Exploring Semantic Relationships in Online Negotiations: A Computational Analysis of Post-pandemic Linguistic Trends and Perceptions

Liana STANCA
Babeș-Bolyai University Cluj-Napoca, Romania
liana.stanca@ubbcluj.ro

Luiela Magdalena CSORBA
Aurel Vlaicu University, Arad, Romania
luiela.csorba@uav.ro

Dan-Cristian DABIJA[*]
Babeș-Bolyai University Cluj-Napoca, Romania
[*]*Corresponding author, dan.dabija@ubbcluj.ro*

Abstract. *In the wake of the COVID-19 pandemic, online negotiations have become a central site of professional transformation, reflecting broader changes in organizational communication and decision-making practices. This research investigates how accelerated digitization has reshaped the discursive landscape of negotiation by analyzing semantic patterns through advanced natural language processing techniques, including N-gram modeling and co-occurrence network analysis. Drawing on a corpus of qualitative interview data from interviews with managerial-level participants involved in online negotiation, the results reveal important linguistic trends - in particular the importance of online negotiation as a dominant theme and its frequent juxtaposition with traditional face-to-face formats. Semantic network mapping exposes robust interconnections between key constructs, suggesting a cognitive reframing of negotiation logics in digital environments. The study contributes to the emerging body of knowledge about digital discourse in professional contexts by providing empirical insights into how global disruptions catalyze linguistic and conceptual change. These findings lay the foundation for future interdisciplinary investigations of language, technology, and negotiation dynamics in post-pandemic organizational contexts.*

Keywords: online negotiation, digitalization, processing natural language in negotiation, co-occurrence network analysis, clusters.

Introduction

The effects of the COVID-19 pandemic are being felt in almost all areas of activity, with the negotiations sector undergoing radical transformations driven by the need to implement and use audio-visual communication/negotiation technologies specific to the digital environment. These digital tools have led to the spread of teleworking, which has forced most of the world's population to adopt online communication. The pandemic has passed, but its effects have not yet. Adapting to new ways of communicating and negotiating is essential for maintaining business ties and securing favorable contracts (Hernandez et al., 2021).

People and organizations have had to adapt quickly to the challenges and transformations brought by online negotiations, and to learn how to make the most efficient use of all the tools in the digital environment to stay connected with everyone else, regardless of the field they are working in. Negotiations in the digital environment are a challenge for the historical stage that

mankind is going through, and familiarizing oneself with them has the major advantage of leading to better time management and substantial financial savings. At the same time, the correct use of online negotiation tools is the key to the development and expansion of interpersonal and professional relationships.

There is very little research in literature that addresses the experiences, motivations, challenges and perceptions related to the transition from face-to-face to digital negotiation formats. For this reason, the analysis intends to fill the literature gap and to trace the active involvement of managers in online negotiation processes in the pandemic and post-pandemic period, as well as the diversity in terms of organizational size and scope of activity, i.e. how these online negotiations have evolved in the sector in which each interview participant operates.

Although the sample size chosen in this research is small, it is justified by the exploratory nature of the study which aims to gain a deeper understanding of the issues mentioned above. To this end, data is collected using the semi-structured interview, an approach that ensures internal validity and practical relevance for a small and homogeneous sample of 36 respondents, such as the one targeted in this paper. In this way a solid basis for analyzing and interpreting the results can be obtained. Data analysis comprised linguistic cleaning of the transcripts and standardized textual pre-processing, including tokenization, stop-word removal, lemmatization and vectorization using the TF-IDF method (*Term Frequency-Inverse Document Frequency*). The final research aim is to analyze in depth the respondents' active involvement in online negotiation processes, both during the pandemic and post-pandemic period, and how these digital negotiations have evolved in the sector in which each interviewee works.

The paper is structured in the following way: after the introductory section there is a literature review, followed by the research methodology. The second part presents the results, discussions and conclusions of the research.

Literature review

Negotiation is a dialog between two or more people with the goal of reaching a consensus, i.e., establishing a mutually beneficial agreement that addresses and resolves the different aspects of a business (Lee et al., 2022). Moreover, negotiation is also a way of resolving conflicts that are highly likely to arise in the business environment, as it is a tool through which relationships are built between the participants in the process, and solutions are sought for obstacles encountered.

In recent years, the negotiation process has undergone various mutations and transformations, evolving in a lightning-fast way, a trend that can be seen from the perspective of several stages: from collaborative negotiation (1974-1981) (Jensen & Unt, 2002) to the principled negotiation (1982-1997) (Fisher & Ury, 2011), then to the expansions of principled negotiation (1998) (Cellich & Jain, 2003) to today's increasingly widespread use of artificial intelligence, AI being able to model and simulate various negotiation scenarios (Li, 2024). These profound and rapid mutations stem not only from the need to move online driven by the evolution of technology, but the COVID-19 pandemic has also reshaped the sector, forcing it to adopt the online negotiation variant not only for periods of epidemic restrictions, but also beyond. In addition to these trends, the internationalization of business is also taking place, which means that the business environment is increasingly expanding its influence in global markets, making the process more difficult not only in terms of the way of communication, but also in terms of cultural barriers (Dobre, 2021; Danciu, 2010). The Internet facilitates global communication, and the field of online negotiations has started to develop more and more because of the place occupied by digitalization in contemporary society.

The advantages and disadvantages of online negotiation include information provided, overcoming distance and the organizational barriers, attractive and more accessible extension towards face-to-face negotiations, diminished hostility, avoidance of unwanted relationships (Dobre, 2021). Of course, online negotiations also have several disadvantages, including sometimes overwhelming character, limited privacy, difficulty of forming personal relationships with the partners, problems in generating multiplication effects (Dobre, 2021) etc. Because during negotiations there can be a difference between how the negotiating participants intend to react and how they behave, the following key elements have been formulated for the parties involved in the process to keep in mind (Fisher & Ury, 1981):

- the participants (must be separated from the problem to be solved). Each participant should aim not only to gain from the negotiation process, but also to build lasting friendships with others.
- the interest of the negotiation (the focus should be on the final aim of the negotiation, not on the position of each participant in the dialogue);
- options/benefits (must be mutual). For both sides to benefit from the process, all obstacles need to be removed (no misjudgments, no single solution to the issues raised, etc.);
- criteria (it is recommended to emphasize objective criteria). The negotiation process must respect ethical criteria to generate real, fair results.

To these key elements must be added the transformations that have taken place in the field of online negotiations because of the influence of the COVID-19 pandemic, which has generated changes in both organizational communication and managers' decision-making practices. The transformations in the contemporary business environment have caused the role of negotiation in business to evolve towards a new model of organizations where teamwork and cooperation are the two elements on which the functioning of organizations depends (Malutan, 2024).

The business environment is a global one, which is why international negotiations are conducted by representatives appointed by firms, institutions, corporations, governments, etc. (Moore et al., 2021). These representatives, even if they speak English, it is not always native to the participants, so to avoid misinterpretation or distortion, attention must be paid to the semantic patterns or approaches of the language, which is why interpreters are often used in the negotiation process. Globally there is a great diversity of languages spoken, but English is the most used language in digital negotiations (Kusumaningputri, 2023). However, it has different nuances and connotations, which is why semantic coordination of dialog is necessary (Kabbach & Herbelot, 2021). Dialogue alignment is not only an outcome of successful human interaction, but also a communication resource exploited by interlocutors in converging to a semantic pattern.

Dialogue coordination mechanisms are relevant to explain how semantic coordination is achieved (Mills & Healey, 2008; Song et al., 2020). Correct and effective communication in the online environment (and beyond) requires skill, talent, competence, skills, and finally, a lot of experience. Negotiation and communication skills to overcome conflict/crises management are soft skills that require certain competencies that organizations are increasingly demanding from their employees. Crisis and conflict management and negotiations are based on language and behavior variables, theoretical models and characteristics. A model such as natural language is a key variable in conflict management, because linguistic choices may reflect factors such as context, individual characteristics, and interpersonal attitudes of representatives in negotiations (Pacella & Marocco, 2022).

Natural language processing (NLP) is a sub-domain of artificial intelligence (AI), computer science, and linguistics, in which computers can understand, generate and manipulate human

language (Jurafsky & Martin, 2023). Due to the existence of natural language, a computer can understand not only the content of documents, but also the contextual nuances of the language used. NLP is the underlying technology behind virtual assistants, a technology that began to develop in the 1950s, after the invention of digital computers, and is based on both linguistics and AI (Turing, 1950; Jurafsky & Martin, 2023). In the field of negotiations, a sector that uses natural language processing, NLP is used to analyze customer opinions and comments, which leads to the evaluation of customer sentiment, with benefits on increasing customer satisfaction and company revenue (Voss, 2016).

At the same time NLP can analyze the language of the company's customers, managing their wishes more effectively. The most well-known typical use cases of NLP are sentiment analysis, chatbot, machine translation, text categorization, spell checking, keyword searching, question answering, spam detection, etc. (Anwar et al., 2024). The implementation of NLP in the negotiation process can improve negotiation skills and the person's ability to channel the whole process towards the desired direction by better connecting to all participants present, create the possibility of raising objections to change the perspective of the dialog and the ultimate goal pursued, simultaneously reducing the risk of human error and simplifying the negotiation process (Li, 2024).

Among text analysis methods that incorporate the visualization of graphs of potential relationships that may exist between individuals, organizations, concepts, etc. is the semantic network or co-occurrence networks (Goberna &Verdu, 2022). Co-occurrence networks are a method of analyzing entities of the same type by identifying hidden connections and subgroups of entities that work together to achieve a particular goal. The construction process of a co-occurrence network includes the identification of key words in the text, the calculation of the frequency of co-occurrence, and the analysis of the network to find central words and themes in the network (Elad, 2020). A co-occurrence is the simultaneous existence of more than two linguistic entities in the same context (Sinclair, 1991).

Research methodology

To examine in-depth the experiences, motivations, challenges and perceptions related to the transition to the digital format of negotiations, this research adopted a qualitative exploratory approach, suitable for investigating emerging and under-theorized phenomena. The primary method of data collection was the semi-structured interview, selected for its ability to capture discursive nuances and provide flexibility in exploring emergent topics.

The research was carried out on a purposive sampling sample of 36 respondents in managerial positions in service sector organizations. This approach was chosen to ensure data relevance and depth, in line with recommendations in the literature (Raiffa, 1982; 2007; Manning et al., 2008) which emphasize that small samples are particularly suitable in qualitative research that relies on in-depth interviews, allowing for a detailed analysis of context-specific decision-making processes and motivational factors. Purposive selection of participants, especially when they have direct experience in the field under study, can provide unique and essential insights for understanding complex phenomena (Gonzalez-Feliu, 2015).

The robustness of this approach is supported by the literature (Bazerman & Neale, 1992) which shows that in negotiation and conflict resolution research, small and homogeneous samples allow the identification of relevant behavioral patterns. Thematic saturation, which indicates the point at which new data no longer provides significant additional information, can also be achieved with a small number of participants when interviews are well structured (Guest et al., 2006). The

chosen approach therefore ensures internal validity and practical relevance, providing a solid basis for analyzing and interpreting the results. Inclusion criteria focused on active involvement in online negotiation processes during the pandemic and post-pandemic period, diversity in terms of organizational size and scope of activity, and how these online negotiations have evolved in the sector in which they operate. Although the sample size is small, this is justified by the exploratory nature of the study, which aims at depth of understanding rather than statistical generalizability.

The research instrument used was an interview guide consisting of five open-ended questions designed to investigate:
(1) level of professional negotiation experience, with a focus on digital format.
(2) internal and external factors that have driven the transition to online negotiations;
(3) challenges encountered and coping strategies;
(4) perceptions of the evolution and relevance of online negotiations;
(5) the role of digital technologies in shaping the efficiency and outcomes of the negotiation process.

Interviews were conducted in hybrid format (online and face-to-face), depending on the availability of participants. All interviews were audio-recorded with the express consent of the respondents, fully transcribed and anonymized by assigning numerical identification codes, in accordance with the ethical principles of qualitative research.

The data analysis process was systematic, including linguistic cleaning of transcripts and standardized textual preprocessing. This included tokenization, removal of stop words, lemmatization and vectorization using the Term Frequency-Inverse Document Frequency (TF-IDF) method (Blei et al., 2003) to highlight the contextual relevance of the terms. In parallel, frequent N-gram analysis (Jurafsky & Martin, 2023) identified recurrent concepts and phrases, such as 'online negotiations' or 'negotiations have become', which reflect the main themes in the responses. This step provided an in-depth understanding of linguistic trends and common modes of expression, complementing the information obtained by TF-ID vectorization.

Reducing dimensionality and facilitating the identification of latent patterns in the textual corpus, Principal Component Analysis - PCA (Bengfort et al., 2018) was applied. Subsequently, two unsupervised machine learning methods were used to explore the thematic structure of the discourse. The analysis was performed in two complementary steps. In the first stage, the K-means clustering algorithm (Bishop, 2006; Bishop, 2006; Silge & Robinson, 2017) was used to segment the textual responses into four distinct thematic clusters. The optimal number of clusters was determined by the elbow method and confirmed by the silhouette score, thus ensuring a consistent separation of semantic clusters. To assess the differences between clusters in terms of the amount of information provided, the Kruskal-Wallis test (Kruskal & Wallis, 1952; Bengfort et al., 2018), appropriate for non-parametric distributions, was used.

Despite the relatively small sample size (N = 11), the statistical power of the model remained robust ($1 - \beta = 0.85$), exceeding the conventional threshold of 0.80 and thus supporting the reliability of the reported inferences. These findings underline the consistent internal thematic structure of the corpus around online negotiations and provide a sound empirical basis for further generalizable research in broader digital communication contexts. The analysis tracked variations in response length and key term frequency across clusters. Although the results did not reach the conventional level of statistical significance (H = 6.93, p = 0.047), they revealed marginally significant differences supporting the existence of thematically and semantically relevant variation between clusters, reflecting qualitative rather than quantitative distinctions. Latent Dirichlet Allocation - LDA (Blei et al., 2003) was applied to identify latent themes within the corpus. Each

topic was represented by a probabilistic distribution of relevant terms, and thematic coherence was assessed by topic-term coherence scores to validate the semantic relevance of the extracted structures.

Overall, the applied methodology allows a comprehensive exploration of the transition to online negotiations, providing a thorough understanding of this process from an organizational and individual perspective. The analytical rigor, combined with the interpretative depth provided by the qualitative approach, reinforces the relevance and validity of the results obtained.

Results
Cluster Analysis
The results of the cluster analysis provide a detailed and nuanced understanding of perceptions and experiences of online negotiations, helping to explore the diversity of views and practices in a rapidly transforming field. The uneven distribution of responses across the four clusters identified suggests the existence of distinct segments of organizational actors, each with their own priorities, challenges and perspectives on the transition to the digital format of negotiations.

Cluster 1, entitled 'Practical features of online negotiations' (13.89% of responses), focuses on the application aspects of online negotiations in the business context (Figure 1). The title of this cluster reflects the pragmatic nature of the associated discourse but could be revised to more clearly emphasize its orientation towards operational efficiency and market expansion. The lexical analysis of this cluster highlighted keywords such as 'reach', 'estate', 'business', 'sales' and 'real', indicating a strong focus on the use of online negotiations as a strategic tool for growing and optimizing operations in the service and sales sectors. This cluster has the lowest average sentiment score (0.123), suggesting a more cautious or even critical approach to the effectiveness of digital negotiations.

This trend may be interpreted as reflecting respondents' concerns about the challenges inherent in this format, including (1) the technical difficulties that can arise during online negotiations, (2) the limitations imposed by the lack of access to non-verbal cues in digital communication, and (3) the need to develop effective strategies for maintaining involvement and engagement in prolonged virtual negotiation sessions. From a methodological perspective, this cluster highlights the thematic coherence identified through Latent Dirichlet Allocation (LDA) analysis, where the probabilities associated with the central terms confirmed the semantic relevance of the theme "practicality" in relation to online negotiations. Moreover, the positioning of this cluster in the overall context of the analysis indicates that respondents in this category perceive online negotiations rather as a functional but imperfect solution that requires technical and organizational adjustments to maximize its potential.
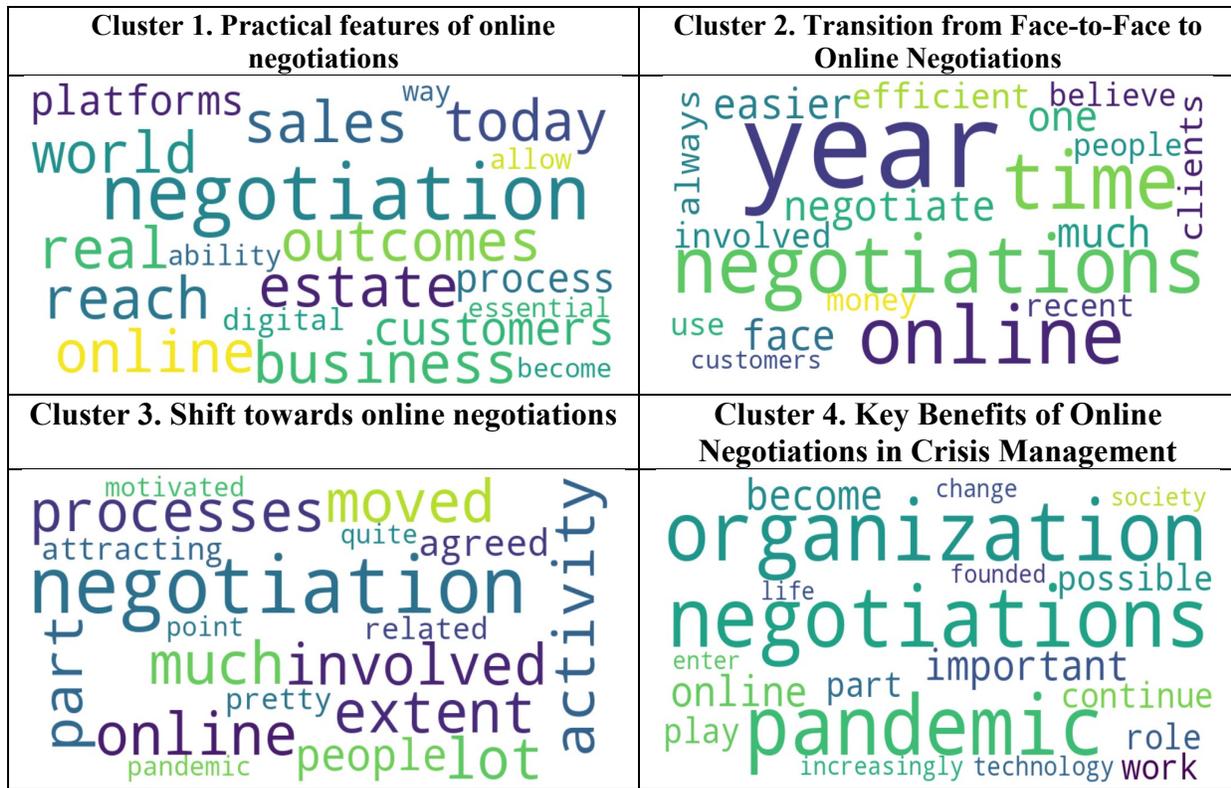
Cluster 1. Practical features of online negotiations	Cluster 2. Transition from Face-to-Face to Online Negotiations

Cluster 3. Shift towards online negotiations	Cluster 4. Key Benefits of Online Negotiations in Crisis Management

Figure 1. Word-cloud of the four clusters

Cluster 2, entitled "Transition from Face-to-Face to Online Negotiations" and representing 47.22% of the responses (Figure 1), highlights the comparative and temporal aspects of the transition from traditional to digital negotiations. Respondents in this cluster perceive online negotiations as a positive development, emphasizing the gains in efficiency and flexibility, highlighted by key terms such as "time", "years", "easier" and "efficient". However, the frequent connection between the terms 'face' and 'online' indicates that the transition is still ongoing, with participants continuing to compare the advantages and limitations of the two formats. Within this cluster, respondents noted the economic benefits of online negotiations, such as the elimination of costs associated with travel and logistics, but also the challenges posed by the need to invest in digital infrastructure and employee training. The transition has also been accelerated by the pandemic context, which acted as a catalyst for the adoption of digital technologies, initially turning a contingency solution into an operational standard.

Another central aspect of this cluster is the impact on interpersonal relationships, where respondents noted difficulties in maintaining trust and managing non-verbal interactions in the digital environment. They emphasized the need to use advanced technologies, such as high-quality video platforms, to replicate face-to-face interactions as closely as possible. In addition, the transition to online negotiations has involved a significant adaptation of the skills needed by negotiators, including both advanced digital skills and the adjustment of traditional techniques to meet the demands of virtual communication. Respondents also highlighted the potential for emerging technologies, such as artificial intelligence and virtual reality, to further transform online negotiations by providing greater personalization of experiences and improving decision-making.

In this context, cluster participants emphasized the value of a hybrid model of negotiation, combining the advantages of online negotiations with face-to-face interactions. Online negotiations are perceived as ideal for recurring interactions and less complex transactions, while the traditional format is considered essential for negotiations requiring a high level of personalization and trust. With a positive sentiment score of 0.182, this cluster reflects a predominantly optimistic and favorable attitude, with participants highlighting the opportunities offered by online negotiations, but also recognizing the challenges that need to be managed to maximize the potential of this format. The transition is perceived not only as a process of adaptation, but also as a strategic opportunity to transform and modernize organizational practices.

Cluster 3, entitled "Shift towards online negotiations" and representing 22.22% of the responses (Figure 1), highlights the systematic transformations and processes involved in adapting negotiations to the digital environment. This cluster reflects an analytical perspective on how online negotiations have transformed traditional practices, and key terms such as 'moved', 'extent', 'activity' and 'processes' suggest a particular interest in understanding the mechanisms of integrating digital technologies into organizational negotiation processes. Respondents in this cluster seem to be actively involved in the adaptation process, focusing on reconciling traditional negotiation practices with the specific requirements of the digital environment.

A central element of Cluster 3 is the integration of traditional techniques with digital tools. Respondents identify the need to maintain fundamental elements of negotiations, such as relationship building, conflict management and adaptability, but also recognize the importance of using emerging technologies to supplement the limitations of the digital environment. For example, video platforms, real-time collaboration systems and document sharing solutions are being used to facilitate negotiation processes and bridge cultural and geographical distances. In this respect, Cluster 3 emphasizes the importance of a hybrid approach, combining the advantages of digital technology with traditional negotiation values. Another key aspect observed in this cluster is the focus on building trust in the digital environment. Respondents recognize that the lack of face-to-face interactions can undermine trust between parties, an essential element in negotiations.

Counteracting this obstacle requires approaches such as information transparency, the use of high-quality technologies for non-verbal language replication and the implementation of clear and frequent communication strategies. Thus, building and maintaining trust in the digital environment is perceived as a vital component of successful online negotiations. Cluster 3 also highlights the need to continuously adapt negotiation processes to maximize the benefits of digital platforms. This adaptation involves not only the use of existing technologies, but also an openness to innovation, such as the adoption of artificial intelligence to analyze information or the use of virtual reality to create more immersive experiences.

Respondents emphasize that negotiation processes need to be flexible, scalable and able to respond to the dynamic challenges of the digital environment. The moderately positive sentiment score associated with this cluster (0.145) indicates a balanced attitude of respondents, who recognize both the benefits and challenges associated with digital negotiations. While efficiency and accessibility are seen as major advantages, respondents draw attention to technical limitations, such as non-verbal communication shortcomings or difficulties in managing cultural differences. Also, the need for continued investment in digital infrastructure and training is seen as essential for successful online negotiations.

Cluster 3 reflects a systematic and adaptation-oriented approach, with respondents exploring both the opportunities and limitations of online negotiations. It highlights the importance of combining digital technologies with traditional negotiation fundamentals, emphasizing that

success in this environment depends on a careful balance between innovation, flexibility and interpersonal skills. In the longer term, Cluster 3 suggests that digital negotiations are not just a temporary solution, but also a strategic opportunity to redefine organizational practices to better respond to global demands and challenges.

Cluster 4, entitled "Key benefits of online negotiations in crisis management" and representing 16.67% of the responses (Figure 1), explores the strategic role and impact of online negotiations in the context of crisis management, with a particular focus on the COVID-19 pandemic period. Key terms such as 'organization', 'pandemic', 'important', and 'become' reflect a clear recognition of the essential contribution that digital negotiations have made in maintaining the operational continuity of organizations in the face of unprecedented constraints. This cluster highlights the transformation of online negotiations from an optional and convenient solution to a strategic necessity, essential for organizations to adapt to the uncertainty and volatility of the global environment.

Central to Cluster 4 is the use of digital negotiations as a tool for organizational resilience in crisis situations. Respondents emphasize that these technologies have enabled organizations to avoid major disruptions to operations by providing an immediate platform for business to continue regardless of physical restrictions imposed. Associated practices include integrating traditional negotiation techniques with digital platforms to ensure a seamless transition, creating new strategies for building trust remotely, and adapting negotiation processes to take full advantage of the flexibility and accessibility offered by the digital environment. In addition to the obvious benefits, respondents in this cluster also recognized the challenges associated with online negotiations in a crisis context.

One of the difficulties reported is maintaining trust between the parties, an essential aspect of negotiation processes, which can be compromised by the lack of face-to-face interactions. Respondents noted solutions such as the use of high-quality video technologies to replicate non-verbal cues and information transparency in digital communication as ways to mitigate these challenges. In addition, respondents emphasized the importance of a continuous process of adaptation and innovation, including not only the use of existing platforms, but also the exploration of emerging applications such as artificial intelligence or real-time data analytics to improve the efficiency and accuracy of negotiations.

Another significant aspect of Cluster 4 is the emphasis on the flexibility and scalability of online negotiations, which have enabled organizations to respond quickly and effectively to the challenges of the global crisis. This flexibility is perceived as a competitive advantage, especially in sectors where rapid adaptation to changing environments is essential. Respondents highlighted those online negotiations enabled organizations to better manage international relations, reduce operational costs associated with face-to-face meetings and expand their partnership networks, even in conditions of economic uncertainty. The sentiment score associated with Cluster 4 (0.146) indicates a moderately positive perception, highlighting a balanced appreciation by respondents of the benefits and challenges of online negotiations. Although, recognizing the constraints associated with this format, participants emphasize that digital negotiations have become an indispensable component of organizational crisis management strategies. In conclusion, Cluster 4 provides a clear insight into the strategic potential of online negotiations, not only as a response to crises, but also as a long-term transformational tool to increase the resilience, efficiency and adaptability of organizations in the face of an increasingly complex and dynamic business environment.

The analysis continued by exploring the structure of the data and the relationships between the responses, applying principal component analysis (PCA). Figure 3 illustrates the distribution

of responses in the PCA space, colored by cluster. This visual representation highlights how the responses are grouped based on their similarities, providing additional information about the separation and internal coherence of the clusters.
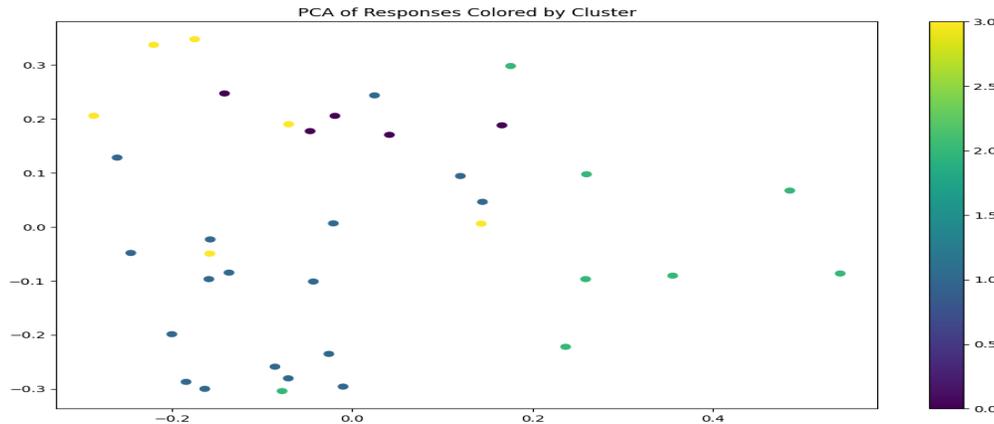
Figure 2. PCA of responses

It can be observed that some clusters seem to show a higher degree of homogeneity, which may indicate a high level of similarity between answers. On the other hand, there are clusters in which the responses are more dispersed, suggesting greater variation in the perspectives expressed. Figure 2 demonstrates that well-defined clusters, such as the yellow one, suggest homogeneous views and a clear perception of online negotiations, while more dispersed clusters, such as the purple one, indicate a high diversity of perspectives, possibly influenced by varied experiences or different professional backgrounds. The clear separation between certain clusters, such as yellow and green, highlights marked differences between the groups, which may reflect factors such as different levels of comfort with digital tools or distinct expectations about the effectiveness of online negotiations.

The partial overlap between other clusters, such as purple and blue, could signal common areas of perception where general solutions could have a broad impact. Individual points away from the center of the clusters draw attention to unique or exceptional perspectives, providing opportunities for more detailed analysis of the marginal or unconventional needs of some respondents. This visualization highlights not only the diversity of responses, but also the complexity of interactions between clusters, providing a solid foundation for tailoring strategies to the characteristics of each cluster.

Sentiment analysis

Sentiment analysis (Aggarwal et al., 2012) within each cluster reveals a generally positive attitude towards online negotiations, with subtle variations that may reflect different experiences, perspectives or focuses on discussions on the topic. Cluster 2 appears to be the most enthusiastic about online negotiations, while Cluster 1 adopts a more reserved, though still positive, stance. These results can guide future strategies for improving and optimizing online negotiation processes, addressing the specific concerns identified in the lower-sentiment clusters and capitalizing on the positive perspectives in the higher-sentiment clusters (Figure 3).
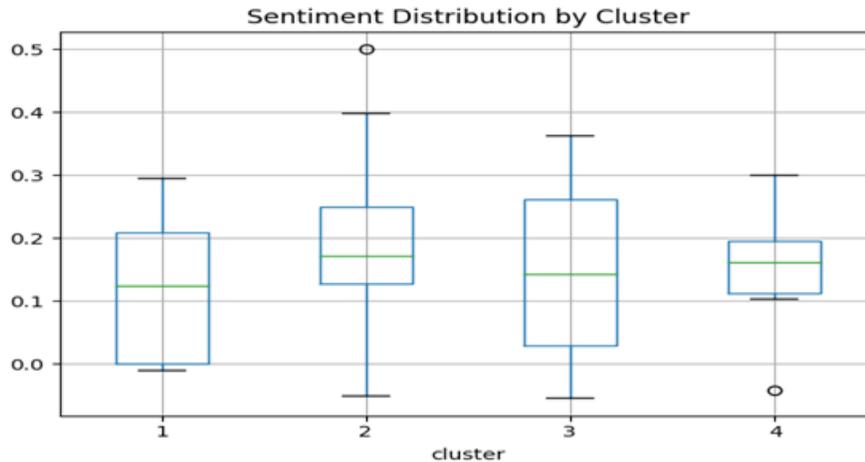
Figure 3. Sentiment analysis on clusters

Figure 2 provides a detailed picture of the sentiment distribution for each cluster, highlighting the general trends and variations within each group. For Cluster 1, the median sentiment is approximately 0.1, indicating a slightly positive perception. However, the distribution is quite wide, with some low values and outliers below 0, suggesting more reserved or mixed opinions. This indicates that although there is a generally positive attitude, some concerns or reservations are present in this cluster. In the case of Cluster 2, the median sentiment is the highest at around 0.2, suggesting the most enthusiastic sentiment of all the clusters. The distribution is compact, indicating consistent and predominantly positive opinions, with a few higher values reflecting high enthusiasm. This suggests that the members of this cluster perceive the greatest benefits of online negotiations and have a more favorable experience in this context.

Cluster 3 has a median like Cluster 2, but the distribution is wider, including lower minimum values and some outliers. Although the overall sentiment is positive, the wider variance indicates more diverse experiences or perceptions among members of this cluster. This may reflect both favorable perspectives and some specific challenges faced by professionals. Cluster 4, with a median of around 0.15, indicates an overall positive sentiment, but lower than in Cluster 2. The distribution is relatively compact, with less variation, although there are some extreme values below 0. This suggests that opinions are more homogeneous, but the positive perception is not as strong as in Cluster 2.

Cluster 2 stands out with the highest average sentiment and a constant distribution, indicating a very favorable perception of online negotiations. In contrast, Cluster 1 shows the lowest average sentiment and several negative outliers, reflecting a more reserved attitude or specific concerns. Cluster 3 and Cluster 4 show overall positive sentiments, but with wider variations, suggesting more diverse opinions. This information can guide interventions to improve the experience in Cluster 1 and harness the enthusiasm in Cluster 2 to promote good practice in online negotiations**.**

LDA Analysis
The LDA analysis supports and complements the interpretation of the clusters, identifying consistent themes reflecting adaptation to the COVID-19 pandemic, evolving negotiation practices and the growing importance of digital skills. This analysis provides a more nuanced perspective on the perceptions and experiences of professionals, highlighting the multidimensional

transformations in online negotiation. The themes identified through the LDA can be correlated with those observed in the cluster analysis, with similar names to maintain conceptual consistency.

The first topic, "Evolving and adapting to online negotiations", highlights the accelerated transition to the digital environment and the impact of the COVID-19 pandemic on this process. Terms such as 'negotiation', 'online', 'involved' and 'pandemic' suggest a rapid change in traditional practices driven by the global health crisis. This topic reflects the narrative of change, highlighting how the pandemic acted as a catalyst for the adoption of online negotiations. Also, terms with temporal connotations, such as 'years' or 'extent', indicate that this transition was already underway, but was significantly accelerated by recent circumstances. Like the clusters identified, this topic highlights the dynamics of the long-term evolution of digital negotiations.

The second topic, 'Transition from Face-to-Face to Online Negotiations', focuses on the operational aspects and perceived benefits of digital negotiations and can be associated with the cluster themes reflecting the effectiveness of the new medium. Terms such as 'negotiations', 'online', 'time' and 'much' suggest a concern with increasing productivity and saving resources. This topic captures the perspective of practitioners evaluating the transition to online in terms of efficiency. The presence of the term 'role' also indicates a recognition of the growing importance of digital skills in the professional profile of modern negotiators, an aspect that complements the observations in Cluster 2 and Cluster 3.

The third topic, "Shift towards online negotiations, focuses on maintaining and strengthening customer relationships in the context of digitization. Terms such as 'clients', 'role' and 'important' reflect a continuing concern for the relational underpinning of negotiations, despite the changing environment. This topic can be related to observations in Cluster 4, which emphasize professionals' efforts to adjust negotiation strategies to meet the challenges imposed by predominantly digital interactions. The theme also emphasizes the importance of balancing the use of technology while maintaining human interactions in the negotiation process.

The last topic, "Key benefits of online negotiations in crisis management" aligns with the cluster interpretations, especially those in Cluster 4, providing a clear perspective on the transformations induced by the COVID-19 crisis. Terms such as 'pandemic', 'process' and 'become' emphasize how exceptional circumstances prompted a reassessment and restructuring of bargaining processes. Likewise, the terms 'time' and 'important' indicate a reflection on the speed and efficiency needed to adapt to new conditions. This topic captures the narrative of the transition from a convenient option to a critical necessity for business continuity, highlighting a reinvention of the way negotiations are conducted.

In fact, the LDA analysis provides a complementary picture to the interpretation of the clusters, illustrating the profound transformation of online negotiations. The identified themes highlight not only the technological adaptation but also the maintenance of the relational foundations of this domain. These results confirm that digital negotiations are not a mere transposition of traditional practices, but a strategic reinvention of professional and commercial interactions, highlighting both the challenges and opportunities arising from this transition.

N-gram Analysis

The analysis of frequent N-grams (Figure 4) allows the identification of key concepts, trends in discourse and common ways of expressing ideas related to online negotiations. The bi-gram "online negotiations" (48 occurrences) dominates the analysis, highlighting the centrality of this concept in the participants' responses and the clear orientation towards the topic of digital negotiations. Frequent expressions such as "have become" (13 occurrences) and "negotiations have become" (11

occurrences) reflect a strong perception of significant changes in the field, indicating awareness of the rapid evolution of negotiation practices

The mentions of 'face to face' (11 occurrences) and 'to face' (13 occurrences) suggest an implicit comparison between online and traditional negotiations, with respondents consistently weighing up the advantages and challenges of each method. The presence of the word 'COVID-19' (9 occurrences) highlights the major impact of the pandemic on the uptake of online negotiations, being a catalyst for recent changes. In addition, phrases such as 'in recent' and 'in recent years' (both with 9 occurrences) reinforce the idea of a significant and recent transformation in negotiation practices, correlating with the general perception of rapid change in the field.

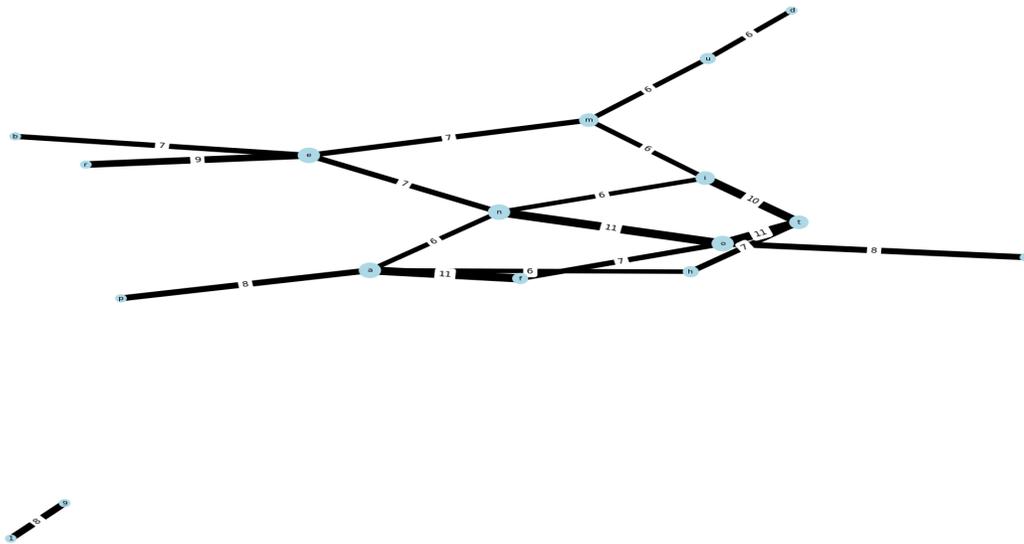Co-occurrence Network of Top N-grams in Combined Responses

Figure 4. N-grams co-occurrence

Figure 4 illustrates the co-occurrence network of the most frequent N-grams in the combined responses, providing a visual representation of the relationships between the key expressions. The nodes in the network represent the N-grams, and the thickness of the lines between them indicates the frequency of co-occurrence in the same context or phrase. For example, "online" and "negotiations" form a strong connection, highlighting the centrality of this concept in the discourse. Other notable links, such as between 'do' and 'to do', suggest frequent comparisons between online and traditional negotiations. The presence of more isolated nodes points to recurring expressions that are not necessarily directly connected to other main themes but contribute to an understanding of the overall context. This visual representation emphasizes how the different concepts are associated in respondents' perceptions and provides additional insight into the thematic structure of the responses

The results obtained from the N-gram analysis can be correlated with other analysis methods used, such as Latent Dirichlet Allocation (LDA) or clustering, to highlight the convergence of the identified themes. For example, the frequent presence of the term "COVID-19" (9 occurrences) both in the N-gram analysis and in the themes identified by LDA, reinforces the idea of pandemics as a major transformative factor in the field of online negotiations. Another aspect of interest is the temporal dynamics of the expressions used. Terms such as "in recent" and "in recent years" (both with 9 occurrences) indicate a clear perception of recent changes in

negotiations and analyzing them according to their temporal context could provide insights into the evolution of perceptions during the different phases of the pandemic. In addition, the analysis of the N-grams can be deepened by exploring the links between the key expressions and the respondents' professional context. For example, certain N-grams might be more common in sectors where the use of technology is more advanced, providing clues about specific adaptation according to the field of activity.

To complement the quantitative analysis, a term co-occurrence diagram is introduced to highlight the relationships between frequent expressions. This would show, for example, how terms such as 'online negotiations' and 'COVID-19' frequently appear together, suggesting a close link between the digitization of negotiations and the pandemic context. Last but not least, it is important to explore the contextual meanings of N-grams, identifying whether terms such as 'face to face' or 'online negotiations' are used with positive, negative or neutral connotations. This aspect adds a qualitative dimension to the analysis and contributes to a more nuanced understanding of respondents' perceptions of changes in the field of negotiations.

The network highlights the interdependencies between the key concepts used by the respondents, each node symbolizing a lexical unit (bi-gram or tri-gram), and the thickness of the edges between nodes being proportional to the frequency of their co-occurrence in the same textual context. Thus, N-gram co-occurrence network analysis allows not only the identification of dominant themes, but also the investigation of the semantic architecture of the corpus, providing a solid basis for the interpretation of conceptual relations and modes of expression.

Visual discourse map

The co-occurrence network analysis of N-grams in combination with cluster and sentiment information provides a complex insight into the discourse on online negotiations. The branched structure of the network, with strongly connected central nodes, reflects the thematic coherence of the discussions centered around the key concepts of 'negotiation' and 'online'. The central nodes of the network, perhaps representing terms such as 'negotiation', 'online' and possibly 'digital' or 'communication', serve as focal points for various sub-themes and perspectives. These central nodes probably correspond to themes common to all four identified clusters, explaining the overall positive sentiment (scores between 0.123 and 0.182) observed in the sentiment analysis.

The co-occurrence network analysis of N-grams in combination with cluster and sentiment information provides a complex insight into the discourse on online negotiations. The branched structure of the network, with strongly connected central nodes, reflects the thematic coherence of the discussions centered around the key concepts of 'negotiation' and 'online'. The central nodes of the network, perhaps representing terms such as 'negotiation', 'online' and possibly 'digital' or 'communication', serve as focal points for various sub-themes and perspectives. These central nodes probably correspond to themes common to all four identified clusters, explaining the overall positive sentiment (scores between 0.123 and 0.182) observed in the sentiment analysis.

The thicker connections suggest strong and frequent associations between concepts, possibly reflecting the dominant themes in the moderately positive sentiment clusters (Clusters 3 and 4, with scores of 0.144 and 0.146). These connections may represent balanced discussions that recognize both the advantages and challenges of online negotiations. The small, isolated component at the bottom of the network may indicate a single theme or distinct perspective mentioned by a subset of respondents. This could be associated with one of the clusters, possibly representing an innovative insight or specific concern that merits attention in future developments of online negotiation practices. The co-occurrence network, analyzed in the context of the clusters

and sentiments, provides a visual map of the discourse about online negotiation. Its structure reflects a coherent central theme, with variations and nuances represented by the different ramifications and connections.

This visualization underlines the complexity of perceptions of online negotiations, highlighting both the overall positive consensus and the diversity of perspectives and concerns specific to each cluster. Response Length Statistics: the mean of 114.97 words per response, with a median of 98.5 words, indicates relatively detailed and elaborate responses, suggesting a high level of engagement and knowledge on the part of respondents. The large standard deviation (77.32 words) and the significant difference between the minimum (30 words) and maximum (424 words) reflect considerable variability in the depth and detail of responses. This variation can be attributed to differences in respondents' level of expertise, personal involvement or communication style. The interquartile distribution (IQR = 75.25 words) indicates a moderate dispersion of response length around the median value, suggesting that most respondents provided medium to extended length responses. Correlation between Response Length and Assigned Clusters: the low correlation coefficient (-0.065) between response length and assigned clusters indicates the absence of a significant linear relationship between these variables, indicating that the different perspectives on online negotiations represented by the different clusters are not determined by the amount of information provided, but rather by the content and nature of the information.

The analysis reveals a diverse and evolving professional community in online negotiations. There is an emerging consensus on the growing importance of online negotiations, fueled by factors such as the COVID-19 pandemic and the perception of the inherent benefits of this approach (efficiency, accessibility). The variability in experiences and perspectives, reflected in the distribution of clusters and the diversity of N-grams, suggests a dynamic field with multiple facets and approaches. This implies the need for context-sensitive and comprehensive training and professional development strategies in online negotiation. The focus on efficiency and customer relations (highlighted in Cluster 4) indicates the trend towards optimization of online negotiation processes, suggesting potential directions for technological and methodological innovations in this area. The implicit comparison with face-to-face negotiations underlines the importance of developing specific online skills to complement traditional negotiation skills.

The analysis provides a nuanced perspective on work in the field of online negotiations, highlighting a significant transition in practices, a diversity of experiences and perspectives, and a widespread recognition of the growing importance of this field in the contemporary professional context. Such findings have important implications for online negotiation education, professional development and innovation.

Discussions

The cluster-based analysis used in this research reveals the existence of 4 clusters containing non-uniform responses suggesting the existence of distinct segments of organizational actors, each with their own priorities, challenges and perspectives on the transition to the digital format of negotiations (Cuc et al., 2024). The results of this analysis provide a detailed and nuanced understanding of perceptions and experiences related to online negotiations, contributing to exploring the diversity of opinions and practices in a rapidly transforming field.

Cluster 1 emphasizes the pragmatic nature of the discourse used in negotiations and is strongly oriented towards the use of online negotiations as a strategic tool for growing and optimizing operations in the service and sales sectors. This cluster has the lowest average sentiment score, indicating a cautious or critical approach to the effectiveness of digital negotiations.

Cluster 2 focuses on the comparative and temporal aspects of the transition from traditional to digital negotiations. Respondents emphasized the economic benefits of online negotiations (elimination of costs associated with travel and logistics, the challenges posed by the need to invest in digital infrastructure and employee training) and perceive them as having a positive evolution, while being efficient and flexible. The adoption of digital technologies in the negotiations sector has, over time, turned a pandemic crisis period emergency solution into an operational standard. A negative side of this cluster is the influence of digital negotiation on interpersonal relationships which creates difficulties in maintaining trust and managing non-verbal interactions in the digital environment. They emphasized the need to use advanced technologies, such as high-quality video platforms, to replicate face-to-face interactions as closely as possible. In addition, the transition to online negotiations has involved a significant adaptation of the skills needed by negotiators, including both advanced digital skills and the adjustment of traditional techniques to meet the demands of virtual communication.

The third cluster highlights how online negotiations are transforming traditional negotiation practices, but also the transformations and processes involved in adapting negotiations to the digital environment. Respondents in this cluster seem to be actively involved in the adaptation process, focusing on reconciling traditional negotiation practices with the specific requirements of the digital environment. This cluster is also intended to help build trust in the digital environment; a trust undermined by the lack of face-to-face interactions. Success in this environment depends on a careful balance between innovation, flexibility and interpersonal skills, with digital negotiations seen as a strategic opportunity to redefine organizational practices to better respond to global demands and challenges.

Cluster 4 emphasizes the role and impact of online negotiations in the context of crisis management, especially during the COVID-19 pandemic. This cluster proposes that digital negotiations should be used as a tool for organizational resilience in crisis situations. However, in crisis situations, challenges constantly arise, such as maintaining trust between the parties, the need for continuous adaptation to new requirements, the need for increased innovation capacity and the increasing use of artificial intelligence.

Conclusion

In the wake of the COVID-19 pandemic, online negotiations have become a central site of professional transformation, reflecting broader changes in organizational communication and decision-making practices. This research investigates how accelerated digitization has reshaped the discursive landscape of negotiation by analyzing semantic patterns through advanced natural language processing techniques, including N-gram modeling and co-occurrence network analysis. Drawing on a corpus of qualitative interview data from interviews with managerial-level participants involved in online negotiation, the results reveal important linguistic trends - in particular the importance of online negotiation as a dominant theme and its frequent juxtaposition with traditional face-to-face formats.

Interviews were conducted in hybrid format (online -Zoom, Microsoft Team) and face-to-face. Data analysis was done by tokenization, stop words removal, lemmatization and vectorization using the TF-IDF (Term Frequency-Inverse Document Frequency) method. N-gram frequency analysis was used to identify recurring concepts and phrases ("online negotiations" or "negotiations have become"), i.e. the main themes in the responses. To explore the thematic structure of the discourse, the K-means clustering algorithm was first used to segment the textual responses into

four distinct thematic clusters, after the optimal number of clusters was determined by the elbow method and confirmed by the silhouette score, thus ensuring a coherent separation of semantic groups. Latent Dirichlet Allocation (LDA) was applied to identify latent themes within the corpus. In conclusion it was found that the dominant themes were 'negotiation', 'online' and 'change'.

In terms of analyzing the clusters we can conclude that the first one highlights a cautious or critical approach towards the effectiveness of digital negotiations. The second shows that respondents emphasized the economic benefits of online negotiations because they perceived them as having a positive development, while the negative side of this cluster is the unfavorable influence of digital negotiation on interpersonal relationships. The third cluster is intended to help build trust in the digital environment, emphasizing the importance of a hybrid approach that combines the advantages of digital technology with traditional negotiation values. The fourth cluster proposes that digital negotiations should be used as a tool for organizational resilience in crisis situations, providing a clear perspective on the strategic potential of online negotiations, not only as a response to crises, but also as a long-term transformational tool to increase the resilience, efficiency and adaptability of organizations in the face of an increasingly complex and dynamic business environment.

Overall, the applied methodology allows a comprehensive exploration of the transition to online negotiations, providing a thorough understanding of this process from an organizational and individual perspective. The analytical rigor, combined with the interpretative depth provided by the qualitative approach, reinforces the relevance and validity of the results obtained. The study contributes to the emerging body of knowledge about digital discourse in professional contexts by providing empirical insights into how global disruptions catalyze linguistic and conceptual change. These results lay the foundation for future interdisciplinary investigations of language, technology, and negotiation dynamics in post-pandemic organizational contexts.

Acknowledgement

References

Aggarwal, C.C. & Zhai, C.Z. (2012). *Text mining: Classification, clustering, and applications.* Cham: Springer.

Anwar, S.H., Abouaish, K.M., Matta, E.M., Farouq, A.K., Ahmed, A.A., & Negied, N.K. (2024). Academic assistance chatbot-a comprehensive NLP and deep learning-based approaches. *Indonesian Journal of Electrical Engineering and Computer Science*, 33(2), 1042-1056. http://doi.org/10.11591/ijeecs.v33.i2.pp1042-1056.

Bazerman, M.H., & Neale, M.A. (1993). *Negotiating rationally.* Simon and Schuster.

Bengfort, B., Bilbro, R., & Ojeda, T. (2018). *Applied text analysis with Python: Enabling language-aware data products with machine learning.* O'Reilly Media

Bishop, C.M. (2006). *Pattern Recognition and Machine Learning.* New York, Springer.

Blei, D.M., Ng, A.Y., & Jordan, M.I. (2003). Topic modeling for social sciences using latent Dirichlet allocation: A review. *Journal of Machine Learning Research,* 3, 993-1022.

Cellich, C., & Jain, S. (2003). *Global Business Negotiations: A practical guide.* South-Western Educational Pub.

Creswell, J.W., & Poth, C.N. (2018). *Qualitative inquiry and research design* (4th ed.). Sage.

Cuc, L.D., Rad, D., Săplăcan, S., Sendroiu, C., Bâtcă-Dumitru, G.C., Wysocki, D., Dutu, A., Manolescu, A.-A. (2024). A hierarchical clustering analysis of the management accounting practices perceptions in Romania. *International Journal of Computers Communications & Control,* 19(6), 6864. https://doi.org/10.15837/ijccc.2024.6.6864.

Danciu, V. (2010). The impact of the culture on the international negotiations: An analysis based on contextual comparisons. *Theoretical and Applied Economics,* XVII(549), 87-102

Dobre, A.C. (2021). Considerations on business and trade negotiation. *Annals of the University of Petrosani, Economics*, 21(1), 127-136.

Elad, S. (2020). Textual network analysis: Detecting prevailing themes and biases in international news and social media. *Sociology Compass*, 14(4), 12779. https://doi.org/10.1111/soc4.12779.

Fisher, R., & Ury, W.L. (1981). *Getting to yes. Boston: Houghton Mifflin*

Goberna, M., & Verdú, M. (2022). Cautionary notes on the use of co-occurrence networks in soil ecology. *Soil Biology and Biochemistry,* 166, 108534. https://doi.org/10.1016/j.soilbio.2021.108534.

Gonzalez-Feliu, J. (2015). Negotiation Analysis: The Science and Art of Collaborative Decision Making de Howard Raiffa, John Richardson & David Metcalfe. *Revue Française de Gestion Industrielle*, *34*(1), 115-116.

Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and variability. *Field Methods*, *18*(1), 59-82.

Hernandez, D., Monne, C., Sein-Echaluce, M.L. (2021). *Online negotiation*. Theoretical proposal. Available online at: https://ceur-ws.org/Vol-3129/paper061.pdf.

Jensen, K., & Unt, I. (2002). *Negotiating partnerships: Increased profits and reduced risks.* Pearson Education.

Jurafsky, D., & Martin, J. H. (2023). *Speech and language processing* (3rd ed.). Pearson.

Kabbach, A., & Herbelot, A. (2021). Avoiding Conflict: When Speaker Coordination Does Not Require Conceptual Agreement. *Frontiers in Artificial Intelligence*, 3. https://doi.org/10.3389/frai.2020.523920.

Kruskal, W.H., & Wallis, W.A. (1952). Use of ranks in one-criterion variance analysis. *Journal of the American Statistical Association*, 47*,* 583-621. https://doi.org/10.2307/2280779.

Kusumaningputri, R. (2023). Negotiating voices in English as a lingua franca: Indonesian multilingual identity in English digital interactions. *Journal of Multilingual and Multicultural Development*, 1-18. https://doi.org/10.1080/01434632.2023.2173758.

Lee, A.J., Mason, M.F., & Malcomb, C.S. (2022). Beyond cheap talk accounts: A theory of politeness in negotiations. *Research in Organizational Behavior*, 100154. https://doi.org/10.1016/j.riob.2021.100154.

Li, H. (2024). AI powered negotiations: Opportunities, challenges, and the future of business strategy. *Transactions on Economics Business and Management Research,* 13, 148-154. https://doi.org/10.62051/dg1trh68.

Malutan, D. (2024). The hybrid approach to negotiation: Bridging traditional and contemporary practices in 2024. *Journal of Research and Innovation for Sustainable Society,* 6(2), 233-244. https://doi.org/10.33727/JRISS.2024.2.26:233-243.

Manning, C.D., Raghavan, P., & Schütze, H. (2008). *Introduction to Information Retrieval*. Cambridge: Cambridge University.

Mills, G.J., & Healey, P.G.T. (2008). *Semantic negotiation in dialogue: the mechanisms of alignment*. Proceedings of the 9th SIGdial Workshop on Discourse and Dialogue, 46-53.

Moore, E.M., Brandl, K., & Dau, L.A. (2021). Intergovernmental organizations, institutional schisms, and business environments. *Journal of International Business Policy*, 6. https://doi.org/10.1057/s42214-021-00121-w.

Pacella, D., & Marocco, D. (2022). Understanding negotiation: A text-mining and NLP approach to virtual interactions in a simulation game. *Applied Sciences*, 12(10), 5243. https://doi.org/10.3390/app12105243.

Raiffa, H. (1982). *The art and science of negotiation*. Harvard: Harvard University Press.

Raiffa, H. (2007). *Negotiation analysis: The science and art of collaborative decision making*. Harvard: Harvard University Press.

Turing, A.M. (1950). Computing Machinery and Intelligence. *Mind*, 59(236), 433-460. https://doi.org/10.1093/mind/LIX.236.433.

Silge, J., & Robinson, D. (2017). *Text Mining with R: A Tidy Approach*. O'Reilly Media.

Sinclair, J.M. (1991). *Corpus, Concordance, Collocation*. Oxford: Oxford University Press.

Song, Y., Lei, S., Hao, T., Lan, Z., & Ding, Y. (2020). Automatic Classification of Semantic Content of Classroom Dialogue. *Journal of Educational Computing Research*, 59(3), 496-521. https://doi.org/10.1177/0735633120968554.

Voss, C. (2016). *Never split the difference: Negotiating as if your life depended on it*. Harper Business.