Chapter 4

Risk Visualisation & Trustworthiness

The Chapter addresses RQ3 which reads:

> **RQ3:** *To what extent is it possible to improve user trustworthiness for Intelligent Contracts via the visualisation of risk during legal question-answering?*

Our research aims to show how contractor *trustworthiness* for iContracts improves via the visualisation of risk. Traditionally, contractors relied on legal experts who conducted the analysis of risk and proposed contracting solutions. Currently, trustworthiness is still an *open question* concerning the state-of-the-art in user interfaces for contract automation. Nowadays, the available interfaces do not present much valuable information, and the question is whether it is sufficient information (or what are the criteria for sufficient information). To measure the impact of the trustworthiness at the end users side, we will investigate to what extent we can visualise legal risk for legal-question answering addressed to contracting parties. For this task, we developed an explorative survey that requested end users to rate how their trustworthiness level is different when compared to (a) an empty user interface or (b) a legal expert physically discussing legal risks with them. The results show that the end user reaction is almost sufficiently positive. The discussion highlights the importance of risk analysis visualisation for user trustworthiness in iContracts and provides improvement suggestions. The conclusion is that end user trustworthiness improves with risk visualisation, yet further improvements are necessary.

The current chapter corresponds to the following publication:

Stathis, G., Trantas, A., Biagioni, G., and van den Herik, H. J. (2023c). Risk Visualisation for Trustworthy Intelligent Contracts. *In the Proceedings of the 21st International Industrial Simulation Conference (ISC), EUROSIS-ETI*, pages 53–57

4.1 Trust and Trustworthiness

While the scientific interest regarding contract automation is accelerating, users are not adopting such solutions at the same pace. As with most technology innovations, several validation iterations are necessary. Here we remark that the difference between general technology innovation (for example in consumer internet offerings) and innovation in contract automation is to a large extent based on *trust*, since any end-user action may have binding legal consequences. In our study we use the following definition of trust (see Definition 4.1, cf. [Bauer, 2019]).

Definition 4.1 – ***Trust***

Trust is a subjective estimate (to be performed by the truster) of the probability that the trustee will accept the truster's preferred behaviour.

The behaviour, as described in Definition 4.1 is called the truster's trustworthiness [Bauer, 2019]. For the purposes of this research we define trustworthy (see Definition 4.2) and (see Definition 4.3) as follows.

Definition 4.2 – ***Trustworthy***

Trustworthy is the behaviour of people who show or accept trust.

Definition 4.3 – ***Trustworthiness***

Trustworthiness is the state in which the behaviour of people is expected to show or accept trust.

4.1.1 End User Trustworthiness

The underlying idea is that the implications of contractual agreements for end users have a high legal impact. Therefore, end users also need to trust the available technology to a very significant extent for adopting contract innovation with the aim to avoid potential legal risks. Given the importance of legal risk in contract design, the task to improve the communication of legal risk in contract automation for end users is a way to handle the *trustworthiness* issue. This is also the case for iContracts, which currently lie at the epicenter of the academic attention. Our research aim is to improve the following three issues by visualising:

1. the risk analysis of a legal expert, in a user-friendly manner to contracting parties,
2. the trustworthiness, and
3. the subsequent user adoption of iContracts.

Obviously, a particular obstacle affecting user trustworthiness for iContracts is the lack of sufficient understanding of legal risk involved in legal question-answering. Due to the binding effects of contracts, users remain currently reluctant to trust technology when replacing legal experts. With the visualisation of contract risk, users may experience an improved understanding of the legal consequences during legal question-answering.

4.1.2 Risk Visualisation

The most recent literature is investigating the *effects* of improved risk visualisation for users in (1) LegalTech and contract automation, as well as in (2) additional industries, as listed in the relevant literature (see Section 4.2). Even though the visualisation of risk is seriously examined, there is *no academic* study that shows the extent to which researchers deal with *user trustworthiness* in practice. In particular, this is the case in the context of improved trustworthiness for legal question-answering procedure for iContracts.

We see that risk visualisation occurs mainly when using the bow-tie method as is done in several industries. There, it is also the most advanced method. In Chapter 3, we have enriched the bow-tie visualisation via the Enriched Bow-Tie Ontology [Stathis et al., 2023b]. Currently, this innovation is still in its test phase with end users. To stress the importance, we will focus in this Chapter on three issues.

1. The impact of end user trustworthiness via risk visualisation,
2. The context of iContracts, and
3. The use of the Enriched Bow-Tie Ontology for the visualisation of contract risk analysis.

4.1.3 Research Benefits

The benefits of the research are clear (1) for both the contracting parties as well as (2) the end users and (3) the legal experts. Contracting parties will be able to experience more legal benefits (at both sides) and less substantial legal costs when using contract automation technology. Traditionally, the “outcome” of

more legal benefits is expected from a legal expert who physically assists the contracting parties. As we see the current developments, we note that legal experts soon will be able to tune their legal advice to multiple parties and use risk analytics to improve the impact of their advice for end users. This implies that the adoption of iContracts by end users and legal experts will become more impactful. This will be the more so if we take the nature of iContracts into consideration, since they have a high impact on contract risk management.

4.1.4 Research Question 3

The above-mentioned information leads us to RQ3.

> **RQ3:** *To what extent is it possible to improve user trustworthiness for Intelligent Contracts via the visualisation of risk during legal question-answering?*

4.1.5 Research Contribution

The Chapter explains our innovation within risk management, which is to facilitate end users understanding, interpretation and trustworthiness for the interpretation of legal risk data. End users will be able to take better legal decisions with more awareness based on risk factors. Moreover, legal experts will be able to communicate with end users on risks involved in their decisions in a clear manner, based on actual analysis derived from risk data, in a structured manner. The contribution to LegalTech is that it shows how risk management and analysis can be explained and be embedded in the contracting process, especially in iContracts, to facilitate the complex stakeholder management of contracting. The most valuable impact is the consequences of our research for end user trust, due to clearer explanations of legal risk.

The relevance between visualisation and trustworthiness relies on the fact that with visualisation it is easier to explain to laymen complex information. Visualisation is essentially for expressing information. It is a way of communicating legal information easily due to higher understandability and interpretability for end users. On the topic of risk management applied in law, that is not usually the case because risk analysis is often implicit. Thus, after structuring risk data in the formal risk management process of EBTO, the visualisation facilitates discussions among experts and end users.

4.1.6 Research Structure

We structure the Chapter as follows. Section 4.1 provides the introduction. In Section 4.2, a brief literature review is provided. Section 4.3 presents the method of research. Section 4.4 states the results and Section 4.5 discusses those results. Finally, Section 4.6 answers RQ3 and provides our conclusion.

4.2 Relevant Literature

The relevant literature Section is partitioned into five parts. Subsection 4.2.1 introduces literature on the user adoption of *iContracts*, Subsection 4.2.2 does the same for user adoption of *contract automation*. Subsection 4.2.3 presents sources on *legal design thinking* and *user trustworthiness*. Then, Subsection 4.2.4 discusses the state-of-the-art of *legal design* and *Preventive/Proactive Law* (PPL). Finally, Subsection 4.2.5 mentions sources on the *visualisation* of the *bow-tie method* for improved trustworthiness.

4.2.1 User Adoption of iContracts

Our literature search concerning user adoption of iContracts shows that the academic research investigating this subject is still under early development [Smits, 2017]. The little research there is, concludes that even though there exists a certain end user desire for the digitisation of designing contracts, the readiness of users for such disruptive change is unknown [McNamara and Sepasgozar, 2020]. The authors mentioned above have investigated the subject of *user acceptance*. They highlighted the disconnection between academic efforts and the industrial adoption of iContracts, with user acceptance being one of the main challenges for adoption [McNamara and Sepasgozar, 2021]. Regrettably, we could not find more recent research, probably due to the high complexity involved in developing and examining the adoption of iContracts.

4.2.2 User Adoption of Contract Automation

Most literature work on *user adoption* relates to smart contracts such as contract automation solutions. Two issues, *user-friendliness* and the *visualisation of legal obligations* in smart contracts, are vital for the adoption of smart contracts [Ullah and Al-Turjman, 2021].

Still, it seems that not all users are willing to adopt this technology. We note that the adoption curve is currently determined by prioritising early adopters [Badi et al., 2021]. Three factors are important for measuring perceived influence and the ease of use, viz. (1) perceived financial costs, (2) facilitating conditions, and (3) trust and readiness [Chaveesuk et al., 2020]. The most important risks are the administrative risks that may affect the adoption of smart contracts, including (a) the regulatory change, (b) the lack of sufficient legal planning, and (c) the lack of dispute resolution mechanisms as discussed by [Gurgun and Koc, 2022].

For the *specific use* of contract automation solutions, we mention one of the first economic analyses of contract technology [Acemoglu et al., 2007]. The anal-

ysis of multi-stakeholder relationships showed that forming contracts is central to the successful completion of a project [Gerkensmeier and Ratter, 2018]. However, the relative contractual incompleteness by a stakeholder leads to a generally lower level of contractual technology adoption. In the last years we have seen that this observation remains valid, especially in some geographical areas or market verticals where adopting digital solutions is uncommon (e.g. see discussions in relation to the adoption of notarial technology in Greece [1]).

Focussing on risk aversion, we point to an interesting study conducted on Chinese farmers [Mao et al., 2019]. It shows that the higher the risk aversion of a farmer, the less likely it is for colleague farmers to adopt technology. However, when specific contractual terms that *reduce risk* are included in contracts and understood by the farmers their adoption rate increases. Hence, a first conclusion is that the *attitudes* and risk *perceptions* of the farmers risk play an essential role in shaping risk management strategies to address risks and uncertainties (see [Pham et al., 2021]). The analogous conclusion can be made for the case of a contracting party as an end-user concerning iContracts, irrespective of their professional background (as we partially validate during the discussion of the explorative survey results in Subsection 4.5.1).

4.2.3 Legal Design Thinking and User Trustworthiness

Central to the delivery of legal services is the concept of *legal risk*. Studies have shown that legal risk analysis is *flawed*, often leading to *poor predictability* [Fraser and Roberge, 2016, Kiser et al., 2008]. This is one of the main reasons why smart contracts have increased in adoption, viz. due to the higher trust they bring by their better predictability (already announced by [Kiser et al., 2008]). On the same line of reasoning, researchers proposed *legal design thinking* as a method for the re-evaluation of value and predictability [Fraser and Roberge, 2016]. Even though the literature highlights the *need* for risk prevention solutions, there is a *lack of practical solutions*. At this point, other researchers emphasise that attention should be given to the fact that clients eagerly need an improved view of legal risk [Yankovskiy, 2019]. In the meantime, we see that beyond the focus on risk, design thinking (see above) should also direct their attention to helping clients to make improved business decisions [Sainz, 2020].

4.2.4 Legal Design Thinking and Preventive/Proactive Law

The research by Haapio addresses the connection between legal design and PPL [Rossi and Haapio, 2019]. PPL researchers support the notion that im-

[1] https://www.ekathimerini.com/news/1225145/government-notaries-reach-contracts-agreement/

proved legal visualisation techniques are necessary in the legal industry [Rossi and Haapio, 2019]. Barton reinforces that notion by stating that the emerging information culture is largely compatible with the assumptions underlying PPL [Barton, 2016]. Barton's recent research seeks to identify design methods, such as *simplification* and *visualisation*, for using the emerging technology to help legal systems function better in the information age [Barton et al., 2016]. Barton has ventured the proactive law movement, such as suggested by Haapio, to solve some of the so-called *design challenges* [Berger-Walliser et al., 2017]. Haapio focusses on the field of *visual law* and is in fact stimulating a design revolution [Corrales et al., 2019a]. The reason behind the ideas is that they are *driven by the market* [McLachlan and Webley, 2021]. The most advanced method thus far for risk visualisation is the *bow-tie method*, and our research shows how it can be enriched for higher impact [Stathis et al., 2023b]. In this respect, we once more remark that Haapio already stated that with risk visualisation the clarity of contracts improves [Haapio, 2011].

4.2.5 Bow-Tie Visualisation for Improved Trustworthiness

All in all, the literature on bow-tie visualisation for improved user trustworthiness in contract automation and LegalTech is still rather scarce [Stathis et al., 2023b]. In the last two decades the bow-tie method has mostly been implemented as a method for increasing *user trustworthiness*. This has happened in a multitude of domains including Chemistry, Energy and Aviation [de Ruijter and Guldenmund, 2016]. Indeed, the active academic researchers have pointed in this direction during more than fifteen years on *risk visualisation* via the bow-tie method (the managers of risks are mostly also the end users) [Book, 2012]. The approach is the equivalent of the *legal expert* in the Onassis Ontology. There, subsequent research highlights the benefits of visualising the bow-tie method for multi-stakeholder environments [Gerkensmeier and Ratter, 2018]. Here, an interesting observation comes from Luhmann who argues that risks are *mental constructs* which are bounded and influenced by perception [Luhmann, 2002]. Hence, risk management and bow-tie analysis should be subject to a continuous social discourse [Gerkensmeier and Ratter, 2018]. Thus far, the current research supports the bow-tie as the most influential method of visualising risk in a multi-stakeholder environment, mainly according to [Gerkensmeier and Ratter, 2018] and [Bernsmed et al., 2018]. The importance of risk communication to stakeholders is well described by earlier academic research [Gerstenberger et al., 2013].

Currently, we observe that the literature on this topic has strongly developed in recent years. Despite the positive remarks of many researchers for bow-tie and risk visualisation, there is actually not recent new research (i.e., new ideas) on the subject. Providing an explanation is difficult.

4.3 Research Methodology

This Section presents the research methodology containing four recently developed main topics: (4.3.1) the use of a case study, (4.3.2) the application of the Enriched Bow-Tie Ontology visualisation (see Chapter 3) (4.3.3), the development of an explorative *user survey* measuring the extent to which the visualisation impacts the user trustworthiness, and (4.3.4) the clarification of *sufficiency criteria*. The survey contributes to developing *methods for measuring* the improvement in user trustworthiness based on the visualisation of the Enriched Bow-Tie Ontology.

4.3.1 Case Study on Payment Risk

The case study focusses on representing payment risk related to legal question-answering for a *simplified freelance agreement*. The legal questions are addressed to freelancers. The most common legal questions freelancers receive in relation to (1) payment risk, concern (2) price expectations and (3) milestone planning or (4) payment planning. The case study facilitates the definition of the scope of both the visualisation and the survey. Our case study builds upon the KG validation presented in Chapter 2 (it does not include the ten case study examples for efficiency purposes).

4.3.2 Enriched Bow-Tie Ontology Visualisation

In our representation of the *payment risk*, the legal expert is responsible for conducting the contract risk management process [Stathis et al., 2023b]. In Chapter 2, we developed the Enriched Bow-Tie Ontology, which visualises also a method of analysing the Enriched Bow-Tie Ontology from the point of view of the legal expert. Once the legal expert has completed the analysis, it is possible to present it as a visual report for inspection to the end-user, in the form of legal question-answering.

4.3.3 Explorative Survey

The purpose of our explorative user survey is to measure the level of end user trust for a contract during legal question-answering, after the risk has been vi-

sualised. It is an explorative survey being the first of its kind in literature. The aim is to gather an introductory understanding of end user trustworthiness.

The survey takes into consideration background information about users in order to reduce bias by gathering survey participants with diverse backgrounds. Each participant is introduced to the legal question-answering context. The theme of the contract places the participant into a freelancer's position who is interested in signing a contract to provide services to one of the clients of the end user. The primary risk which the end user and the freelancer are facing is payment risk. For purposes of efficiency we have prioritised that risk in the survey. Before answering any question, the replies include the presentation of a level of risk (higher-middle-lower [2]) and a prompt to consult the visualisation of associated risks. The risk analysis is visualised next to the questions.

The users are asked to assume a scale from 1 to 10, where 1 refers to a list of questions without the visual risk representation, and 10 to a list of questions with a legal expert explaining the associated risks to each guest extensively as the ultimate source of trustworthiness. Then, the users are asked to rate from 1 to 10 the perceived trustworthiness of the risk visualisation accompanying the questions. We provide a *tailored* definition of trustworthiness below; it is based on the definition of trustworthiness (cf. Definition 4.3).

> **Trustworthy**, *within the context of this survey, is the level of trust a contractor feels towards a user interface or a legal expert when answering legal questions related to their legal rights and obligations.*

The survey is accessible in the Appendices (Appendix 3B [3]). Moreover, the survey provides participants with secondary explorative questions investigating their productivity, anxiety, satisfaction and likelihood of referral levels. The survey also requests the provision of qualitative feedback.

4.3.4 Sufficiency Criteria

Provided the limited research on the iContract topic, identifying sufficiency criteria for an explorative research survey of data results is not a straightforward task. However, given that our research is focussed on (1) end users and (2) their reaction, we will use a GUI, of which the criteria have been developed under Net Promoter Score (NPS). This testing is developed in Harvard Business Review for market research purposes and can be taken into consideration for such research as ours [Fisher and Kordupleski, 2019]. According to NPS, there are three categories of numerical data that can be gathered in surveys: (1) the

[2] The comparison is on the basis of complexity and risk protection as seen in the Appendix 3B.

[3] https://github.com/onassisontology/onassisontology/blob/main/Appendices_PhD.pdf

detractors (1 to 6), (2) the passives (7 to 8) and (3) the promoters (9 to 10) [4]. To calculate the NPS, one needs to calculate the total percentage of promoter scores minus the total percentage of dectractor scores. NPS results range from -100 to +100. Anything over +50 is considered a good NPS, with +70 or higher being excellent [5]. In our survey, we apply the same method to determine the sufficiency of the explorative survey-data results.

We should note that the mere collection of data is in itself not sufficient in determining a level of sufficiency without having established appropriate controls during the investigation of data. Therefore, in the design of our survey we have ensured to maintain the highest possible levels of data security and protection according with Leiden University's Data Management Plan guidelines (including the filling of Consent Forms from the data subjects) as well as with Scientific Ethical norms [6].

4.4 Research Results

This section presents the results of our research. The results concern (4.4.1) the Enriched Bow-Tie Ontology visualisation, (4.4.2) the explorative survey results, and (4.4.3) the results of testing the sufficiency criteria.

4.4.1 Enriched Bow-Tie Ontology Visualisation

Acting as the legal expert, we conducted the contract risk analysis based on the Enriched Bow-Tie Ontology visualisation for the payment risk. We take on the start of our analysis the risk of no payment as the main potential hazardous event. Below we enlist our seven event results (which are not exclusive, but defined as such to facilitate the survey in an efficient manner [7]).

- First, we identified potential hazardous event causes, which included: (a) lack of deadline, (b) quality objection, (c) payment default, and (d) lack of budget (see Figure 4.1 left upper side).
- Second, for each cause we designed a proactive control, namely: (a) timeline, (b) quality control, (c) payment plan, and (d) budget screenshot (see Figure 4.1 right upper side).

[4] https://www.hotjar.com/net-promoter-score/how-to-calculate/
[5] https://blog.hubspot.com/service/how-to-calculate-nps
[6] https://www.staff.universiteitleiden.nl/research/it-and-research/datamanagement/law#tab-1
[7] Potentially more measures can be identified (e.g., start legal procedure as reactive control).

- Third, we identified a consequence which was: (a) less monetary availability.
- Fourth, we identified reactive controls, which were: (a) stop service, and (b) pause service.
- Fifth, on the available data we assigned a probability number of 0.7 to the hazardous event occurring (see [8]).
- Sixth, we assigned an impact number of 0.9 due to the severity of the hazardous event for a freelancer.
- Seventh, we concluded that the level of risk is high, at 0.6.

The connection among the different data points identified during the analysis is as follows. The hazardous event has (a) causes and proactive controls, whereas (b) a cause is contained by proactive controls. Moreover, the hazardous event has (c) a consequence and reactive controls, whereas the consequence is contained by (d) reactive controls. In addition, the hazardous event has (e) a probability, which is based on (f) a source, as well as (g) an impact which affects an agent, and cumulatively the result lands in (h) a specific level of risk. The visualisation is presented below in Figure 4.1 and it is also accessible via the Onassis Ontology GitHub repository [9] or in the Appendices (Appendix 3A [10]).

4.4.2 Explorative Survey Results

The survey collected one hundred and nine (109) replies, based upon which an average score of six point nine (6.9) was given to the visualisation representation, placing it on the scale of significantly trustworthy. Out of the one hundred and nine (109) replies, sixty eight (68) of them reported a score of seven or higher, with forty nine (49) being passives and nineteen (19) promoters, while there were forty one (41) replies that assigned a number below six, which were the detractors. The number was consistent for groups of users which originated from divergent backgrounds. Users with different backgrounds "averaged" rather similar scores. Finally, the participants rated that their productivity level increases by six point seven (6.7), their anxiety level decreases by six point seven (6.7), their satisfaction level increases by six point nine (6.9) and their referral likelihood is seven point five (7.5). Table 4.1 shows the results.

[8] https://blog.freelancersunion.org/2016/03/28/add-your-ious-worlds-longest-invoice/

[9] https://github.com/onassisontology/onassisontology/blob/main/img/Visualisation.png

[10] https://github.com/onassisontology/onassisontology/blob/main/Appendices_PhD.pdf

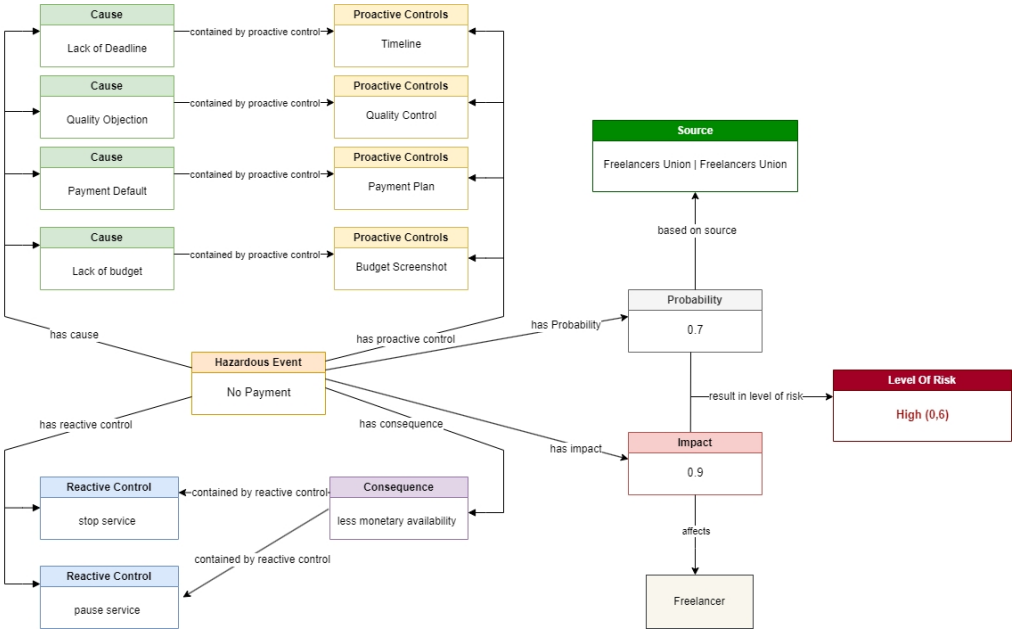

Figure 4.1: Payment Risk Analysis Visualisation

4.4.3 Sufficiency Test

At this point we are applying the NPS test to the received survey replies. There were forty one (41) detractors (1 to 6), forty nine (49) passives (7 to 8) and nineteen (19) promoters for the level of trustworthiness (41+49+19=109). After applying the relevant NPS calculations the final score is minus twenty one (-21). That is a relatively low score. It shows that significantly more work is required.

4.5 Discussion

The discussion concentrates on examining the research impact. We do so for user trustworthiness (4.5.1), the risk visualisation from an end user perspective (4.5.2), and the sufficiency criteria (i.e., Net Promoter Score, 4.5.3).

4.5.1 User Trustworthiness

The average user trustworthiness score provided by survey participants was seven point five out of ten (7.5). The score demonstrates that end users exhibit a high average level of trust towards risk visualisation for legal question-answering.

The risk visualisation is useful for access to justice purposes. It is particu-

Table 4.1: Explorative Survey Data

	Reaction
Trustworthiness	Increased by 6.9
Productivity	Increased by 6.7
Anxiety	Decreased by 6.7
Satisfaction	Increased by 6.9
Referral	Increased by 7.5

larly helpful for groups of people who find it challenging to pay lawyers. Moreover, it is useful for users who have little professional experience and prefer to know the risks rather than not to know. The risk visualisation is also helpful for people with low legal education, who may be eager to avoid committing unnecessary legal mistakes.

Comparatively, in relation to professionals with more complex professions and educational backgrounds, the risk visualisation is not considered as a trustworthy asset. We observed them together with professionals who engage in such higher complexity professions. They ”doubt” in relation to whether the risk visualisation can indeed replace a legal expert who is able to grasp more details for their specific scenarios.

In relation to the legal expert conducting the risk analysis there are many legal analysis limitations. We mention three of them. (1) The trust of end users on the risk visualisation depends on the legal expert doing the analysis in the back-end. For instance, as a participant states ”on the intermediary handling the contact” who should be highly credible. As a survey participant expressed, lawyers may remain skeptical even with risk visualisation due to the nature of their job. (2) A survey participant expressed concerns as to how the legal expert is able to identify and take into consideration the unique risks that end users might be facing since it is highly dependent on a per case basis. (3) A survey participant suggested they might seek additional risk protection, despite the already detailed analysis of risk, in order to achieve higher protection.

In general, most survey participants found risk visualisation to significantly improve their work as is evident by the scoring of the secondary questions that were focused on their work and psychology.

All in all, it is vital to provide criticism, to assess the risk visualisation and its real value. Some users may still prefer legal experts, even if they assigned

high survey scores, e.g., as (1) they themselves lack time for performing the task, (2) they do not feel they can trust a graph over a human expert, or (3) they also have sufficient budget to hire lawyers. Not all users are expected to find usefulness in the risk visualisation. This is identical to what we saw at the detractor survey scores. The visualisation may be perceived as simplistic and a legal expert may still be perceived as significantly more trustworthy than a graph. It is mainly because in cases where a question or another matter is not predicted in the visualisation, a legal expert can provide an immediate answer.

The topic of end user trustworthiness is important to show how end users trust on a micro level the explanation of risk involved in their decision but also to show what is their legal position on a macro level in the contracting process, relative to negotiating strength, which may assist with strategic negotiating considerations.

4.5.2 Risk Visualisation

The survey is also useful for (1) how the entities relate to each other and (2) extracting information in relation to the enriched bow-tie visualisation. The comments focussed on (1) the conceptualisation, (2) the use of the bow-tie analysis, and (3) the visualisation. Even though *optimising* the visualisation was beyond the scope of this research, the observation gave a first insight into the intricacies we will face in this new way of representing legal information.

For instance, first some survey participants claimed that eventually the visualisation can be utilised for practical contracting, yet they were uncertain whether this type of visualisation fits every scenario. Second, a user requested a clearer and perhaps easier visualisation of risk to achieve higher understandability for non-legal experts. Third, a user questioned how the visualisation changes, depending on the fluctuations in the selection of answers or during the contract execution phase. As for the bow-tie analysis, users found the analysis aspect of the bow-tie detailed. A user with a legal background expressed that the analysis could be extended with more information for a greater level of protection. A second user found the analysis to be assumptive. Whatever the case, all users found the analysis worthwhile sufficiently secure, and trustworthy. Even though we are testing the conceptualisation and not the visualisation *per se*, some users also provided useful feedback in that direction. A participant supported the need for user experience improvements regarding the visual representation, introducing an idea for dynamically adjustable user interface changes depending on personalised options. The risk visualisation needs to rely on a robust risk data anlaysis in order for the right data foundations to be in place. Beyond the risk data analysis, a larger risk management process should be in place to facilitate the iContracts process.

4.5.3 Net Promoter Score

The Net Promoter Score helps us examine the degree to which an end user is willing to adopt a new technology, based on their willingness to introduce such new way of working to colleagues. The NPS of minus twenty one (-21) is considered low NPS, especially in the field of software (see relevant benchmarks [11]). It is therefore obvious that a significant amount of improvements is necessary to increase the NPS to an acceptable rate, which in the case of software is 41 and above [12].

We attribute the main reason supporting such NPS score to the unclarity and complex nature of the visualisation, especially for non-legal experts. A second reason behind this NPS rating is that NPS ratings are usually calculated on the basis of full fledged software solutions, while in our survey, we only presented a scientific "feature" to end users. Despite the low NPS, the end user feedback and reactions are significant to identify how to improve further the risk visualisation and it is a necessary milestone for further progress. Consequently, following the improvement of the visualisation as well as further research it is necessary to conduct more surveys and research on this topic. So far, the NPS is not satisfactory.

We may arrive to the same thoughts after examining the secondary metrics regarding the levels of productivity, anxiety and satisfaction against the NPS rating. Despite the general positive end user reaction on such secondary metrics, when examined comparatively, especially against the NPS standard, we find that significant work is required to improve such end user ratings.

4.6 Chapter Conclusion

Section 4.6 provides the research conclusion by answering RQ3 in Subsection 4.6.1, mentioning the research novelty (the Enriched Bow-Tie Ontology) in Subsection 4.6.2, and offering further research suggestions in Subsection 4.6.3.

4.6.1 Answer to RQ3

RQ3 reads as follows:

> **RQ3:** *To what extent is it possible to improve user trustworthiness for Intelligent Contracts via the visualisation of risk during legal question-answering?*

The answer to RQ3 is that user trustworthiness *can only be relatively improved* to the extent that the visualisation of risk is *sufficiently explainable* for end users;

[11] https://delighted.com/nps-benchmarks
[12] https://delighted.com/nps-benchmarks

yet at this moment not to a sufficient degree for end users to project a sufficient NPS. We measured the scores by a practical test and found a reward factor of seven point nine (in a scale from one to ten) based on risk explanation via the use of the Enriched Bow-Tie Ontology. There is, still, sufficient space for increasing the trustworthiness by further improving the risk visualisation from the users' perspective. Beyond the positive impact on trustworthiness, end users found added benefits to their levels of productivity, anxiety and satisfaction, motivating them to refer this way of working to their peers.

Finally, we remark that the reason for the detractor scores mostly relates to personal user expectations and lack of trust for computers more generally than only this survey in relation to matters related to risk. Therefore, it is expected for this starting point that certain users will continue to display a low level of trustworthiness even with follow up improvements.

4.6.2 Research Novelty

At the end we reiterate the contribution of our research in at least four areas. First of all, it clarifies how it is possible to visualise the Enriched Bow-Tie Ontology. Second, it adds the perspective of risk visualisation to the user-friendliness and trustworthiness discussion on contract automation domain. Third, it specifically shows how risk visualisation can improve the trustworthiness of the iContracts domain. Fourth, it shows how it is possible to measure user reactions from divergent user backgrounds, with an explorative survey.

4.6.3 Further Research

For any further research, we are above all interested in (1) conducting a larger scale survey to achieve higher statistical significance and (2) implementing the Enriched Bow-Tie Ontology in larger case studies to examine practical application matters.

CRediT Author Statement

Below I would like to give credit to all persons involved.

Stathis, G., Trantas, A., Biagioni, G., and van den Herik, H. J. (2023c). Risk Visualisation for Trustworthy Intelligent Contracts. *In the Proceedings of the 21st International Industrial Simulation Conference (ISC), EUROSIS-ETI*, pages 53–57

Stathis, G.: Conceptualization, Methodology, Writing - Original Draft, Investigation, Visualization, Validation, Project Administration, Data Curation, Funding Acquisition, Writing - Review & Editing; **Trantas, A.**: Conceptualization, Methodology, Investigation, Writing - Original Draft, Writing - Review & Editing; **Biagioni, G.**: Conceptualization, Methodology, Validation, Investigation, Visualization, Writing - Review & Editing; **van den Herik, H.J.**: Writing - Review & Editing, Supervision.