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# Improving Conflict Support Environments with Information Regarding Social Relationships

Marco Gomes[1], Javier Alfonso-Cendón[2], Pilar Marqués-Sánchez[3], Davide Carneiro[1]
and Paulo Novais[1]

[1] Department of Informatics, University of Minho, Braga, Portugal,
{marcogomes,dcarneiro,pjon}@di.uminho.pt
[2] Department of Mechanical, Computing and Aerospace Engineerings, University of Leon,
Leon, Spain,
{javier.alfonso}@unileon.es
[3] Department of Nursing and Physiotherapy, University of Leon, Leon, Spain,
{pilar.marques}@unileon.es

**Abstract.** Having knowledge about social interactions as a basis for informed decision support in situations of conflict can be determinant. However, few attention is given to the social network interpretation process in conflict management approaches. The main objective of the work presented here is to identify how the parties' social networks correlate to their negotiation performance and how this can be formalized. To do so, an experiment was set up in which we tried to streamline all the relevant aspects of the interaction between the individual and its environment that occur in a rich sensory environment (where the contextual modalities were monitored). This research explicitly focuses on the idea that an Ambient Intelligence system can create scenarios that augment the possibilities of reaching a positive outcome taking into account the role of contextualized social relationships in various conflict management strategies.

**Keywords:** Ambient Intelligence, Social Network Analysis, Negotiation, Context-Aware

## 1 Introduction

Conflicts arise from the complexity of society and the human mind. They may have positive or negative consequences depending on how conflicts are handled or managed. To learn to lead with them correctly is a complex, challenging but necessary task. Especially when, these days, the conflict is brought to the digital environment where new business processes (buying and selling products on the internet) are already sufficiently popular. Therefore, it is necessary that the conflict that arises in digital environments or the ones that are brought to must be properly managed. With conflicts now also emerging in virtual environments, a new field of research has been developed in which Artificial Intelligence and particularly Ambient Intelligence (AmI) are interesting. However, the development of tools for this purpose is insufficient. Therefore, it is important to develop conflict management platforms covering important aspects that are present in traditional processes of resolution and conflict management, including context-dependent aspects that have a major role in human behavior.

Contextual information can influence the course of the process and therefore the result of a conflict setting. Moreover, it is generally accepted that the type of relationship that exists between conflicting parties will often determine the intensity of the conflict and its outcome. Having the knowledge to mapping and measuring the relationships between the parties will allow the conflict manager to measure the relationship, communication, and information flow between the parties through relations and focuses on uncovering the patterns of parties' interactions in the network. This kind of information can be obtained using the well-known Social Network Analysis (SNA) theory. This theory has been used to connote complex sets of relationships between members of social systems. Nevertheless, this kind of social networks perspective of the conflict will benefice both researchers and practitioners of conflict management by encouraging the assessment of conflict in broader social systems instead of focusing on the primary parties involved in the conflict. To do so, we base our approach on the idea that our AmI system creates scenarios that augment the possibilities of reaching a positive outcome taking into account the role of contextualized social relationships in various conflict management strategies [6]. In that sense, this work tries to gives a general overview of how one can apply social network approaches to shed light on conflict, and establishes a description of how important knowledge may be used to further the understanding of conflict [8].

With this purpose was developed a technological framework that will support the decision-making of the conflict manager by facilitating access to information such as the conflict handling style of the parties or their social context. In this work, it is introduced a new module that takes into account the social context by means of social network analysis. The development of such a framework results in a set of services or functionalities that will support the work of the conflict manager. The underlying aim is to release him so that he can have a more inform and effective approach to deal with complex issues such as the improvement of interpersonal communication and relationships.

## 2   Conflict and Conflict Handling Styles

Conflicts occur regularly in daily life, as people present different opinions about problems and procedures and vie for their preferred approaches. In every conflict, all parties involved make choices to take some action they think will help them get what they want and need. These choices may be spontaneous or calculated, constructive or destructive. One should be wary of making the common mistake of assuming that conflict is necessarily a problem and is something to be avoided at all costs. That is far too an simplistic approach to the complex subject of conflict management. Is difficult to define and to reach a universally accepted definition of conflict. We define it as a disagreement through which the parties involved perceive a threat to their needs, interests or concerns [4]. Similarly, it can also be seen as a opposition of interests that disrupts or blocks an action or making-decision process [9]. Thus, a conflict may be seen as a process that begins when a party feels that the other has or is about to negatively affect any interest your. The ideal conflict management process is one in which the parties are better at the end than they were at the beginning. Not all conflicts have such conclusion. In order to

improve this, we believe that it is meaningful context and behavioral information and its relevance for conflict management of utmost importance to: (1) provide the parties and manager with important knowledge about the conflict and (2) potentiate the role of the parties throughout all the process. Having this kind of information one can lead to a reduction in the severity of a conflict, in which parties continue the conflict but adopt less extreme/harmful tactic.

Conflicts can develop in stages and consequently may involve many different responses as the conflict proceeds. People involved develop various strategies, solutions or behaviors, to deal with the conflict. The style of dealing with a conflict that each one has must be seen as having a preponderant role in the outcome of a conflict resolution process, especially on those in which parties interact directly (e.g., negotiation, mediation). In order to classify the conflict style, the proposals must be analysed, namely in terms of their utility. In that sense, in each stage of the negotiation the parties' proposals are analysed according to their utility value and a range of possible outcomes defined by the values of the Worst Alternative to a Negotiated Agreement (WATNA) and Best Alternative to a Negotiated Agreement (BATNA) of each party. This approach uses a mathematical model [3], which classifies a party's conflict style considering the range of possible outcomes, the values of WATNA and BATNA as boundaries, and the utility of the proposal. Regarding that utility quantifies how good a given outcome is for a party, it is acceptable to argue that a competing party will generally propose solutions that maximize its own utility in expense of that of the other party (the utility of the proposal is higher than the WATNA of the other party), whereas, for example, a compromising party will most likely search for solutions in an intermediary region (the utility of the proposal falls within the range of the zone of possible agreement, the range of overlapped outcomes that would benefit both parties). Essentially, we were able to classify the personal conflict style of a party by constantly analyzing the utility of the proposals created. Once the styles are identified, strategies can be implemented that aim to improve the success rate of procedures for resolution and conflict management. This information and other insights about how the individual's conflict style is classified can be found in [3] work.

## 3   An Intelligent Conflict Support Environment

An AmI system consists of a series of interconnected computing and sensing devices which surround the user pervasively in his environment and are invisible to him. It is clear that when one designs a system with these characteristics there are some challenges that are raised by the heterogeneity and number of devices and technologies present in this kind of environment. Is not just a bunch of devices interconnected but instead a group of devices working together and sharing information towards a common goal. To cover it the system must ensure that these devices interact and exchange information in a proper way and compatibility must be ensured between the different technologies and components. Our aim is to provide a service that is dynamically adapted to the interaction context, so that users (parties and the conflict manager) can naturally take advantage of interacting with the system and thus enhance the conflict management process. It can be stated that our underlying intent is to extend the traditional

technology-based conflict resolution/management methods, in which a user simply interacts with the system, with a new component, an Intelligent Environment (IE). These environments should be made in a pervasive and transparent way. This is important, since when people are aware that they are under monitorization, they tend to behave differently. Therefore, towards an intelligent conflict support system the following ambient intelligence system was developed (Fig. 1).

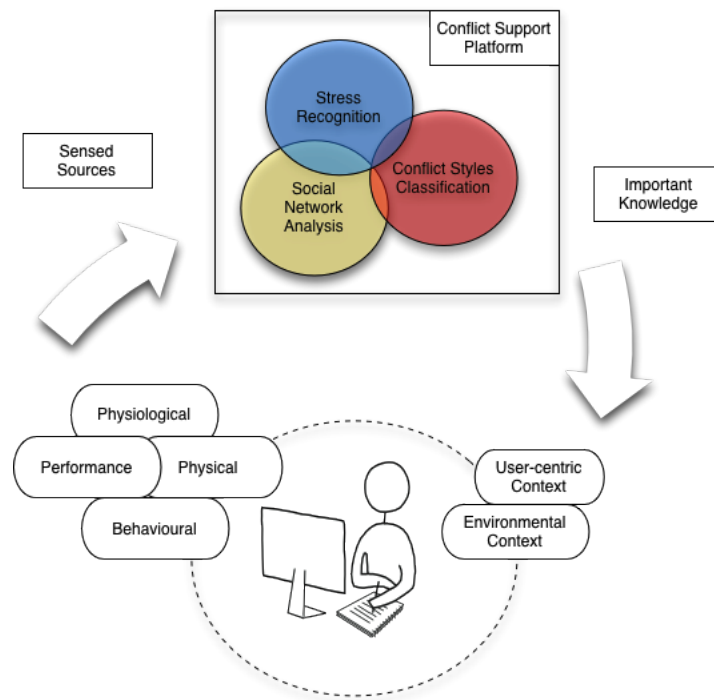The system general working is to sense conflict context, acquire it and then make rea-



**Fig. 1.** Conceptual framework to support the decision-making of the conflict manager.

soning on the acquired context and thus acting in on the parties' behalf. To achieve this, the system build up a profile of each individual and is able to subsequently link that profile with the correct individual performance within the conflict process that is been monitored by the system. In other words, while the user conscientiously interacts with the system and takes his/her decisions and actions, a parallel and transparent process takes place in which contextual and behavioural information is sent in a synchronized way to the conflict support platform. The platform, upon converting the sensory information into useful data, allows to conflict manager for a contextualized analysis of the user's data. The contextualized analysis of user's data is more critical when the data is from heterogeneous sources of diverse nature like sensors, user profile, and social media

and also at different timestamps. To overcome some of these problems, the features are extracted from multiple sensor observations, and combined into a single concatenated feature vector which is introduced into different classification modules (conflict styles, stress recognition, ect.). To integrate all the multimodal evidences is used a decision level integration strategy. Examples of decision level fusion methods used in this work include weighted decision methods and machine-learning techniques and are detailed in previous work [5].

### 3.1 Multimodal approach to gathering Behaviorial and Context Data

Human behaviour can be understood as an all-encompassing spectrum of what people do including thinking and feeling, which are influenced, for example, by culture, attitudes or emotions. So we can stand that nothing characterizes an individual better than his or her behavior. Knowing how an individual reacts to stimuli allows one to foresee their future states. Therefore, this work addresses learning and recognition of human behavior from a multimodal approach in a conflict support environment in order to enrich the knowledge about user states in negotiation processes. It is a challenging task due to the presence of complex nonlinear correlations and interactions across modalities. To evaluate the proposed approach, several multimodal recordings showing different situations have been conducted. To do it a set of features were selected to this end. From between more than two dozen features that can be extracted in a non-invasive and transparent way, the following were selected from keyboard, mouse and webcam sensory data available when a user interacts with our platform:

- *Time between Keys (TBK):* time spent between the use of two keys, that is, the time between events *KEY_UP* and *KEY_DOWN* row. Unit: millisecond;
- *Key Down Time (KDT)* - time spent since the key is pressed down and is released later, in other words, time since the event *KEY_DOWN* and *KEY_UP* consecutively. Unit: milliseconds;
- *Mouse Velocity (MV)* - Mouse Velocity - velocity at which the cursor travels. The distance travelled by the mouse (in pixels) between a $C1$ coordinate $(x1, y1)$ and $C2(x2, y2)$ corresponding to $time1$ and $time2$ over travel time (in milliseconds). Unit: Pixel/Milliseconds;
- *Mouse Acceleration (MA)*: acceleration of the mouse at a given time. The acceleration value is calculated using the mouse velocity on movement time. Unit: Pixel/Milliseconds;
- *Motion (M)* - the motion parameter was measure with 0 (no motion) or 1 (motion detected) and indicates if someone or something is moving in front of the camera;
- *Brightness (B)* - the brightness parameter were represented a value between 0 and 255 and indicates how much light is detected in the webcam image (0 represents complete darkness).

Once data have been gathered each kind of data is to be real time pre-processed in a particular way depending on their nature. Analysing any interaction and experience exposed by traditional mouse and keyboard and webcam input these categories are organized around a user's current profile and the information is presented to the conflict manager.

### 3.2 Incorporation of Social Network Analysis in Conflict Characterization

The study detailed later in the article used a social network analysis method to map and measure the participants' relationships. The network analysis was based on the intuitive notion that these patterns are important features of the activities of the individuals who display them through their interaction, namely in conflict situation. The Advice, Hindrance and Friendship measurements were considered to analysed the participants network. Meanwhile, in this analysis we have emphasized friendship relations (Fig. 2) because they can be especially important in [7] [1]. The underlying intent was to study how friendship ties within a group of individuals are correlated with their conflict performance. The data to extract each of the aforementioned measurements were
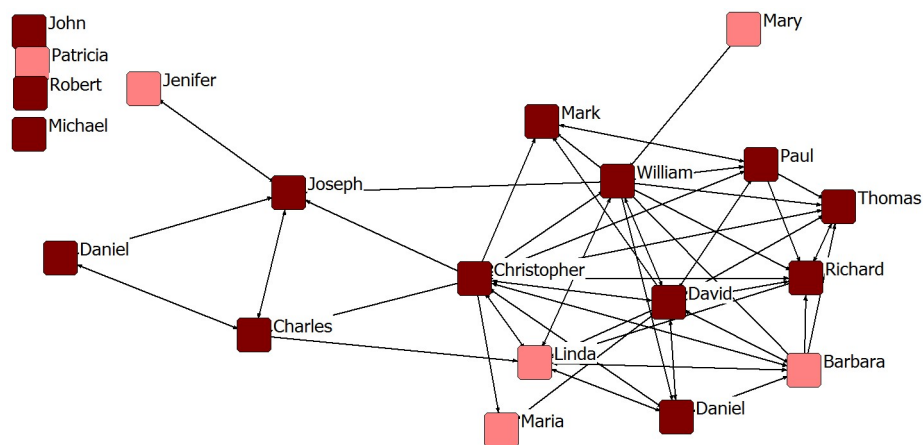


**Fig. 2.** Was used a questionnaire to collect data on friendship network. The network surveys listed the names of each individual in a respondent's friendships group.

obtained through a questionnaire (carefully adapted) of social networks. According to studies Sparrowe [10], the Advice Network, in our experiment, was measured by asking respondents two questions:

- Do you go to this people to ask for help or advice on work-related matter? [10]
- Do you talk with this people about confidential work-related matters? [10]

To test the Hindrance Network, the question used was:

- Does he / she makes it difficult for you to carry out your job responsibilities? [10]

Friendship Network was measured by asking respondents:

- Do you consider this people like "personal friend'? [7]

Since the interest of the research was to analyze the strength of relationships, we use responses in a 5-point Likert Scale from "not at all" (1) to "very much" (5). With the data obtained, we measured the in-degree centrality scores for each individual. The in-degree is a measure of centrality, which measures the number of nominations received by a person. This variable was calculated for all individuals in the Advice, Hindrance and Friendship Network. At the individual level we can also calculate the position of individuals who may be intermediaries (Betwenness Centrality), influential (Eigenvector Centrality) or conflicting (In-degree Centrality in Hindrance Network). The questionnaire was sent to a network of 20 individuals, the data was collected in binary format and were stored in square matrices of 20 x 20. Calculate relational variables were performed with the software program UCINET VI. The meta-analytic techniques used to analyze the data obtained were as follows: Descriptive statistics, both standard deviations, etc; Correlations between the independent variables (centrality and density) and dependent variables (hindrance); Regressions to test the model. Gender was used as a control variable.

In conclusion we note that those individuals who do not have a great reputation or central position in the first networks are hypothetically those most drawn to other individuals as conflicting. We can also see how some of the individuals identified as conflicting are individuals with prestige as in the Council and Friendship Network and some of them designated as a bridge between subnets. There are a large number of nodes that have not pointed to any partner as conflictive by what might not really have a high degree of conflict in this group, this may be because they do not really have a high degree of conflict in this group, or because when they have answered the questionnaires they not have felt comfortable answering this item. In the next section is spawned a more detailed analysis of this results.

## 4 Case-Study: a Negotiation Game

The main objective of this research work is to identify how the users' social networks (namely the resulting friendship network) correlate to their negotiation performance and how it can be pointed out. To demonstrate the relationship discussed in the previous sections, an experiment was set up in which we tried to estimate all the relevant aspects of the interaction between the individual and their environment that occur in a rich sensory environment (where contextual modalities were monitored). This environment was empowered with sensors that acquire different kinds of information from the user in a non-intrusive way (using the multimodal approach described in Sec. 2.1). The participants of the proposed experiment were volunteers socially connected with our lab members. Twenty individuals participated, both female and male, aged between 22 and 36. The first step of the experiment was to ask the volunteers to fill in a small individual questionnaire (depicted in Sec. 2.2). The following step was the monitoring of the individuals' interaction (where the stress conflict support platform was installed) with the developed web-based negotiation game.

During the experiments, the information about the user's context was provided through a monitoring framework, which is customized to perform movement detection from a web cam and collect and treat the interaction data. This data were combined and

synchronized with those provided by the keyboard typing and mouse clicking behavior to fully describe several important aspects of the behavior of the user. The participants played the web based game through computers that allowed the analysis of the described features.

### 4.1 Experimental Setup

As stated before, with the purpose of simulating a conflict situation in real-life environments a web-based game was developed. It was designed to enable test participants in having a conflict experience induced by the presence of Ambient Intelligence systems. In that sense, the game simulates a business situation (a conflict) where each party has to achieve a desired result in the negotiation or go bankrupt. The desired result was a win/win situation for both parties. A performance-based reward was setted to increased participants' intrinsic motivation. The game starts with the application randomly giving one of the predetermined roles to each party. The instructions to win the game were to negotiate a successful deal and make sure that the party in question didn't go bankrupt. Each party's instructions were clearly presented, visible to them through the application interfaces. The objectives and the persona for each party are depicted as:

– Role A - party A was a piano seller who specialized in selling cheap pianos. He was not the only supplier of this kind of pianos. In order to stay in business, he needed to sell 1000 euros or more per piano, knowing that piano prices vary greatly depending on the locale and the particular situation. If he did not achieve this, he would go bankrupt. He was also given the information that Party B needed to make this deal.
– Role B - party B represented a musician that need a piano urgently. He had recently received a contract to make a concert and need a piano to play it. The contractors were prepared to pay 1200 euros per concert. If Party B did not manage to negotiate with Party A to buy the piano at 1200 or less, then he would go bankrupt. Party B was told that party A was in a little financial trouble and needed to make the deal to survive.

Regarding to the conflict styles analysis, the ZOPA (Zone Of Possible Agreement) was bounded by the BATNA (1000 euros) and WATNA (1200 euros) values. The range of possible agreement is 200, but the parties were not aware of this detail.

### 4.2 Results

In the preliminary data analysis the experimental data is organized into two groups based on the analysis of the social network. One group contains the collection of some experimental data about how a user behaves when he/she negotiates with someone without any relationship. This enables the establishment of a baseline for comparison with the second group, that comprises the data gathered from parties that negotiate with someone socially related. In order to statistically deal with data concerning to the utility values of the parties' proposals, it was necessary to convert to an arbitrary numeric scale (0 is the least favourable style for the resolution and 4 the most favourable style).

This type of scale means that the exact numeric quantity of a particular value has no significance beyond its ability to establish a ranking over a set of data points. Therefore, it was built rank-ordering (which describes order), but not relative size or degree of difference between the items measured. This was a mandatory step to make the data suitable for statistical and machine-learning techniques.
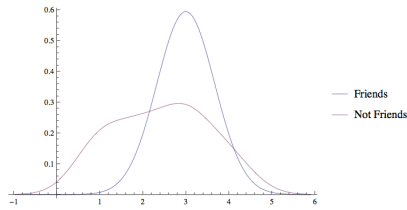


**Fig. 3.** Difference in the distribution (X axis) of the Conflict Handling Style (Y axis) used by the participants, when they where negotiating with a friend or not.
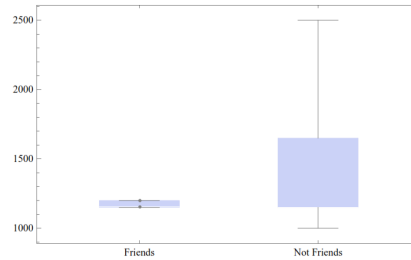


**Fig. 4.** Distance of value of the final proposal to the optimum result when the participant are friends or not.
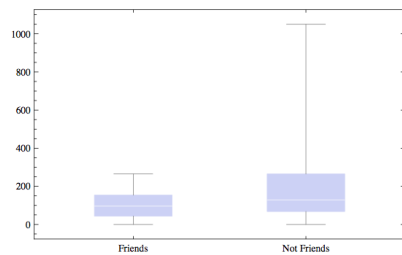


**Fig. 5.** Difference between the size of the messages exchanged when the participants are friends or not.
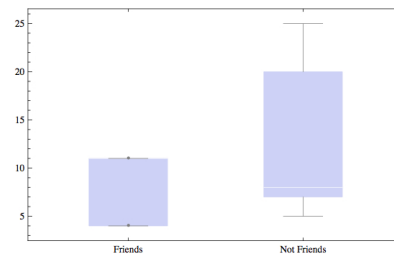


**Fig. 6.** Difference in the necessary number of rounds to reach an agreement when the participants are friends or not.

Regarding the evolution of the conflict handling styles evidenced by the parties (Fig. 3), we conclude that the conflict style is in average more favourable (mutually beneficial) when the parties are friends. We also conclude that the style tends to improve (shifting towards of more cooperative solutions) as the rounds advance. In what concerns the final value of the negotiation process, we conclude that friends reach more mutually satisfactory solutions, i.e., solutions that are closer to the optimum result (Fig. 4). Also interesting is the conclusion that participants who are friends need less rounds and exchange smaller messages to achieve a successful outcome (which is also more satisfactory, as described previously).

The data collected also shows that there is a clear difference between the two groups regarding the conflict styles exhibited during the game. The main conclusion is that when participants are friends the frequency collaborative behaviours is far superior (42%) than when they are not friends (17%) (Fig. 7 (a)). This may mean that a relation of friendship between the parties will make them more sensitive to each other's concerns, despite being in a competitive game. In a similar analysis, but now concerning the roles played by participants, we conclude that the sellers are much more competitive than buyers (63% vs. 25%), while buyers are essentially collaborative (Fig. 7 (b)). To interpret the significance of these results it important to recall that participants were asked to negotiate a successful deal in a competitive and win-lose scenario. Nonetheless, it is shown that when participants are friends, they are more likely to transform it into a win/win situation. This is especially visible in the final results of the negotiations. On the one hand we find that 100% of the agreements made by friends accomplished a successful deal, i.e., between the range of solutions that would benefit both. On the other hand, only 50% of negotiations that occurred between non-friends opponents reached a mutual benefit agreement. It may be that they assumed they had to negotiate and get the best price (win/loose). But that was not the objective. Their objective was to negotiate a deal so they would not go bankrupt (win/win).
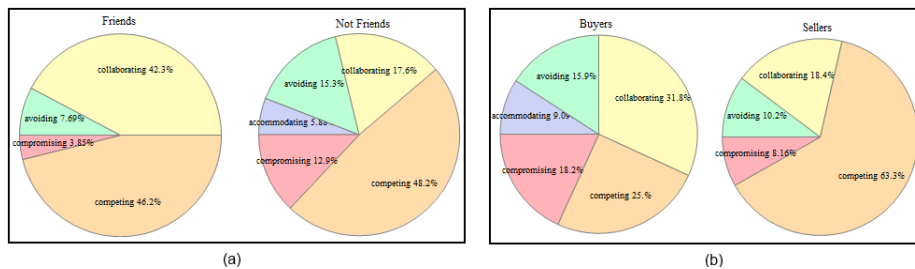


**Fig. 7.** Differences in the conflict styles concerning the social relationship (a) and the role in the game (b).

The preliminary evidence suggests a theoretical basis for expecting a connection between social networks and the use of conflict styles. Despite these results, we still do not know much about how internal configurations of social networks might facilitate (or inhibit) positive conflict outcomes. Therefore, we will perform more and deeper experiments in order to understand how to collect and analysis relational ties that can influence negotiation performance.

## 5 Conclusions

In this work was investigate how to incorporate social conflict analysis in a conflict support environment. After the conceptualization and development of a conflict support framework within an intelligent environment, explained in the previous sections,

a test environment was set up. During some weeks several tests were performed. This included data gathering from a subjects' activities during the experiment, often using video analysis and software logging. The findings highlight the potential of social network analysis to further the understanding of conflict. They pointed out relationships between the features being monitored and the participants' social networks elicited through a small questionnaire. These relationships, especially those regarding the resulting friendship networks, have the potential to enable the characterization of individuals and enhance negotiation performance. The main contribution of this work is thus the identification of situations in which peoples' social networks influences the negotiation performance. This can be specially important when facing a conflict mediators or conflict managers have the access to the knowledge which can facilitates processes and not let people loose efficiency when they get tangled by their own social and contextual circumstances.

## Acknowledgements

## References

1. Balkundi, P., Harrison, D.A.: Ties, leaders, and time in teams: Strong inference about network structure's effects on team viability and performance. Academy of Management Journal 49(1), 49–68 (2006)
2. Carneiro, D., Castillo, J.C., Novais, P., Fernández-Caballero, A., Neves, J.: Multimodal behavioral analysis for non-invasive stress detection. Expert Syst. Appl. 39(18), 13376–13389 (Dec 2012), http://dx.doi.org/10.1016/j.eswa.2012.05.065
3. Carneiro, D., Gomes, M., Novais, P., Neves, J.: Developing dynamic conflict resolution models based on the interpretation of personal conflict styles. In: Antunes, L., Pinto, H. (eds.) Progress in Artificial Intelligence, Lecture Notes in Computer Science, vol. 7026, pp. 44–58. Springer Berlin Heidelberg (2011)
4. Deutsch, M.: The Resolution of Conflict: Constructive and Destructive Processes. Carl Hovland memorial lectures, Yale University Press (1977)
5. Gomes, M., Oliveira, T., Carneiro, D., Novais, P., Neves, J.: Studying the effects of stress on negotiation behavior. Cybernetics and Systems 45(3), 279–291 (2014)
6. Judd, J.S., Kearns, M., Vorobeychik, Y.: Behavioral conflict and fairness in social networks. Lecture Notes in Computer Science, vol. 7090, pp. 242–253. Springer (2011)
7. Mehra, A., Dixon, A.L., Brass, D.J., Robertson, B.: The social network ties of group leaders: Implications for group performance and leader reputation. Organization Science 17(1), 64–79 (Jan 2006)
8. Nelson, R.E.: The strength of strong ties: Social networks and intergroup conflict in organizations. The Academy of Management Journal 32(2), pp. 377–401 (1989)
9. Robbins, S.: Organizational behavior. Prentice Hall (2001)

10. Sparrowe, R.T., Liden, R.C., Wayne, S.J., Kraimer, M.L.: Social Networks and the Performance of Individuals and Groups. Academy of Management Journal 44(2), 316–325 (Apr 2001)