). Several authors have called for a more in-depth investigation of contract structure and have in that sense attempted to describe contracts in terms of the degree of 'complexity' (see e.g. Poppo & Zenger 2002, Ryall & Sampson 2007; Argyres et al 2007, Reuer & Ariño 2007). Measures that these authors have used to determine contractual complexity include the length of contracts in terms of the number of pages (Gillan, Hartzell & Parrino, 2006), the 'amount' of kilobytes of information in contracts (Robinson & Stuart forthcoming), or the number of provisions in contracts and their stringency (Ariño & Reuer 2004 and Reuer & Ariño 2007; Ryall & Sampson 2007).

Complexity is one of those concepts that are often used but also difficult to define. Attempts to measure complexity are laden with intricacies. As stated by Kades (1997), "…scholars have not had an easy time defining complexity, and some have been disarmingly honest about this difficulty. One author admitted that he was tempted to define complexity by

averring, ‘I know when I read it.’ ” (Kades 1997:406, citing Rook 1993:663, 669). Our understanding of complexity is influenced by Simon (1981:195), who defines complexity in terms of the “… large number of parts that interact in a nonsimple way, … [where]…. the whole is more than the sum of its parts, not in an ultimate, metaphysical sense but in the important pragmatic sense that, given the properties of the parts and the laws of their interaction, it is not a trivial matter to infer the properties of the whole.” For contracts this implies that the more complex contracts are, the more they are characterized by many parts, e.g. provisions, with a large number of interdependencies (see also Rasmusen 2001). More complex contracts also refine and increase the number of events, enforcement mechanisms and clauses that would otherwise be sparsely mentioned in a less complex contract (see Bentley Maclead 2002). A higher degree of interdependency between provisions in a contract increases the information processing costs, caused by the limits of human cognition (Smith 2006). Kades (1997:413) argues that for contracts “…the length and detail of (….) rules, along with their interconnectedness, (…) are directly related to their elaborative complexity …” and as such this complexity goes beyond the mere length of contracts (see also Smith 2006). In that light, it becomes apparent that straightforward measures of length of contracts are probably not sufficient to fully capture the construct of complexity.

In related work, some scholars from the field of law and economics, e.g. Schuck (1992) and in particular Eggleston et al (2000), suggest that objective measures of the complexity of contracts should be complemented by subjective measures related to the degree of cognitive load of contracts, i.e. the degree of difficulty that people face when they attempt to understand

contracts.[1] In other words, these authors argue that the complexity of contracts has to be seen from a multidimensional perspective where both objective and subjective dimensions are taken into account. In order to better capture contractual complexity, as discussed in the above, we therefore follow up on these suggestions to include both subjective and objective elements within the construct of contractual complexity as we investigate the feasibility of a multidimensional measure of the complexity of contracts.

Given this general goal of our paper, we attempt to make several contributions to the existing literature. First, we investigate whether different objective measures of complexity, such as the number of words, the number of pages, and the amount of kilobytes of contracts, are substitutes or complements. Second, we introduce a new measure of contractual complexity that has both an objective element, e.g. the length of contracts, and a subjective element based on the perception of the cognitive load of contracts. We envision that this new measure will enhance our understanding of the complexity of contracts. Third, our study also has some interesting interdisciplinary features, in the sense that we build upon the understanding of the complexity of contracts in business, economics, and law in combination with an understanding of the role of cognitive load as developed in the psychology and education literatures.

The empirical analysis that we present is based on a combination of a sample of nearly 400 R&D alliance contracts in the biopharmaceutical industry and an experiment, where we

[1] Schuck (1992:3) indicates that a definition of complexity of the legal system and its rules might center on "… whether the people who are subjected to that legal rule, process, or institution perceive and experience it as complex…" Miller (1993) agrees that "… [t]he problems associated with elaborative complexity are a function of human frailty …" (Miller 1993:12, cited by Kades 1997:314).

measure the perception and assessment of the cognitive load of these contracts. Our findings indicate that diverse objective measures of contractual complexity, based on the length or size of contracts, are interchangeable. In addition, objective and subjective measures do indeed refer to different dimensions of contractual complexity where the cognitive load of contracts carries both objective and subjective characteristics. Our expanded conception thus allows contractual complexity to vary simultaneously across an objective as well as a subjective dimension.

The remainder of the paper is organized as follows: in the next section we will give an overview of the different measures of contractual complexity currently discussed in the literature. This is followed by an introduction of the concept of cognitive load as this has been defined and researched in the psychology and education literatures. Methods and experimental design are discussed in the next section, after which we present the findings of our research. Finally, the section with the discussion and conclusions not only discusses our findings in the context of the literature on cognitive load and contractual complexity but also suggests some steps for further research that links up to other recent contributions that advocate an in-depth understanding of the content of inter-firm contracts.

OBJECTIVE AND SUBJECTIVE MEASURES OF CONTRACTUAL COMPLEXITY

So far a relatively large number of economists and business scholars have defined contractual complexity in rather general terms and measured the degree of this complexity through straightforward objective and quantitative indicators. Klein (1996) discusses how the greater specification of elements of performance in contracts and the increasing number of contingencies lead to more complex contracts, to which he refers as ‘thicker’ contracts, or ‘thinner’ contracts

with fewer elements of performance and decreasing numbers of contingencies. In Rasmusen's reading cost model of contracting, length of contracts is taken as a proxy for their complexity (Rasmusen, 2001). Joskow (1988, see Poppo and Zenger, 2002) and Lumineau and Oxley (2007) take the length of supplier contracts in vertical inter-firm relationships, i.e. the number of pages in these contracts, as a proxy for their contractual complexity. Similarly, Gillan, Hartzell and Parrino (2006) measure the complexity and length of CEO employment contracts by means of the number of pages of these contracts. Poppo and Zenger (2002) asked firms to indicate on a Likert scale to what extent a specific contract was highly customized and required considerable work, where higher values indicate higher levels of complexity. In addition, they also asked firms to indicate the length of their contract, in terms of the number of pages.[2] Robinson and Stuart (forthcoming), approximate the complexity of alliance contracts in bio-pharmaceuticals through the size of the digital (ASCII) contract files in kilobytes. Their contribution suggest that larger ASCII files indicate that more future contingencies are identified in these contracts and that each possible contingent action requires more complex language to describe these contingencies.

Obviously, economists and business scholars are not the only ones who have studied contractual complexity. Legal scholars have focused on the complexity of contracts from the perspective of the optimal design of contracts in terms of the benefits of either simpler or more complex contracts. These benefits of different levels of the complexity of contracts are assessed in the context of the information asymmetry between contract parties, the circumstances of contractual enforcement, and court rulings that each affect the efficiency of the degree of

[2] However, the low response rate on this item precluded it from being used as a second indicator in their empirical analysis (Poppo and Zenger 2002: 717).

contractual complexity (Eggleston et al 2000; Hill & King 2004). In an interesting response to calls for a broadening of the understanding of contractual complexity, Eggleston et al (2000) propose a multidimensional construct for contractual complexity. Their contribution suggests that, apart from dimensions related to objective measures, the degree to which a contract imposes a significant cognitive load upon contract parties should be taken as another important dimension of contractual complexity. More in particular, this cognitive load refers to the extent to which parties relevant to a contract are able to understand this contract, i.e. a significant cognitive load implies that a contract is more complex and more difficult to understand (Eggleston et al 2000).

The basic idea behind this particular understanding of the role of the cognitive load of contracts is that increasing incorporation of expected contingencies will raise the cognitive load of contracts. In addition, calculating relevant payoffs for contingencies which might arise, demands an amount of mental effort needed to understand the intricacies of contracts. Cognitive load also represents something more, as e.g. "… a detailed schedule of payment amounts (…) will be more difficult to understand than a simple payment formula (for example, a 25% commission). And a payment of $X per widget will impose less cognitive load than an otherwise identical contract that bases payment on a fraction of profits which may be difficult to calculate …" (Eggleston et al 2000, p. 91). Thus, apart from the number of contingencies and variability in payoffs, the way in which contract terms are formulated will influence the cognitive load and thereby the level of complexity of contracts. In that context, it is important to note that, as argued by amongst others Smith (2006), long contracts do not per se impose cognitive difficulties. The increased length of a contract provision may actually promote simplicity through modularity. In this light, Smith (2006) states that "… [i]t is well-known among the practitioners dealing with contracts that boilerplate can be readily identified and mentally segregated, which is possible

because of its relatively stereotype interaction with the operative provisions of the contract ..." (Smith 2006: 1213-1214). Although these different contributions point at various aspects of a more intricate understanding of contractual complexity, they share a common message that suggests that an empirical analysis of contracts needs to go beyond a simple equation of length of contracts with complexity and also incorporate a cognitive dimension of contractual complexity (see Appendix 1).

COGNITIVE LOAD AS A DIMENSION OF CONTRACTUAL COMPLEXITY

Scholars in law, economics and business do recognize that human actors possess bounded rationality which is, amongst other things, affected by the effort and costs of processing information (see e.g. Simon 1955, Williamson 1996, Eisenberg 1995, Korobkin & Ulen 2000). Cognitive load refers to the effort and mental activity imposed on a subject's ability to process information. This cognitive load can therefore be seen as an important aspect of bounded rationality. However, cognitive load has yet to be empirically examined and applied in the study of contracts at the cross-roads of economic, business and legal research. This stands in sharp contrast to some other academic disciplines such as psychology and education, where cognitive load plays a prominent role in research and theory development. In these disciplines, cognitive load is, given differences in individual cognitive abilities, e.g. cognitive processing speed, considered as a crucial factor in understanding a subject's ability to process information, to learn and to understand complex tasks (Brünken et al 2003).

Following Paas et al (2003) and Paas & Van Merriënboer (1994), we understand cognitive load as a complex construct in terms of three elements, i.e. mental load, mental effort and performance. 'Mental load' is the element of cognitive load which is imposed by task or

environmental demands, e.g. the structure of a task, its novelty, and the conditions under which a subject comprehends and completes a task. 'Mental effort' is defined as "… the aspect of cognitive load that refers to the cognitive capacity that is actually allocated to accommodate the demands imposed by the task; thus it can be considered to reflect the actual cognitive load …" (Paas et al 2003, p. 64). Mental effort can be measured during or shortly after the execution of a task. 'Performance' is the element of cognitive load which can be defined in terms of a subject's achievements, e.g. the time spent on performing a particular task, i.e. its time-on-task. (Paas et al 2003, Corbalan et al 2006).

So far, different methods have been developed to measure cognitive load (Whelan, forthcoming). In that context, both objective and subjective measures of cognitive load have been introduced. An objective method of measurement refers to the respondent's time-on-task that produces an indication of the cognitive load that typically increases with task complexity. Increasing time-on-task then points towards a higher cognitive load (Corbalan et al 2006). A well-known indirect subjective assessment of cognitive load uses a questionnaire where respondents are asked to report the invested mental effort in understanding particular materials (Borg et al 1971, Paas 1992, Paas et al 1994). The relationship between the invested mental effort and cognitive load is indirect as a low level of mental effort could be the result of either a low cognitive load or, of such a disproportionately high cognitive load that the respondent subsequently decreased the invested mental effort (Brünken et al 2003). Despite this indirect relationship, numerous studies have shown that most people are quite capable of rating their invested mental effort on a numerical scale (see amongst others, Gophner and Braune 1984, Paas et al 2003, Paas 1992). Other subjective measures of cognitive load include the rating on a numerical scale of the difficulty of the materials that subjects have to evaluate (see e.g. Kalyuga

et al 1998, 1999 and 2000, 2001 and 2004) and the reporting of their experienced stress level (Reid & Nygren 1988, Hart & Staveland 1988).

Most of these subjective measures are multi-factoral in the sense that they are assessed as groups of associated variables with both indirect and direct subjective measures. Paas & van Merriënboer (1994a) have demonstrated that reliable measures for cognitive load can be found using simple scales, such as ratings based on invested mental effort. Subjective workload measurement techniques using rating scales are also popular as they provide various benefits in the sense that they are easy to use and reliable, they do not interfere with primary task performance, they are inexpensive, they can detect small variations in workload, and they provide decent convergent, construct, and discriminate validity (Paas et al 2003, Paas et al 1994). In other words, a substantial body of literature on the measurement of cognitive load indicates that cognitive load as a multifaceted construct can be measured in three main elements (mental load, mental effort, and performance) that represent both objective and subjective elements of this cognitive load (see Appendix 1).

METHODS AND EXPERIMENTAL DESIGN

If we follow contributions such as those by Schuck (1992), Kades (1997) and in particular Eggleston et al (2000), who suggest that contractual complexity has both objective and subjective dimensions, with a strong impact of the cognitive load of contracts, the question remains to what extent these dimensions represent very different aspects of contractual complexity or whether these dimensions are to some extent related to each other. If all elements of the cognitive load of contracts are highly correlated, not only with each other, but also with objective measures of complexity such as the length of contracts, then it should suffice to

measure contractual complexity with a simple, straightforward indicator of the length of contracts measured through e.g. the number of words, pages or kilobytes. If not, these different dimensions and elements would suggest that contractual complexity is indeed a multidimensional phenomenon, in particular if there is some level of overlap between objective, quantitative measures of complexity and objective aspects of cognitive load. The latter aspect is relevant because conceptually it is important that contractual complexity in terms of the content of contracts is to some extent related to the cognitive load of contracts, which otherwise would only indicate that we are dealing with two very different and completely unrelated aspects of contracts.

Following the above, the main research question that we address in the remainder of this paper is then: to what extent do quantitative objective measures of complexity (e.g. length), objective elements of cognitive load (e.g. time-on-task), and subjective elements of cognitive load (e.g. mental effort) measure different aspects of contractual complexity? In order to answer this question, we analyzed a sample of nearly 400 inter-firm R&D alliance contracts with regard to their contractual complexity in terms of their length as well as in terms of their cognitive load. To measure the cognitive load of these contracts we set up an experiment where a large number of subjects were asked to read the contracts and fill out a short questionnaire with various items related to the cognitive load of each contract.

Data

The dataset on contracts that we analyze in this paper refers to a set of 387 contracts in the biopharmaceutical sector. The contracts were obtained from the PharmaDeals database, managed by PharmaVentures, a UK-based corporation which acts as a specialized consultancy firm

serving the global pharmaceutical industry. The information on the actual contracts is based on contract filings with the US Securities and Exchange Commission (SEC). Issuers of publicly traded securities are required to disclose in filings with the SEC all contracts deemed 'material'.[3] The collected contracts fall within one of either two categories identified by PharmaDeals: co-development contracts and collaborative R&D contracts. Co-development is defined as "… two (or more) companies working together with the aim of developing a clinical-stage compound (…). Collaborative R&D is as co-development but used for preclinical or earlier stage research …" (PharmaDeals). The agreements refer to 219 US (domestic) contracts, i.e. the contracting parties are both US-based firms, and 168 international contracts, i.e. a US-based firm collaborates with a non-US based firm. A total of 342 firms were involved in these contracts and roughly two thirds of the agreements are concluded between an established pharmaceutical company and a start-up or emerging firm. All the agreements were set up between 1996 and 2005. The contracts in our sample represent the first interaction between the companies as filed with the SEC within this time period.

The 'objective' measure of the complexity of contracts

As shown by previous studies, a one-dimensional objective measure of contractual complexity can be constructed in terms of either the number of kilobytes of the ASCII file of a contract, the number of pages of a contract or the number of words in a contract. The electronic copies of the contracts provide by PharmaDeals are presented in a comparable layout in pdf-format. We used the document conversion feature of a text miner to convert all the documents into a readable

[3] See Overdahl (1991) for more information on the specific requirements and issues concerning contracts filing with the SEC.

ASCII file. The text miner provides us with information on the number of words and a page count was obtained by opening the ASCII files with Microsoft Word. The number of kilobytes of each file was retrieved from the file properties report.

To see whether there was indeed a difference between the various objective measures of complexity in terms of length, we first performed a correlation test to investigate the possible association between these three measures (see table 1). Table 1 illustrates that for our sample these measures (kilobytes, number of words, and number of pages) are almost perfectly correlated, ranging from 0.951 to 0.987. In our empirical analysis, the number of words was taken as a first quantitative, objective proxy for contractual complexity in terms of the length of these contracts.

---------- Insert Table 1 about here ----------

Experimental setting

The experiment was conducted at Maastricht University in The Netherlands. In both the pilot study and the actual experiment, our subject pool consisted of graduate students from Maastricht University.[4] This choice might raise some concern as, compared to professionals, students lack professional experience and are generally younger, which may lead to a different attitude than one would expect for managers and corporate lawyers who would otherwise deal with these

[4] Although we did consider the option of having these contracts read by managers, corporate lawyers, and legal counsel to assess the cognitive load of the sample of contracts, both our reading of the relevant literature and the consultation of a number of experts convinced us that in practice it would be impossible to have a survey of nearly 400 contracts read by practitioners.

contracts. However, as Siegel and Harnett (1964) have shown, attitudes are not necessarily related to behavior. Research has provided significant evidence that students are indeed valid surrogates for professionals. Comparing professional and student behavior, many studies do not find a substantial difference in behavior (e.g. Abbink and Rockenbach 2006; Siegel and Harnett 1964, Banks et al 1994, King et al 1992, DeJong et al 1988**;** Burnett and Dunne, 1986; Alderfer and Bierman, 1970; Cunningham et al., 1974; Park and Lessig, 1977; Hughes and Gibson, 1991). In addition, Levitt (1965) and Khera and Benson (1970) find that students tend to behave more like businessmen and businesswomen or other relevant professionals when they have an adequate background for the research task.

In a preliminary test round, the group of subjects consisted of six students from the Faculty of Law, three students from the Faculty of Economics and Business Administration, and two students from the Faculty of Medicine and Health Sciences. Each of the students completed their JD, MSc. and MD respectively and had entered the second or third year of their PhD program. Each PhD student received two contracts.

We developed a questionnaire for the pilot study with a total of five questions based on validated items found in the cognitive load literature (see Appendix 2). We used scale-based reporting to investigate the degree of cognitive load in relation to the contracts. As a direct subjective measure of cognitive load, we rated the perceived level of complexity of the contract. For the relevant literature on the measurement of difficulty, see e.g. Marcus et al (1996) and Van Gog & Paas (2007) and for experienced stress level, adopted from the Subjective Workload Assessment Technique (SWAT), see Reid & Nygren (1988), and the National Aeronautics and Space Administration – Task Load Index (NASA-TLX), see Hart & Staveland (1988). As indirect subjective measures, we asked respondents to report the invested mental effort necessary

to understand the materials, adopted from a scale as first developed by Paas (1992) and Paas & Van Merriënboer (1993) and the perceived level of information in the contract. We also asked participants to value the length of the agreement given objectives.

In cognitive load research, 7-point Likert scales are frequently used to measure the invested mental effort (Corbalan et al 2006; Tindall-Ford et al 1997, Marcus et al 1996, Moreno 2005) and the difficulty of the materials (Cuevea et al 2002; Kalyuga et al 1999). In compliance with this literature, the students were asked to record their responses on a 7-point Likert scale. The scale ranges from very low (1) to very high (7) or from very clear (1) to very unclear (7), depending on the question.

The PhD students were also asked to report the time spent reading each contract and as such we obtained an objective indirect measure: time-on-task (see Appendix 2). Paas et al (2003) indicate that time-on-task is often neglected in cognitive load measurements. Corbalan et al (2006) argue that time-on-task provides a meaningful measurement as this reflects the difficulty or ease of a task. Time-on-task typically increases with complexity and a high time-on-task points towards a high cognitive load. See also Brünken et al (2003) who argue that time-on-task can be seen as an indicator of different cognitive load levels. In addition, the length of the contracts was recorded: each student was given one longer and one shorter contract in terms of the number of words.

The pilot study led to some adjustments to the questionnaire for the actual experiment. The question on the level of information in the contract was eliminated as the feedback from the test group indicated that ‘the level of information’ was subject to different interpretations. The word ‘stress’ in the final question was redefined as merely ‘irritated, annoyed’ in order to reduce the chance of divergent interpretations. Several respondents remarked that it was easier to read

the second contract, since the first contract created a learning effect, i.e. by reading the first contract the respondents gained a sense of the structure and content of this sort of contractual agreements. Other studies have also shown that a learner's prior knowledge partly determines the level of cognitive load that an individual will experience (Brünken et al 2003). Therefore, we controlled for this learning effect by first administering one additional single contract of medium size to every respondent in the final experiment, i.e. all subjects received the same contract first. This additional contract was obtained from another source but given its content, it is representative for the other R&D alliance contracts given to the subjects who participated in the experiment. The function of this contract, that was administered to all subjects separately, is somewhat similar to a 'practice task' in psychological experiments. In the final questionnaire we also included some clear instructions for the task (see Appendix 3). This questionnaire contained a total of four questions.

The actual experiment was conducted with two groups, each with 60 students. The first group consists of students from the Faculty of Law at Maastricht University. These students were enrolled in a masters-level course on 'European contract law', pursuing either a JD in 'European and Comparative law' or 'Dutch law'.

If we were to only consider this group of respondents, i.e. law students, one could wonder whether results would be only relevant for that particular group. In absolute terms, the cognitive load may differ across groups of individuals. For example, individuals trained as attorneys may read a contract and see structures and language that would require little extra effort, while others may need to employ a much greater effort to detect similar structures and language, assuming these individuals would be able to uncover such legal implications at all. If the cognitive load were to be measured in practice, it should be done by controlling for different groups within

society. Contracts are not only employed by attorneys or legally trained individuals, but also read and used by managers and other relevant professionals. These groups of individuals use, understand and manage contracts in different ways. See also in this light a recent paper by Argyres and Mayer (2007), who indicate that the management of contract design capabilities resides differentially with managers, engineers and lawyers. In order to control for this potential bias, we also conducted a second experiment with a group of students from the Faculty of Economics and Business Administration at Maastricht University. These students participated in a course on 'Alliances and Mergers & Acquisitions' which is part of an MSc program in International Business. Students in both groups have a Western European background, English is a foreign language to them but it is also a major language of instruction, which they had experienced during at least three years of university education.

The students in both groups were given general information on the types of contracts and they received a brief instruction on the reading of the contracts and how to fill out the questionnaire. Ideally, each student should have received the complete set of contracts. However, with a sample of nearly 400 contracts with an average length of about 50 pages per contract, this would lead to a reading load of nearly 20,000 pages per respondent. Therefore, each student was randomly administered a total of six or seven contracts. These contracts were read and the questionnaires filled out in a private setting to avoid group pressure.

Before these six or seven contracts were distributed to each student, as explained in the above, one contract, representative of the sample of 387 contracts, was administered to all students in a first round in order to control for learning effects. The scores of the students on the various questions for this representative contract were also used to consider the within-group variance for both groups (see also Mason, 2006). As demonstrated by the data on the coefficient

of variation for the various questions, see table 2, the within-group homogeneity was relatively large for both groups. This implies that a single subject can be seen as representative of his or her group (Bedeian & Mossholder 2000; Sorenson, 2007)**.** This finding is important as it implies that, in a second round, we could ask students in each group of 60 students to read 6 or 7 contracts from the sample of 387 contracts in order to get valuable information on the cognitive load of each contract.[5] During this second round, students were asked to read each contract they were given and answer the four questions from the questionnaire in addition to reporting the time-on-task for each contract.

---------- Insert Table 2 about here ----------

RESULTS

In the following, we will, given the similarity of the outcomes for the two experiment groups, concentrate the discussion of the results of our empirical research on the group of law students and discuss the results for the group of business students only in reference to diverging results.[6]

[5] In theory, a random distribution of these contracts among both groups should have been sufficient but for this experimental setting we prefer to remain strict and test the degree to which there is within-group homogeneity.

[6] We also performed the same analyses with both groups for the contracts between US companies and between US and non-US companies separately, to see whether the domestic or international context of these contracts might impact the complexity of contracts. However, the results for these sub-samples are identical to those for the overall sample that we report on in the following.

The descriptive statistics for each of the four questions, the length of contracts in number of words, and the time-on-task are presented in Table 3. The average length in words for these contracts is 14972 with a standard deviation of 9407. The average time necessary to read these contracts was 50.58 minutes with a standard deviation of 39.19 for the group of law students and 67.42 with a standard deviation of 52.06 for the group of business students.

---------- Insert Table 3 about here ----------

A first step in the analysis was to look at the inter-item correlations for the six item scores for the group of law students. The correlation matrix demonstrates that, as also suggested by the literature on cognitive load, several measures of cognitive load do correlate substantially: the level of complexity with mental effort and stress level, and the mental effort with stress level. In addition, relatively high correlations are found between the number of words and the length given objectives. For the group of business students, we also find higher correlations between the perceived complexity and length given objectives, as well as the number of words and time-on-task.

---------- Insert Table 4a and 4b about here ----------

Based on the correlation matrix as found in Table 4a, we use the scores of the law students to conduct a Principal Component Analysis (PCA) with Varimax rotation with the following items: perceived complexity, mental effort, length given objectives, stress level, time-on-task and the length in words. The PCA renders two components and a high discriminant validity for all of

the items. Perceived complexity, mental effort and stress level load high on component 1 and time-on-task and the number of words on component 2. Length given objectives (Q3), however, cross-loads on both components with loadings of .461 and .616 respectively. We eliminated this item from our analysis and ran the PCA with Varimax rotation again (see table 5).

---------- insert Table 5 about here ----------

This PCA also resulted in two components, with similar loadings as the first analysis (exclusive of length given objectives (Q3)), and also generated high discriminant validity. The analysis reveals a Kaiser-Meyer-Olkin (KMO) score of .732 and a significant Bartlett's test. The total variance explained by both components is 76.53%. For each item the communality and thus common variance is above .700. The internal reliability measured by Cronbach's Alpha for the level of complexity, mental effort and stress level is .860. Cronbach's Alpha for both of the items that load on the second component, the time-on-task and the number of words, is somewhat lower at .600.

We find similar results for the group of business students (see Appendix 4). A preliminary PCA with Varimax rotation led us to eliminate length given objectives (Q3) due to cross-loadings. A second PCA with Varimax rotation reveals two components, with comparable item loadings as for the group of law students. The data for the business students show a lower discriminant validity as the 'level of complexity' (Q1) loads to some extent on both components (.832 vs .326). The test for internal reliability on the level of complexity, mental effort and stress level generates a Cronbach's Alpha of .866, which indicates that these three items load on

component 1 and measure the same latent construct. We find a Cronbach's Alpha of .667 for the number of words and time-on-task.

DISCUSSION AND CONCLUSIONS

Our findings indicate that, as suggested by Eggleston et al (2000), contractual complexity is indeed a multidimensional phenomenon with both objective and subjective aspects. The length of contracts as a simple count-based indicator of complexity has some clear overlap with the time-on-task as a performance measure of the cognitive load of contractual complexity. Despite their conceptual differences, both these elements of contractual complexity point at one particular objective dimension of contractual complexity.

However, there is more to contractual complexity than just length and time-on-task as objective indicators of the complexity of contracts. Our research indicates the relevance of another dimension of contractual complexity, based on a number of subjective elements of the cognitive load of contracts, for understanding the complexity of contracts. The mental effort that people have to make to understand the content of contracts can be broken down in two sub-elements: the actual cognitive effort they make to understand contracts and the degree of stress that they experience as they have to read through contracts. The perceived level of the complexity of contracts suggests a more subjective perception of the mental load and the task difficulty that people face when they 'digest' these contracts. These different elements indicate the intricacy of cognitive load as such (see Paas et al 2003; Paas & Van Merriënboer, 1994). This intricacy of the cognitive load is apparent in the context of inter-firm contractual agreements where mental load and mental effort are related to a more subjective dimension of contractual

complexity whereas the performance element of the cognitive load of contracts (time-on-task) is part of an objective dimension of contractual complexity.

Returning to the central question of this paper, we find that the quantitative, objective measures of complexity, such as length, and objective as well as subjective elements of cognitive load do indeed measure different aspects of contractual complexity. Both components of contractual complexity (an objective, quantitative dimension and a more subjective cognitive load-based dimension) and their individual elements suggest that contractual complexity is indeed a multidimensional phenomenon. Also, the relatedness of the objective aspect of cognitive load to the other objective aspect of contractual complexity, i.e. the length of contracts, suggests that a multidimensional understanding of complexity which encompasses cognitive load is indeed relevant for understanding the complexity of contracts.

These findings do indicate that it is worthwhile for scholars to not only 'measure' the complexity of contracts that establish inter-firm relationships through objective measures, even when these measures go beyond simple counts of pages or words. Our experimental set-up suggests that there is a cognitive dimension to the complexity of contracts, which expresses the degree to which contracts impose a cognitive load on contract parties. If the groups in our experiment are representative for managers and corporate lawyers, who represent companies as contract parties, then the cognitive load of contracts does indeed affect the degree to which these managers and lawyers experience the complexity of their alliance contracts beyond the mere length of such contracts.

It is important to note that our contribution is based on an experimental research design that leaves ample room for improvement and directions for further research. One line of future research would be to consider a broader set of indicators for contractual complexity that might

lead to additional dimensions of this complexity. A number of recent contributions point at some interesting, possibly additional, indicators of contractual complexity. This line of work considers the complexity of contracts through counts of the number of particular groups of clauses and provisions incorporated in a range of contracts, e.g. R&D alliances, human resource outsourcing contracts, standard outsourcing contracts, and vertical inter-firm agreements (see Ariño and Reuer 2004; Barthelemy and Quelin 2006; Lumineau and Oxley 2007; Mellewigt et al 2007; Reuer and Ariño 2004 and 2007; Reuer et al 2006; Ryall and Sampson, 2006 and 2007). The complexity of these contracts is expected to increase with the number and the type of clauses and provisions, the monitoring mechanisms, and the description of specific tasks included in these contracts.

In an alternative approach, Hansen & Higgins (2007) mention that the number of provisions included in a contract do not consistently define contractual complexity, while focusing only on certain provisions may ignore other relevant aspects of contracts. These authors define contractual complexity along a multidimensional framework of functional and technological scope. Functional scope provides a measure of breadth of the alliance contract, while technological scope provides a measure of depth of the alliance contract. This complexity indicator is a measure of the activities and technologies chosen to be in the alliance, which is subsequently specified in the contract. In particular, functional scope (breadth) identifies the extent of value chain activities, such as manufacturing, marketing and distribution while technological scope (depth) relates to firm capabilities and overall uncertainty of focal projects (Hansen & Higgins 2007).

As with the other recent attempts to deepen or broaden our understanding of the complexity of contracts, briefly discussed in the above, it appears worthwhile for future research

to investigate the degree to which we can identify such additional dimensions of the complexity of contracts. However, in the end the value of such a multidimensionalization has to be found in studies that indicate the degree to which the complexity of contracts, in terms of the size of contracts, their cognitive load, the weight of different contractual terms, their value chain coverage, and their technological scope, tells us something about the actual contracting behavior of companies. In that light, our current paper, although limited to two dimensions of contractual complexity, has to be seen as a first step towards a more in-depth understanding of the complexity of inter-firm contracts, in terms of its objective and subjective characteristics, that can benefit future empirical research on this contracting behavior of firms in different legal, industrial, and inter-firm settings.

REFERENCES

Abbink, K., Rockenbach, B. 2006. Option pricing by students and professional traders: a behavioural investigation. ***Managerial and Decision Economics,*** 27: 497-510.

Alderfer, C.P., Bierman, H., 1970. Choices with risk: beyond the mean and variance. ***Journal of Business***, 341-353.

Argyres, N.S., Bercovitz, J., Mayer, K.J. 2007. Complementarity and evolution of contractual provisions: an empirical study of IT services contracts. ***Organization Science,*** 18(1): 3-19.

Ariño, A., Reuer, J.J. 2004. Designing and renegotiating strategic alliance contracts. ***Academy of Management Executive,*** 18(3): 37-48.

Barthelemy, J., Quelin, B.V. 2006. Complexity of outsourcing contracts and *ex post* transaction costs: an empirical investigation. ***Journal of Management Studies***, 43(8): 1775-1797.

Banks, J., Camerer C., Porter, D. 1994. An experimental analysis of Nash refinements in signaling games. ***Games and Economic Behavior,*** 6: 1–31.

Bedeian, A.G., Mossholder, K.W. 2000. On the use of the coefficient of variation as a measure of diversity. ***Organizational Research Methods,*** 3: 285-297.

Bentley Macleod, W. 2002. Complexity and contract. In E. Brousseau, J-M. Glachart (Eds.), ***The economics of contracts – theories and applications***: 213-240. Cambridge, Cambridge University Press:.

Borg, G., Bratfish, O., & Dorinc, S. 1971. On the problem of perceived difficulty. ***Scandinavian Journal of Psychology***, *12*: 249-260.

Brünken , R., Steinbacher, S., Plass, J.L., Leutner, D. 2002. Assessment of cognitive load in multimedia learning using dual-task methodology, ***Experimental Psychology,*** 49(2): 109-119.

Burnett, J., Dunne, P. 1986. An appraisal of the use of student subjects in marketing research. ***Journal of Business Research***,14: 329–343.

Cunningham, W.H., Anderson, W.T., Murphy, J.H. 1974. Are students real people?. ***Journal of Business:*** 399-409.

Corbalan, G., Kester, L., Van Merriënboer, J.G. 2006. Towards a personalized task selection model with shared instructional control. ***Instructional Science,*** 34: 399-422.

Cuevas, H.M., Fiore, S.M., Oser, R.L. 2002. Scaffolding cognitive and metacognitive processes in low verbal ability learners: use of diagrams in computer-based training environments. ***Instructional Science,*** 30: 433-464.

DeJong, D.V., Forsythe, R., Uecker, W.C. 1988. A note on the use of businessmen as subjects in sealed offer markets. ***Journal of Economic Behavior and Organization,*** 9: 87–100.

Eggleston, K., Posner, E.A., Zeckhauser, R. 2000. The design and interpretation of contracts: why complexity matters. ***Northwestern University Law Review***, 95(1): 91-132.

Eisenberg , M. 1995. The Limits of Cognition and the Limits of Contract. ***Stanford Law Review,*** 47: 213-259.

Elfenbein, D.W., Lerner, J. 2003. Ownership and control rights in Internet portal alliances. 1995-1999, ***RAND Journal of Economics*** 34(2: 356-369.

Gillan, S.L., Hartzell, J.C., Parrino, R. 2006. ***Explicit vs. Implicit contracts: evidence from CEO employment agreements***. Working paper.

Van Gog, T., Paas, F.G.W.C. 2007. ***Instructional efficiency: revisiting the original construct in educational research***. Working paper.

Gopher, D., Braune, R. 1984. On the psychophysics of workload: why bother with subjective measures?. ***Human Factors,*** 26: 519–532.

Hansen, Z., Higgins, M. 2007. ***The effect of contractual complexity on technology sourcing agreements***. Working paper.

Hart, S. G., Staveland, L. E. 1988. Development of NASA-TLX (Task Load Index): Results of empirical and theoretical research. In P. A. Hancock, N. Meshkati (Eds.), ***Human mental workload*****:** 139-184. North-Holland: Elsevier Science Publishers.

Hill, C., King, C. 2004. How do German contracts do as much with fewer words? ***Chicago-Kent Law Review,*** 79: 889-926.

Hughes, C.T., Gibson, M.L. 1991. Students are surrogates for managers in a decision-making environment: an experimental study. ***Journal of Management Information Systems,*** 8(2): 153-166.

Joskow, P.L., 1988. Asset specificity and the structure of vertical relationships: empirical evidence. ***Journal of Law, Economics, and Organization,*** 4(1): 95-117.

Kades, E. 1996. The laws of complexity and the complexity of laws: the implications of computational complexity theory for the law. ***Rutgers Law Review,*** 49: 403-484.

Kalyuga, S., Ayres, P., Chandler, P., Sweller, J. 1998. Levels of expertise and instructional design. ***Human Factors,*** 40: 1-17.

Kalyuga, S., Chandler, P., & Sweller, J. 1999. Managing split-attention and redundancy in multimedia instruction. ***Applied Cognitive Psychology***. 13: 351-371.

Kalyuga, S., Chandler, P., & Sweller, J. 2000. Incorporating learner experience into the design of multimedia instruction. ***Journal of Educational Psychology***, 92: 126-136.

Kalyuga, S., Chandler, P., & Sweller, J. 2001. Learner experience and efficiency of instructional guidance. ***Educational Psychology***, 21: 5-23.

Kalyuga, S., Chandler, P., & Sweller, J. 2004. When redundant on-screen text in multimedia technical instruction can interfere with learning. ***Human Factors***, 46: 567-581.

Kaplan, S.N., Stromberg, P. 2003. Financial contracting theory meets the real world: an empirical analysis of venture capital contracts. ***The Review of Economic Studies***, 70(2): 281-315.

Klein, B. 1996. Why hold-ups occur: the self-enforcing range of contractual relationships. ***Economic Inquiry***, 34: 444-463.

Korobkin, R., Ulen., S. 2000. Law and behavioral science: removing the rationality assumption from law and economics. ***California Law Review,*** 88(4): 1051-1144.

Khera, I.P.,http://72.14.253.104/search?q=cache:t450d32v-uEJ:www.lansmuseum.a.se/inneh/pdf2004/Taljoweb.pdf+ryd+%26+nygren+1988&hl=nl&ct=clnk&cd=2&gl=nl Benson, J.D. 1970. Are students really poor substitutes for businessmen in behavioral research? ***Journal of Marketing Research****:* 529-532.

King R.R., Smith V.L., Williams A.W., Van Boening M. 1992. The robustness of bubbles and crashes in experimental stock markets. In I. Prigogine, R.H. Day, R. Chen (Eds.), ***Evolutionary Dynamics and Nonlinear Economics, A Transdisciplinary Dialogue***. Oxford: Oxford University Press.

Lerner, J., Merges, R.P. 1998. The control of technology alliances: an empirical analysis of the biotechnology industry. ***The Journal of Industrial Economics,*** 46(2): 125-156.

Levitt, T. 1965. ***Industrial purchasing behavior***. Cambridge: Harvard University Press.

Lumineau, F., Oxley, J. 2007. ***The determinants of dispute resolution mode in inter-firm contracts***. Working paper.

Marcus, N., Cooper, M., Sweller, J. 1996. Understanding instructions. ***Journal of Educational Psychology,*** 88(1): 49-63.

Mason, C. 2006. Exploring the processes underlying within-group homogeneity. ***Small Group Research,*** 37: 233-270.

Mayer, K.J., Argyres, N. 2004. Learning to contract: evidence from the personal computer industry. ***Organizational Science,*** 5: 394-410.

Mellewigt, T., Madhok, A., Weibel, A. 2007. Trust and fromal contracts in interorganizational relationships – substitutes *and* complements. ***Managerial and Decision Economics,*** 28: 833-847.

Moreno, R., 2004. Decreasing cognitive load for novice students: effects of explanatory versus corrective feedback in discovery-based multimedia. ***Instructional Science,*** 32: 99-113.

Overdalh, J.A. 1991. A researcher's guide to the contracts of firms filing with the SEC. ***Journal of Law and Economics,*** 34(3): 695-701.

Paas, F. 1992. Training strategies for attaining transfer of problem-solving skill in statistics: a cognitive-load approach. ***Journal of Educational Psychology,*** 84: 429-434.

Park, C. W., P. V. Lessig 1977. Students and housewives: differences in susceptibility to reference group influence. ***Journal of Consumer Research***, 4(2): 102-109.

Paas, F.G.W.C., Van Merriënboer, J.G 1993. Short note: the efficiency of instructional conditions: an approach to combine mental effort and performance measures. ***Human Factors,*** 35(4): 737-743.

Paas, F.G.W.C., Van Merriënboer, J.J.G., 1994a. Instructional control of cognitive load in the training of complex cognitive tasks. ***Educational Psychology Review*** 6(4): 351-371.

Paas, F.G.W.C., Van Merriënboer, J.G., Adam, J.J. 1994. Measurement of cognitive load instructional research. ***Perceptual and Motor Skills*** 79: 419-430.

Paas, F.G.W.C., Van Merriënboer, J.G. 1994. Variability of worked examples and transfer of geometrical problem-solving skills: a cognitive-load approach. ***Journal of Educational Psychology*** 86(1): 122-133.

Paas, F.G.W.C., Renkl, A., Sweller, J. 2003a. Cognitive load theory and instructional design: recent developments. ***Educational Psychologist*** 38(1): 1-4.

Paas, F.G.W.C., Tuovinen, J., Tabbers, H. 2003b. Cognitive load measurement as a means to advance cognitive load theory. ***Educational Psychologist*** 38(1): 63-71.

Poppo, L., Zenger, T. 2002. Do formal contracts and relational governance function as substitutes or complements? ***Strategic Management Journal***, 23: 707-725.

Rasmusen, E.B. 2001. Explaining incomplete contracts as the result of contract-reading cost. ***Advances in Economic Analysis & Policy***. Available at http://www.bepress.com/bejeap/advances/vol1/iss1/art2.

Reid, G. B., Nygren, T. E. 1988. The subjective workload assessment technique: a scaling procedure for measuring mental workload. In P. A. Hancock & N. Meshkati (Eds.), ***Human Mental Workload***: 185-218. North-Holland: Elsevier Science Publishers.

Reuer, J.J., Ariño, A., Mellewigt, T. 2006. Entrepreneurial alliances as contractual forms. ***Journal of Business Venturing,*** 21: 306-325.

Reuer, J.J., Ariño, A. 2007. Strategic alliance contracts: dimensions and determinants of contractual complexity. ***Strategic Management Journal,*** 28: 313-330.

Robinson, D.T., Stuart. T.E. forthcoming. Financial contracting in biotech strategic alliances. ***Journal of Law and Economics***.

Ryall, M.D., Sampson, R.C. 2006. Do prior alliances influence alliance contract structure. In A. Ariño, J.J. Reuer, (Eds.), ***Strategic Alliances:*** *206-216.* Houndsmills: Palgrave MacMillan.

Ryall, M.D., Sampson, R.C. 2007. ***Formal contracts in the presence of relational enforcement mechanisms: evidence from technology development projects***. Working paper.

Sampson, R.C. 2004. The cost of misaligned governance in R&D alliances. ***The Journal of Law, Economics & Organization,*** 20(2): 484-526.

Schuck, P.H. 1992. Legal complexity: some causes, consequences, and cures. ***Duke Law Journal,*** 42(1): 1-52.

Siegel, S., Harnett, D.L. 1964. Bargaining behavior: a comparison between mature industrial personnel and college students. ***Bargaining Behavior****:* 334-343.

Simon, H. 1955. A behavioral model of rational choice. ***Quarterly Journal of Economics,*** 69(1): 99-118.

Simon, H. 1981. ***The sciences of the artificial***. Cambridge: MIT Press.

Smith, H.E. 2006. Modularity in contracts: boilerplate and information flow. ***Michigan Law Review,*** 104: 1175-1222.

Sorenson, J.B., 2007. ***The use and misuse of the coefficient of variation in organizational demography research***. Working paper.

Suchman, M. 2003. The contract as social artifact. ***Law and Society Review,*** 37: 91-142.

Tindall-Ford, S., Chandler, P., Sweller, J. 1997. When two sensory modes are better than one. ***Journal of Experimental Psychology: Applied,*** 3: 257–287.

Whelan, R. 2007. ***Measuring cognitive load: a comparative study of self-report and direct measurement techniques***. Working paper.

Williamson, O. 1996. ***The mechanisms of governance***, Oxford: Oxford University Press.

Table 1 **Correlations between kilobytes, number of words, and number of pages in R&D alliance contracts (n= 387)**

		kilobytes	words	pages
kilobytes	Pearson Correlation	1.000		
words	Pearson Correlation	.987**	1.000	
pages	Pearson Correlation	.951**	.961**	1.000

**. Correlation is significant at the 0.01 level (2-tailed).

Table 2 **Results on the scores (mean, standard deviation, and coefficient of variation) for the questions on the representative contract, both groups (n=60 for both groups)**

	Law and Business	Mean	Std. Deviation	Std. Error Mean	CV
Q1: level of complexity	Law	4.825	0.986	0.127	0.204
	Business	4.683	1.186	0.153	0.253
Q2: mental effort	Law	4.900	1.203	0.155	0.246
	Business	4.483	1.334	0.172	0.298
Q3: length given objectives	Law	4.842	1.155	0.149	0.239
	Business	4.797	1.126	0.147	0.235
Q4: stress level	Law	4.350	1.696	0.219	0.390
	Business	4.333	1.724	0.223	0.398
Length (words)	Law	14528.000	0.000	0.000	0.000
	Business	14528.000	0.000	0.000	0.000
Time (minutes)	Law	59.833	36.309	4.687	0.607
	Business	81.500	44.979	5.906	0.552

Table 3 **Descriptive statistics (means and standard deviation) for contractual complexity (cognitive load and time and length) of contracts, law and business students (n=387)**

Group	Items	Minimum	Maximum	Mean	Std. Deviation
Law	Q1: level of complexity	1.000	7.000	4.386	1.391
	Q2: mental effort	1.000	7.000	4.310	1.428
	Q3: length given objectives	1.000	7.000	4.528	1.378
	Q4: stress level	1.000	7.000	3.806	1.726
	Time (minutes)	2.000	270.000	50.576	39.192
	Length (words)	601.000	74415.000	14972.103	9407.515
Business	Q1: level of complexity	1.000	7.000	4.129	1.620
	Q2: mental effort	1.000	7.000	4.104	1.537
	Q3: length given objectives	1.000	7.000	4.311	1.523
	Q4: stress level	1.000	7.000	3.803	1.830
	Time (minutes)	5.000	300.000	67.419	52.064
	Length (words)	601.000	74415.000	14972.103	9407.515

Table 4a Item correlations for contractual complexity (cognitive load and time and length) of contracts, law students (n=387)

		Q1: level of complexity	Q2: mental effort	Q3: length given objectives	Q4: stress level	Time (minutes)	Length (words)
Q1: level of complexity	Pearson Correlation	1.000					
Q2: mental effort	Pearson Correlation	.777**	1.000				
Q3: length given objectives	Pearson Correlation	.463**	.394**	1.000			
Q4: stress level	Pearson Correlation	.639**	.645**	.457**	1.000		
Time (minutes)	Pearson Correlation	.255**	.223**	.283**	.173**	1.000	
Length (words)	Pearson Correlation	.315**	.225**	.533**	.227**	.429**	1.000

** Correlation is significant at the 0.01 level (2-tailed).

Table 4b Item correlations for contractual complexity (cognitive load and time and length) of contracts, business students (n= 387)

		Q1: level of complexity	Q2: mental effort	Q3: length given objectives	Q4: stress level	Time (minutes)	Length (words)
Q1: level of complexity	Pearson Correlation	1.000					
Q2: mental effort	Pearson Correlation	.768**	1.000				
Q3: length given objectives	Pearson Correlation	.549**	.430**	1.000			
Q4: stress level	Pearson Correlation	.621**	.690**	.449**	1.000		
Time (minutes)	Pearson Correlation	.384**	.334**	.427**	.304**	1.000	
Length (words)	Pearson Correlation	.461**	.337**	.591**	.330**	.500**	1.000

**. Correlation is significant at the 0.01 level (2-tailed).

Table 5 Principal Component Analysis of contractual complexity with Varimax rotation, law students

	Component	
	1	2
Q1: perceived complexity	**0.884**	0.217
Q2: mental effort	**0.903**	0.128
Q4: stress level	**0.854**	0.086
Time (minutes)	0.100	**0.846**
Length (words)	0.165	**0.822**

a. Rotation converged in 3 iterations.

Appendix 1 Overview cognitive load and contractual complexity constructs

CONSTRUCT	SUBJECTIVE/OBJECTIVE	SUBCONSTRUCTS	SUBJECTIVE/OBJECTIVE	SUBCONSTRUCT-ELEMENTS	INDICATORS
COMPLEXITY	Subjective measure	COGNITIVE LOAD	subjective elements	MENTAL LOAD	Perceived task difficulty/complexity
				MENTAL EFFORT	Invested mental effort
					Stress level
			objective elements	PERFORMANCE	Time-on-task
	Objective measure	LENGTH	objective elements		Words
					Kilobytes
					Pages

Appendix 2 Questionnaire pilot study – PhD students

Questions

(1) How do you perceive the level of complexity of the contract?

(2) How much effort did you have to invest in order to understand the contract?

(3) How do you perceive the level of information contained in the contract?

(4) How would you rate the length of the contract, given the objective of the agreement?

(5) How stressed (insecure, discouraged, irritated, annoyed) did you feel while reading the contract?

Time needed for reading the contract.

Question 1: see Marcus et al (1996) and Van Gog & Paas (2007).

Question 2: see Paas (1992).

Question 3: see e.g. Brünken et al (2003) and Paas et al (2003).

Question 4: see e.g. Brünken et al (2003) and Paas et al (2003).

Question 5: adopted from the SWAT (Reid & Nygren 1988) and NASA-TLX (Hartland & Staveland 1988) scales.

Appendix 3 Final questionnaire – law and business students

Instructions:

'Imagine you are a legal counsel at an international company. One of your main tasks is to draft and conclude alliances. Please read the attached contract and answer questions 1-4.

Please be aware of the following while reading the contract:

(1) The page numbers indicated in the table of contents (if included), do not correspond with the actual page numbers of the contract due to formatting.

(2) The stars [***] in the contract designate confidential information which has been omitted.'

Questions*

(1) How do you perceive the level of complexity of the contract?

(2) How much effort did you have to invest in order to understand the contract?

(3) How would you rate the length of the contract, given the objectives of the agreement?

(4) How stressed (irritated or annoyed) did you feel while reading the contract?

Time needed for reading the contract.

* See Appendix 2 for the references for these questions.

Appendix 4 Principal Component Analysis of contractual complexity with Varimax rotation, business students

	Component	
	1	2
Q1: perceived complexity	**0.832**	0.326
Q2: mental effort	**0.907**	0.176
Q4: stress level	**0.855**	0.154
Time (minutes)	0.175	**0.850**
Length (words)	0.225	**0.833**

a. Rotation converged in 3 iterations.