



Artificial Intelligence and Automation Impacts for the Future of Negotiation

Pedro B. Agua^{1*}, Anacleto Correia¹, and Armindo Frias^{1,2}

¹ CINAV, Escola Naval, Instituto Universitário Militar, Base Naval de Lisboa, Almada, Portugal

² Advance/CSG, ISEG-Universidade de Lisboa, Portugal

Abstract

Since the dawn of time, negotiation has been the way human societies have interacted, transitioned, and prospered. The Latin word *negotium*, which literally means 'the negation of *otium*' or 'the negation of leisure', is also related to the word 'business'. Societies and organizations that perfected the way to negotiate prospered or captured the most value available at any deal, while others did not. For a long time, the negotiation capabilities remained solely with individuals. Artificial Intelligence (AI), however, has been invading all spheres of human existence, with potentially positive and negative impacts. Consequently, automated negotiations have become a reality, despite being just in their early stages. Aside from the effective evolution of *Negotiation Support Systems* (NSS), the *Age of Negobots*, or automatic negotiation agents, is gaining traction and may have an unexpected impact on all aspects of life. It is not difficult to imagine the economic impacts of powerful algorithms conducting automated negotiations on behalf of humans, organizations, or States, while analysing massive volumes of historical and real-time data, which provides an advantage for the most performing ones. The purpose of this paper is to provide an application of a framework to identify and rate potentially disruptive technologies, achieving this goal by drawing a parallel between the assessment of potential disruptive technologies and the taxonomy concepts used by biologists and naturalists to evaluate species. A framework that incorporates fifteen critical variables across five dimensions was applied and preliminary results suggest that such framework effectively helps in assessing the potential impact of disruptive technologies. Notably, it was found that variables with the highest scores play a crucial role in shaping current and future global affairs across all spheres of human activity.

Keywords: Artificial Intelligence, Automation, Emergent Disruptive Technologies, Framework, Negotiation

1. Introduction

Negotiation automation has been evolving and supported by software, such as Negotiation Support Systems (NSS), negotiation agents, or just training software packages, with the simpler ones providing help or even training to help develop people's skills in negotiation matters. However, the development of Artificial Intelligence (AI) is a reality and is changing the whole paradigm, involving negotiation support systems, potentially towards a new age full of negotiation automation and negotiation agents. Therefore, it is important to consider the potential impacts of these technologies on all aspects of human life. AI and its various variations, as well as many applications, have a clear potential for disruption, making them an emerging disruptive technology (EDT).

Inspired by Negotiation Support Systems (NSS) concepts, the development of negobots, negotiation agents, and automated negotiation is becoming a reality. As the saying goes, life is negotiation, which makes it simultaneously an art and science, that most impacts humankind's lives in both the personal and professional spheres (Raiffa, 1982). Negobots and negotiation agents may replace a significant portion of human activity, giving organizations and individuals equipped with the most advanced AI and machine learning algorithms a competitive advantage. Due to human cognitive limitations (memory and processing), it is not difficult to imagine how unbalanced the competitive field may be when humans will have to compete with powerful machines.

Negotiation agents have various advantages over humans. To be specific, negotiation agents have the following advantages: (1) speed and efficiency, as they can process huge amounts of information and make decisions quicker than humans; (2) consistency, as they strictly comply with predefined goals and rules and will have no fatigue, bias, or succumb to emotions during negotiations, hence increasing outcomes predictability; (3) lacking emotions, and as such, these agents are not influenced by situations of frustration, anger, or excitement, leading to more objective decisions; (4) objective analysis, where agents can analyse negotiation information and outcomes objectively, without being misled by personal biases or subjectivities, hence increasing assessments accuracy. Negotiation agents also have learning algorithms that enable them to learn and adapt their strategic standing dynamically in almost real-time, which can lead to better negotiation outcomes (Beam & Segev, 1997; DeChurch et al., 2010).

Knowing the competitive nature of humankind in general, which has been behind the seeds of progress, it would be naive to assume "markets will tend to equilibrium, and everything will be fine," in reaching a more inclusive world. In parallel with the automation of negotiation, the development and possible normalization of quantum computing may have an even greater impact on this situation as we progress towards the singularity (Kurzweil, 2005; Boden, 2018). The nations and organizations that get first to a critical level of quantum computing may gather the potential to gain the first mover advantage, thereby acquiring a competitive positioning without precedents—perhaps at the level of the winner takes all.

The Latin term *negotium*, which literally means the negation of *otium*, or negation of laziness, is the origin of the word negotiation. The concept is itself related to the word 'business' as the later results from joining busy and -ness, thus conveying the meaning of being busy or pursuing one's aims as opposed to "busiless", an old English word that is associated with laziness and is not normally used nowadays, but which William Shakespeare often used across his works (Dyce, 1857). Therefore, negotiation has probably been the most impactful driver of commercial trade and human development throughout the ages, both economically and politically, including the avoided and non-avoided conflicts across all humankind's history.

Moreover, negotiation is perhaps the most eclectic field of human knowledge and action. It is impossible to identify a self-contained knowledge field that maps the extremely broad concepts associated with negotiation. Negotiation spans all humankind's knowledge fields, from soft skills to hard skills, from psychology and sociology to management, decision theory or mathematics, logic, economics, finance, and biology, among several others.

Negotiation used to be the main force behind most goods and services traded, and it still is in some geographies. Throughout history, the balance across global trade, industries, and societies was dependent on the way such entities negotiated. Negotiation itself is a blend of art and science; however, AI, machine learning, negobots, and negotiation agents will most likely change the traditional balance, introducing new dynamics and pushing some organizations, regardless of whether they are countries, governments, industries, or companies, into new competitive paradigms—some becoming winners and some others, losers. This concept is not new; however, what is new is that the new paradigm, which takes advantage of processing power of machines over humans' current limited cognitive limitations, may marginalize some parties to unprecedented paradigms. If societies aim to tackle sustainability, they must exercise caution, do adequate research, analysis, and ultimately drive policy design efforts to avert potentially catastrophic risks.

In William Shakespeare's *Merchant of Venice* masterpiece, the sentence "He is well paid that is well satisfied" is associated with the ultimate goal of negotiation (Shakespeare, 2005). Negotiation has been a game of satisfaction from which further human motivation originated or self-reinforced itself, regardless of the context. Such satisfaction may now vanish with the advent of machines, as the relationships between human beings and machines are quite different from the relationships between two human agents. Therefore, without embracing futuristic 'meta-human' concepts, humans may not be able to match machines in terms of memory, processing capacity, and velocity during negotiation processes, potentially removing human satisfaction from the equation. All this legitimacy raises the following questions: What role do humans play in these negotiations? How will we handle ethics in the negotiation process with machines? What will be the role of trust between human and machines?

For instance, in the realm of negotiation strategy and tactics, if humans can still outperform machines in the early stages of these technologies' deployment, it's likely due to their creativity. However, this will not last long, as machine learning algorithms are capable of capturing all the nuances humans may prompt them during the interaction processes, thereby facilitating machine learning. Furthermore, such AI negotiation agents do not learn only from a single negotiation; they may access millions or even billions of negotiations in order to learn from them on how to keep an edge over human negotiators. Moreover, when it comes to negotiation strategies and tactics, there are subcategories that tend to be associated with different negotiation contexts, such as, for instance, negotiation in a procurement context or negotiation in an intercultural context, to mention just two from a broad set of categories (Brett, 2014; Água et al., 2021; Água et al., 2022). With the further development of AI and negotiation agents, all the knowledge and typical strategic approaches, tactics, and countertactics specific of a particular negotiation context or subcategory, can be part of a possibly enormous database of known strategies and tactics grouped by categories, against which machines will have no match from the side of humans, as they can access all this information in a fraction of a second. Real-time negotiation agents can automatically and dynamically generate some key classical concepts in negotiation, such as the Zone of Potential Agreements (ZOPA), negotiation bands, or Pareto curves, surpassing human capabilities (Raiffa, 1982; Lax & Sebenius, 1986; Fisher & Ury, 1991; Shell, 1999; Raiffa et al., 2002; Dietmer & Kaplan, 2004).

Having stated the subject and associated problems, how can one assess the disruptive potential of such technology? This article is based on the application of a five-dimensional and fifteen-variable framework to assess potentially disruptive technologies (Bartolomeu & Gua, 2023). It follows the IMRaD structure (Introduction, Methods, Results, and Discussion). Therefore, after this introduction, Section two introduces the methodology and the mentioned framework. Section three provides the results of applying the framework to the potentially disruptive technology under consideration. Section four concludes this paper by presenting a discussion on the main subject.

2. Methods

Assessing a potentially disruptive technology can be made in a similar way biologists and naturalists assess species using taxonomy concepts. Systemics, a closely related concept used to classify and study biodiversity, is a useful one for understanding the role of the framework presented by Bartolomeu & Água (2023). Systematists name and describe species (i.e., taxonomy) while determining the relevant relationships (i.e., phylogenetics). Therefore, the study of organisms' identification, nomenclature, and classification which is known as systematics, actually goes beyond taxonomy and phylogenetics, as it also relates to the study of how the evolution of organisms' relationships develops. Systematics has classified organisms into various 'kingdoms', which serves as an underlying concept in this framework for assessing potentially disruptive technologies. Alternative analysis techniques supported a critical thinking approach in the development of the framework.

According to the Bartolomeu and Água (2023) framework, fifteen variables are relevant in assessing the potential for disruption associated with any technology. Table 1. summarizes the fifteen critical variables distributed across the five relevant dimensions.

Table 1: Disruption potential scorings

| Dimension | Variable | Scoring Possibilities |
|----------------|------------------------------|-----------------------------------|
| Strategic | Political, <i>P</i> | Null/Moderate/High/ Revolutionary |
| | Economic, <i>E</i> | |
| | Cultural, <i>C</i> | |
| | Legal, <i>L</i> | |
| Operational | Performance, <i>P'</i> | |
| | Congruence, <i>C''</i> | |
| | Opportunity, <i>O</i> | |
| Tactics | Secrecy, <i>S</i> | |
| | TTP | |
| Technical | Performance, <i>P''</i> | |
| | Maturity, <i>M</i> | |
| | Interconnectedness, <i>I</i> | |
| Organizational | Internal Support, <i>IS</i> | |
| | Pacing Gap, <i>PG</i> | |
| | Cost, <i>C'''</i> | |

Source: Bartolomeu and Água (2022)

The proposed framework comprises five dimensions: strategic, operational, tactical, technical, and organizational. Political, economic, cultural, and legal factors serve as variables in the strategic dimension. The operational dimension concerns performance, congruence, and opportunity. As for the tactical dimension, the variables are secrecy, as well as tactics, techniques, and procedures (TTP). The technical dimension considers performance,

maturity, and interconnectedness. Finally, the organizational dimension’s variables are: internal support, pacing gap, and cost. Bartolomeu & Água (2023) provide detailed definitions for all the fifteen listed variables. By assessing how a specific technology scores across these dimensions and variables, the framework aids in classifying the level of impact of the considered technology as: *null*, *moderate*, *high*, or *revolutionary*. The added scores resulting from the potentially disruptive technology assessment, provide an absolute value against a full scale, as per the below equation (Eq. 1). One can, however, provide a perhaps better assessment through visual mapping by making use of some graphical typologies, such as RADAR graphs.

$$Disruptive\ Potential = P + E + C + L + P' + C'' + O + S + TTP + P'' + M + I + IS + PG + C''' \tag{1}$$

Where the characters $P, E, C, L, P', C'', O, S, TTP, P'', M, I, IS, PG, C'''$ represent the fifteen variables in Table 1.

3. Results

Talele 2 summarizes the preliminary scoring of the fifteen critical variables across the five dimensions using the framework from Section 2 as a first approach to assessing the disruption potential for automated negotiation. These scorings were determined by considering the criteria proposed by Bartolomeu & Água (2023).

Table 2: Disruption potential scorings

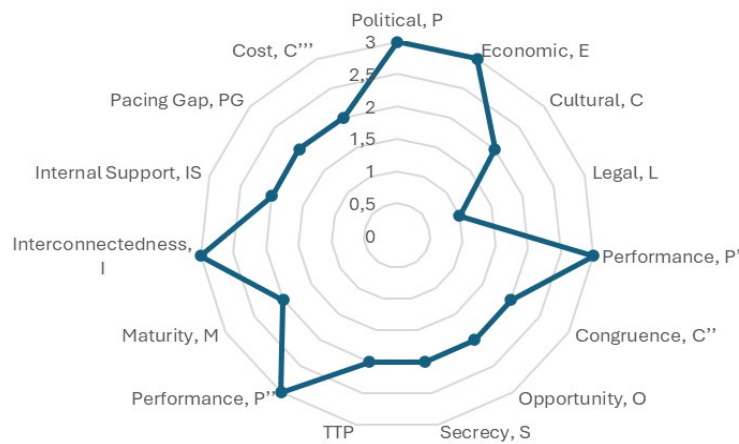
| Dimension | Variable | Scoring | Numerical |
|----------------|-------------------------|----------------------|-----------|
| Strategic | Political, P | <i>Revolutionary</i> | 3 |
| | Economic, E | <i>Revolutionary</i> | 3 |
| | Cultural, C | <i>High</i> | 2 |
| | Legal, L | <i>Moderate</i> | 1 |
| Operational | Performance, P' | <i>Revolutionary</i> | 3 |
| | Congruence, C'' | <i>High</i> | 2 |
| | Opportunity, O | <i>High</i> | 2 |
| Tactics | Secrecy, S | <i>High</i> | 2 |
| | TTP | <i>High</i> | 2 |
| Technical | Performance, P'' | <i>Revolutionary</i> | 3 |
| | Maturity, M | <i>High</i> | 2 |
| | Interconnectedness, I | <i>Revolutionary</i> | 3 |
| Organizational | Internal Support, IS | <i>High</i> | 2 |
| | Pacing Gap, PG | <i>High</i> | 2 |
| | Cost, C''' | <i>High</i> | 2 |

From the scoring in the previous table (Table 2) and associating a numerical scale to such scoring (ex., *null* = 0; *Moderate* = 1; *high* = 2; *Revolutionary* = 3), one can get a first sense regarding the disruptive potential of the assessed technology—the domain of negotiation agents and similar technologies—by using Eq. 1. It is worth noting that technology itself encompasses both the *things*, such as hardware or software, and the necessary *know-how* in using such things. Below, Eq. 2 displays the overall value alone.

$$Disruptive\ Potential = 3+3+2+1+3+2+2+2+2+3+2+3+2+2+2 = 34 \tag{2}$$

Confronting this value, 34, against the full scale (which would be a maximum of 45 = 15 variables x 3), provides a first rating of the disruption potential of this technology. Another way to understand the impact could be by using a 100-point scale, for example: 0–24% is not relevant (*null*); 25–49% means it is moderately relevant (*moderate*); 50–74% is a relevant score (*relevant*); and 75–100% is highly relevant (*revolutionary*). Moreover, other tools like the RADAR graph (Figure 1) can further complement this assessment. Figure 1 provides a graphical view mapping the overall scoring of the fifteen considered variables, hence calling attention to the variables that need more attention. According to Pareto analysis, some variables or parameters are more relevant than others, which may indicate where one should focus more attention and analysis effort.

Figure 1: RADAR graph showing the fifteen critical variables regarding the technology under assessment



Source: Authors

4. Discussion

The suggested framework for evaluating the impact of automated negotiation as a potentially disruptive technology serves as a valuable tool for informing policymakers, business, and industry leaders, and may be a support for decision making concerning a range of strategic options, from technology investment, capability development, among others.

Machine learning and AI, both support the evolution of automated negotiation, according to this preliminary application of the framework. Negotiation support systems, negobots, and automated negotiation are already a reality. This first analysis used the authors' experience across the domains of negotiation, machine learning, and AI. Clearly, additional analyses are required to confirm the results, particularly involving subject matter experts (SMEs) across industries and knowledge domains. In-depth interviews are the most appropriate means of validation in this case, although statistical analysis is important due to the uncertainty associated with the nature of negotiations (Boyce & Neale, 2006).

The preliminary results suggest a score of 34 over a maximum of 45, which may be considered highly relevant, given that 34 over a maximum range of 45 is comparable to 75.6% on a 100-point scale. However, as suggested before, perhaps a sole and absolute number does not fully clarify the disruptive potential one is facing when assessing a specific technology, nor even a percentage would do. Therefore, graphical representations like the RADAR graph could be more beneficial in clarifying the potential for disruption of the technology under evaluation, particularly in terms of its critical variables and dimensions.

The rating given to each of the critical variables has room for improvement or refining, as, for instance, not all variables might have the same understanding depending on the context and

businesses. For instance, security or defence contexts often rate the variable secrecy (tactical dimension) highly, while commercial and economic contexts, where its widespread adoption is just beginning, may rate it as revolutionary. This means that there is always a certain range of subjectivity inherent to the context and fields of human activity, as well as the application of these technologies.

Overall, and as a first step, one can realize that the variables with the highest scores, hence having revolutionary potential for disruption, are critical for current and future world affairs across any sphere of human activity, professional, societal, or personal: political, economic, interconnectedness, and performance (both operational and technical). As anticipated, a scarcity of null scores among the fifteen assessment parameters was discovered - a phenomenon consistent with the disruption concept's nature. Therefore, in the context of automated negotiation technologies, all parameters received scores ranging from 1 to 3, with a majority falling between 2 and 3. Moreover, the resulting assessment of the application of the suggested framework is not a one-time static one, as the world dynamics rooted in innovation dictate continuous changes. Therefore, it would be advisable to periodically repeat any assessment using this framework on the same technology, as the context, endeavour, technologies, or policies dynamically change over time.

5. Conclusion

The world is facing a disruptive revolution that may only be comparable to the discovery of fire. Many distinct technologies are fostering this revolution, but machine learning and artificial intelligence may have the highest potential for disruption, even challenging the current human, economic and social paradigms. Besides affecting almost all human spheres of activity, from personal to professional contexts, it may have a considerable disruptive impact on negotiation due to the automation of negotiation. Such disruption begins with the introduction of *negobots*, and the emergence of automated negotiation agents which have the potential to eliminate human involvement from the process. This holds significance not only in the fields of economics, management, government, and public affairs, but also in the defence and security domains.

This article is a first approach to assessing automated negotiation as a potentially disruptive technology, using the referred framework to assess potentially disruptive technologies in business in general. Further research may involve either subject matter experts in both the fields of negotiation, machine learning, and artificial intelligence, or the deployment of a questionnaire for statistical validity purposes in order to capture a general understanding of the disruptive potential of these technologies as perceived across industries. Most likely, the future of negotiation in the long term will use only machines negotiating with machines under established protocols. Such protocols are part of algorithms, and such algorithms may potentially evolve without human intervention and use complex programming structures beyond human understanding, hence contributing to *the singularity* paradigm.

Acknowledgment

The authors would like to acknowledge the support of the Portuguese Navy Research Centre (CINAV), the EEA Grants and Blue Growth via the PT-INN-0066 – M4ML project.

References

- Agua, P. B., Correia, A., & Frias, A. (2021). Strategic Procurement Negotiation. In L. Wood & L. Duong (Eds.), *Logistics and Supply Chain Management in the Globalized Business Era*. IGI Editions. doi: 10.4018/978-1-7998-8709-6.ch001.
- Agua, P. B., Frias, A. S., & Correia, A. (2022). Negotiating Across Cultures: Insights for the 21st Century. In R. Perez-Uribe, C. Salcedo-Perez, & A. Carvajal-Contreras (Eds.), *Handbook of Research on Organizational Sustainability in Turbulent Economies* (pp. 247-265). IGI Global. doi:10.4018/978-1-7998-9301-1.ch014.
- Bartolomeu, J., and Água, P. (2023). A Framework For Assessing the Impact of Potential Disruptive Technologies in Business, *Proceedings in Human Interaction & Emerging Technologies*. Nice, France, pp. 651 – 661. doi:10.54941/ahfe1004072.
- Beam, C., & Segev, A. (1997). Automated Negotiations: A Survey of the State of the Art. *Wirtschaftsinf*, vol. 39, no. 3, pp. 263-268.
- Boden, M. A. (2018) *The Singularity, in Artificial Intelligence: A Very Short Introduction*. Oxford, United Kingdom: Oxford University Press.
- Boyce, C., and Neale, P. (2006). *Conducting In-Depth Interviews: A guide for Designing and Conducting In-Depth Interviews for valuation Input*. Watertown, Pathfinder International.
- Brett, J. (2014). *Negotiating Globally. How to Negotiate Deals, Resolve Disputes, and Make Decisions Across Cultural Boundaries*. San Francisco, CA: Jossey-Bass.
- DeChurch, L., Wang, N., & Wood, R. W. (2010). Using automated agents to study strategies in human negotiation. *Group Decision and Negotiation*, vol. 19, no. 1, pp. 5-21.
- Dietmer, D., and Kaplan, R. (2004). *Strategic Negotiation*. Chicago, IL: Dearborn Trade Publishing.
- Dyce, A. (1857). *The Works of William Shakespear*, London, United Kingdom: Edward Moxon.
- Fisher, R., Ury, W. (1991). *Getting to Yes. Negotiating Agreement Without Givin In*. New York, NY: Penguin Books.
- Kurzweil, R. (2005). *The singularity is near*. London, UK: Duckworth Publishers.
- Lax, D., and Sebenius, J. (1986). *The Manager as Negotiator. Bargaining for Cooperation and Competitive Gain*. New York, NY: The Free press.
- Raiffa, H. (1982). *The Art and Science of Negotiation. How to Resolve Conflicts and Get the Best Out of Bargaining*. Cambridge, MA: Harvard University Press.
- Raiffa, H., Richardson, J., and Metcalfe, D. (2002). *Negotiation Analysis. The Science and Art of Collaborative Decision Making*. Cambridge, MA: Harvard University Press.
- Shakespeare, W. (2005). *The Merchant of Venice*, San Diego, CA: ICON Group International, pp. 102.
- Shell, R. (1999). *Bargaining for Advantage. Negotiation Strategies for Reasonable People*. London, United Kingdom: Penguin Books.