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The Strategies for Quorum Satisfaction in Host-to-Host Meeting Scheduling Negotiation

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Abstract

This paper proposes two strategies for satisfying the quorum of two colliding meetings through host-to-host negotiation scheme. The strategy is to let a member attend the other meeting under the condition that the group decision regarding the schedule is not changed and meeting quorum is fulfilled, namely the unassignment strategy. Another strategy is to substitute the absent personnel member in order to keep the number of attendees above the quorum, namely the substitution strategy. This paper adapts a mechanism design approach, which is Clarke Tax Mechanism, in order to implement incentive compatibility and individual rationality principle in meeting scheduling. By using the unassignment strategy and substitution strategy, the meetings can still be held simultaneously according to the schedule without the need for rescheduling. This paper shows the simulation result of using the strategies within some scenarios. It demonstrates that the number of meeting failures caused by unsatisfied quorum can be reduced with host-to-host negotiation.

Keywords*: meeting scheduling, conflict handling, negotiation strategies, Clarke Tax mechanism, meeting quorum*

1. Introduction

Meeting scheduling is included under the area of problem optimization which pertains to uncertainty in scheduling problem. An optimal meeting schedule influences meeting value, but it may reduce some costs [1]. Instead of focusing on the use of mandatory decision to select a timeslot for a meeting schedule, much research has been done on negotiation of personnel preferences to reach an optimal schedule [2-4]. Negotiation is processed through several iterations between personnel or personnel-to-personnel (P2P) in order to find a mutual time for all personnel. The negotiation permits personnel to update their preferences, but with no guarantee for their true availability [2, 3]. The uncertainty of personnel availability may lead to a meeting scheduling failure caused by the veto power of a personnel member who is absent or cancels the meeting [4]. In order to manage the conflict caused by new meeting schedules which can appear over time, designing negotiation strategies to avoid meeting scheduling failure becomes a challenging task.

Meeting scheduling can be viewed as a complex decision making problem in artificial intelligence domain, particularly in mechanism design problem [5]. Mechanism design approach has been used in meeting scheduling to optimize the meeting of social welfare goals [9-11]. This approach is based on two principles, namely incentive compatibility and individual rationality. Incentive compatibility represents personnel preferences in bidding mechanisms, whilst individual rationality considers the possibility of personnel absence and calculates its effect on group decision. Clarke Tax Mechanism is one shot voting mechanism that proposes an equilibrium strategy in bidding the value. The mechanism is non-manipulable. However, since the personnel have no control over their role in the meeting afterwards, the mechanism needs to be improved.

Due to the possibility of changeable personnel preferences, this study employs a host-to-host scheme to obtain personnel availability information directly. Every personnel member can only be scheduled by one host at one time and interpreted by other hosts as unavailable personnel at that time. Furthermore, this scheme also enables a host to negotiate with other

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hosts in order to continue assigning or unassigning the personnel member, with or without a substitute, which is explained in the next section.

This study determines meeting failure by measuring quorum satisfaction. The existing meeting scheduling negotiation is conducted in several times in order to gain a meeting schedule that meets the quorum. Nevertheless, the quorum compliance does not happen onwards because of the dynamic of personal schedule. This paper proposes two negotiation strategies in host-to-host scheme, namely unscheduled meeting host and scheduled meeting host. The negotiation aims to decide who will unassign or assign personnel, in order to keep the schedule between two conflicted meetings. The negotiation strategies are adapted from the mechanism design approach, particularly Clarke Tax Mechanism (CTm).

2. Adapting Mechanism Design

Mechanism design or known as reverse game theory is concerned with the method to implement a good system in a wide range of solutions that involve multiple self-interested agents. In meeting scheduling, mechanism design attempts to optimize group decision in selecting the desired time to hold a meeting, when each personnel member has his/her own preferences. Mechanism design is commonly used in auctions, in particular to bid an outcome by a value. Assuming that outcomes are possible times for personnel member ($member_i$) to hold a meeting in a meeting period t_j $\{j = 1,2,..m\}$, the bidding value that is called personnel member utility not only represents personnel preferences, but also their availability to attend the meeting in each timeslot. High utility denotes personnel's high possibility to come; conversely, lower utility indicates some conflicts with personal schedule that may cause personnel absence. By considering the incentive compatible principle, this study totalizes personnel member's utilities which are in the range of zero to nine with nine as the most preferable time and vice versa. The total utility (B_j), number of personnel (n), and personnel member's utility in timeslot *j* ($u_{i,j}$), is denoted in (1).

$$B_j = \sum_{i=1}^{n} u_{i,j} \tag{1}$$

The selected timeslot is based on group decision or social welfare. The selected timeslot (*j**) or a meeting time is the timeslot which has the maximum total utility defined in (2).

$$j^* = \arg max \sum_{i=1}^{n} u_{i,j} \tag{2}$$

This study calculates the pivot value for each member by using CTm in order to satisfy the individual rationality principle. CTm calculates the maximum total utility with personnel absence for each member and each timeslot, such as (3).

$$B_{-i,j} = \sum_{k\neq i}^{n} u_{k,j} \tag{3}$$

When the member's absence does not change j^* as a meeting time, then the member's pivot is represented by zero value. Pivot value describes the member's pivotal presence in a meeting which influences the success of the meeting or in previous work called veto power [6]. The absence of a member who has no zero pivot value may cause the meeting schedule to be delayed or canceled and rescheduling becomes necessary. Rescheduling meeting caused by the absence of pivotal member is a common way, but the decision is based on a subjective value. CTm shows the perspective to explain the pivot of a member through the pivot value. Pivot value is the difference of maximum total utility except $member_i$ in timeslot $\boldsymbol{t_j}$ and total personnel's utility except $member_i$in t_{j^*} as defined in (4).

$$\text{Pivot}_\text{i} = \begin{cases} \left(max \sum_{j=1}^{m} B_{-i,j}\right) - B_{-i,j^*}, if \left(max \sum_{j=1}^{m} B_{-i,j}\right) > B_{-i,j^*} \\ 0 \; otherwise \end{cases} \tag{4}$$

In this study, pivot value describes the influence of one member's absence on a group decision. Therefore, the meeting scheduling needs to update all personnel's pivot if the decision is to unassign the member. Table 1 shows the example of pivot calculation.

Table 1. Pivot Calculation

Personnel ($member_i$)	Personnel's Utility in t_j					Total Utility except $member_i$ in t_j					Total Utility Except $member_i$ in t_{j^*}	Maximum total utility except $member_i$ in t_j	Pivot
	t_1	t_2	t_3	t_4	t_5	t_1	t_2	t_3	t_4	t_5	t_2		
$member_1$	9	8	3	0	5	8	20	*22	20	9	20	22	2
$member_2$	0	5	8	5	7	17	*23	17	15	7	23	23	0
$member_3$	2	7	8	6	2	15	*21	17	14	12	21	21	0
$member_4$	6	8	6	9	0	11	*20	19	11	14	20	20	0
Total utility in t_j	17	*28	25	20	14								

Game theory tells about the dominant strategy of each player; therefore, no other choice from other players can make one player get worse. Meanwhile, mechanism design uses the system's perspective, designing a system that can make players reveal their true valuation as a dominant strategy [5]. Since personnel can lie or manipulate their utility value, this study uses the CTm to gather the true personnel preferences. However, the utility update may persist in some conditions, such as the invitation of a high priority meeting which is requested later.

Table 2 shows the manipulation value in t_2 by $member_1$ by updating 8 with 6. The calculation result shows that the manipulation does not change or influence the pivot of $member_1$. The outcome desired by CTm is not controlled by person to person but depends on the *social welfare*. The red numbers in Table 2 are updated values from Table 1.

Table 2. Utility Update by Member 1

Personnel ($member_i$)	Personnel's Utility in t_j					Total Utility except $member_i$ in t_j					Total Utility Except $member_i$ in t_{j^*}	Maximum total utility except $member_i$ in t_j	Pivot
	t_1	t_2	t_3	t_4	t_5	t_1	t_2	t_3	t_4	t_5	t_2		
$member_1$	9	6	3	0	5	8	20	*22	20	9	20	22	2
$member_2$	0	5	8	5	7	17	*21	17	15	7	21	21	0
$member_3$	2	7	8	6	2	15	*19	17	14	12	19	19	0
$member_4$	6	8	6	9	0	11	18	*19	11	14	18	19	1
Total utility in t_j	17	*26	25	20	14								

This paper adapts tax value in original CTm in order to design personnel's pivotal influence on group decision. Furthermore, pivot values are used in negotiation strategies proposed in this study which are compatible with the host-to-host scheme. The strategies are defined as the unassignment strategy and substitution strategy. The design of negotiation strategies aims to satisfy meeting quorum.

2.1. Unassignment Strategy

In the real meeting scheduling, a meeting can still be held on schedule, although it is not attended by all members. Conversely, the negotiation made by other schemes is a cycle of constraints or preference relaxations until all the members meet at the same available time. This study raises the quorum variable as the consequence to determine meeting success due to the possibility of a conflict. In this study, the amount of personnel availability is negotiable as long as it satisfies the quorum. Accordingly, both colliding meetings, which are scheduled meeting and unscheduled meeting, can still be held simultaneously.

Since the pivot value in CTm indicates personnel influence on group decision, the use of this method in meeting scheduling enables a personnel member's absence whose pivot value is zero. The strategy is called the unassignment strategy. This paper defines meeting failure as the condition when a meeting does not meet quorum and needs to be rescheduled. Firstly, meeting failure is caused by the pivotal personnel unavailability; therefore, the social welfare or group decision should be moved to another timeslot. Secondly, it is caused by the unavailability of personnel with zero pivot but causing the number of attendees to not meet the quorum. Based on Table 1, if personnel $member_1$ is in conflict caused by a new meeting assignment, then his/her absence in the scheduled meeting will cause scheduling meeting failure. Meanwhile, when personnel $member_2$ is in conflict, the system will check the quorum before unassigning the member.

2.2. Substitution Strategy

The utilization of pivot value in CTm prompts this study to propose another negotiation strategy, which is the substitution strategy. The idea comes from adding personnel scenarios as described in Table 3. $Member_5$ is an additional member to substitute $member_1$, thus the utility in selected time (t_2) takes the same value as that of $member_1$.

Table 3. Pivot Recalculation for Additional Member

Personnel ($\boldsymbol{member_i}$)	Personnel's Utility in $\mathbf{t_j}$					Total Utility except $\boldsymbol{member_i}$ in $\mathbf{t_j}$					Total Utility Except $\boldsymbol{member_i}$ in $\boldsymbol{t_{j^*}}$	Maximum total utility except $\boldsymbol{member_i}$ in $\mathbf{t_j}$	Pivot
	t_1	t_2	t_3	t_4	t_5	t_1	t_2	t_3	t_4	t_5	t_2		
$member_1$	9	8	3	0	5	8	*28	22	20	9	28	28	0
$member_2$	0	5	8	5	7	17	*31	17	15	7	31	31	0
$member_3$	2	7	8	6	2	15	*29	17	14	12	29	29	0
$member_4$	6	8	6	9	0	11	*28	19	11	14	28	28	0
$member_5$	0	8	0	0	0	17	*28	25	20	14	28	28	0
Total utility in $\mathbf{t_j}$	17	*36	25	20	14								

In case of $member_1$conflict, the system suggests to add personnel $member_5$. CTm recalculation shows that $member_1$ will be free because of the zero pivot and accordingly can be unassigned to attend other meeting. This strategy is used in order to hold the schedule and avoid rescheduling. Substitution strategy is such a second-tier strategy to prevent meetings from failure. Finding a proper substitute is the next challenge, beginning with research in community detection problem [7] and similarity detection problem [8] about personnel profile.

3. Host-to-Host-Objectives

The personnel's utility is gathered by using host-to-host scheme. This part explains the use of CTm in a host-to-host meeting scheduling negotiation, which includes input, process, and output. There are three intentions of assembling meeting scheduling in a centralized manner and executing host-to-host negotiation to handle meeting conflicts.

3.1. Complete Information

Meeting scheduling research is related to research on Groupware Calendar System (GCS) [14-16]. GCS collects personnel schedules in order to arrange every new meeting without any conflict. However, GCS development had a usability problem. This study examines the problem by using three perspectives, namely personnel as individuals, meeting host with social focus, and technology [9], as illustrated in Figure 1.

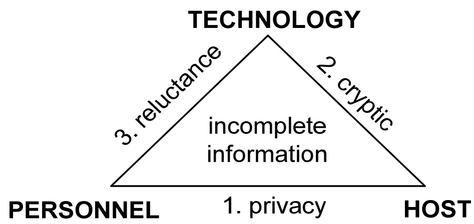

Figure 1. GCS' Problem

1. To avoid schedule conflict, each member of the personnel must share his or her schedule to the meeting host through GCS, which unfortunately raises privacy issue (edge 1). This problem has been mentioned by previous research [5, 6].
2. In a socially-centered perspective, a host meeting has a difficulty in determining priority level of personnel attendance because the utility value which represents personnel preference is cryptic (edge 2) [10]. In addition, personnel availability can change any time due to a higher priority of after meeting schedule.
3. Every organization may have its own GCS. Since every member of the personnel can be invited by several organizations, s/he must share her/his schedule repeatedly, which causes reluctance of using GCS (edge 3). Then, to get personnel schedule completely, a meeting host duplicates other hosts to its system and negotiate with its personnel [11]. However, this method is not effective because personnel utility in meeting is still fluctuating until the due time.

The three points mentioned in Figure 1 describes the main problem of GCS, which is incomplete information. The information about personnel schedule may be left blank or not blank but cryptic. Blank utilities are either because of the personnel reluctance to share or their unknown situations regarding the future schedule. On the other hand, cryptic utility comes from their difficulties to reveal their convenient utility. Without complete information, optimal schedule is difficult to achieve.

This study attempts to find the solution of incomplete information problem in meeting scheduling. When personnel utility delivered by each member of the personnel is suspected to be the root problem, assignment information from each meeting host can be gathered as an alternative scheme to get the personnel member's utility information. This scheme is named host-to-host scheme and has been mentioned in previous work [12, 13]. The personnel member becomes passive by only receiving the meeting invitation, whilst a meeting host inputs the meeting requests which are delivered by system as personal schedules if GCS meets the appropriate timeslot.

Host-to-host meeting scheduling involves multiple meetings from multiple organizations such as shown by the previous work [14, 15]. GCS detects meeting conflicts if the invited personnel have been scheduled by a previous meeting. Assuming that every meeting tends to invite personnel using this GCS scheme, meeting scheduling can use complete information without the risk of personnel reluctance to use GCS. Therefore, personnel only get meeting invitation that is free from conflict. By the time the new meetings emerge, every host can communicate to each other to handle any conflict and negotiate their constraints.

3.2. Stable Scheduling

Personnel preference of meeting depends on the existing situation. The conflict may come over time and influence the personnel availability in meeting scheduling. Even though the CTm has been proved to be a non-manipulable mechanism [16], utility is not only about personnel preference, but also personnel availability or conflict. Since the probability of schedule conflicts emerges in uncertainty, a meeting schedule will never be fixed until the due time.

This study designs a meeting scheduling to produce a more stable scheduling by adapting pivot value from the CTm in a host-to-host negotiation. The aim is to avoid rescheduling when conflicts occur after a meeting has been scheduled and published. There are some strategies introduced in this paper that can be chosen for either unscheduled meeting or scheduled meeting.

3.3. Win-win Solution

The negotiation strategies proposed in this paper are inspired by the conflict handling mode [12]. To implement the strategies, this paper raises a variable in meeting scheduling with the host-to-host negotiation scheme, namely quorum. This variable is attached to a meeting role, which is defined below:

$$quorum = quorum\, percentage\ x\ number\ of\ invited\ members \quad (5)$$

Quorum or minimum number of attendees is usually used to define meeting success when a meeting has been held. Quorum is not used to define a meeting schedule which is not successful yet. In a host-to-host scheme, quorum variable can be used in meeting scheduling negotiation process to reach a win-win solution when a conflict occurs as shown in Figure 2.

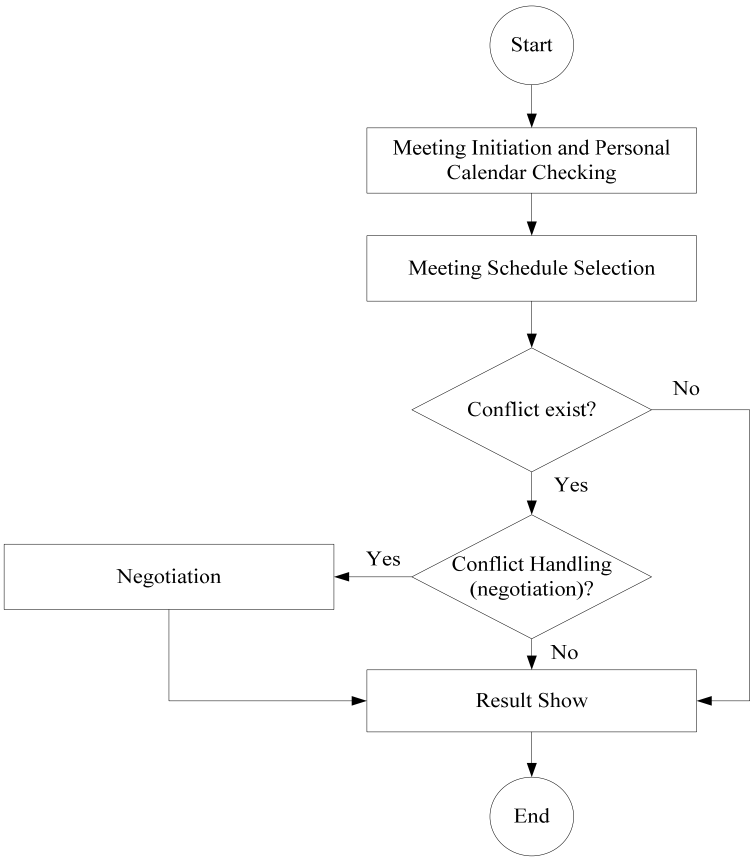

Figure 2. Meeting Scheduling with Host-to-Host Negotiation Scheme Flowchart

Negotiation is triggered by personal schedule conflict. The conflict is detected after meeting schedule is selected. The system will check the personnel availability based on their personal calendar to determine the member who may not attend the meeting. Furthermore, conflict handling is called negotiation whose procedure is explained below:

Procedure Host-to-Host Negotiation

```
Input: mayNotAttend, unscheduledMeeting, scheduledMeeting
Output: attendee_um, attendee_sm
nm← gets numbers of mayNotAttend personnel
na_um← gets numbers of attendees in unscheduledMeeting
attendee_um← gets a list of attendees in unscheduledMeeting
na_sm← gets numbers of attendees in scheduledMeeting
attendee_sm← gets a list of attendees in scheduledMeeting
quo_um← gets unscheduledMeeting quorum
quo_sm← gets scheduledMeeting quorum
for i=1, i<=nm, i++
  pivot_um ←gets pivot mayNotAttend(i) in unscheduledMeeting
  if pivot_um = 0 and na_um - 1 > quo_um
      attendee_um ← update attendee, unassign member mayNotAttend (i)
                      in unscheduledMeeting
      na_um ← na_um-1;
      else
         pivot_sm ←gets pivot mayNotAttend(i) in scheduledMeeting
         if pivot_sm = 0 and na_sm - 1 > quo_sm
             attendee_sm ← update attendee, unassign mayNotAttend (i)
                             in scheduledMeeting
             na_sm ← na_sm-1;
        else
             subtituted_um ←find subtituted mayNotAttend(i)  in unscheduledMeeting
             if subtituted_um  exists
                 attendee_um ← update attendee_um, subtitute mayNotAttend (i)
                                 with other personnel
                 else
                     subtituted_sm ←find subtituted mayNotAttend(i) in scheduledMeeting
                     if subtituted_sm exists
                        attendee_sm ← update attendee_sm, substitute member
                                        mayNotAttend (i) with other personnel
                     end
             end
        end
  end
end
```

Negotiation strategies selected by unscheduled meeting or scheduled meeting is based on the meeting's status. The strategies are designed to keep the number of meeting attendees satisfying the meeting quorum.

4. Simulation Results

Since this study uses a different scheme of negotiation, a new measurement is proposed to define meeting scheduling success. The objective is to fulfill meeting quorum; otherwise, the meeting will fail and need to be rescheduled as a new meeting request. Meeting failure (F) is defined as (2).

$$F \in \mathbb{N} + \begin{cases} \mathbf{0}, & \text{if (number of attendees} \geq \text{quorum)} \\ \mathbf{1}, & \text{if (number of attendees} < quorum) \end{cases} \tag{6}$$

Meeting failure measurement simulation in this study takes 4 scenarios, which are the combination of different calendar densities and quorums as depicted in Figure 3.a., 3.b., 3.c., and 3.d. Calendar density is the occupancy of personnel schedule in the ranges of 20%-50% and 20%-80. Meanwhile, quorum or the number of minimum attendees in each role used in this study is between 50% and 80%. Every meeting invites between 5-25 personnel members and a period takes 14 days with 8 times a day. This simulation aims to show the performance of host-to-host negotiation (H2H) compared to personnel-to-personnel negotiation (P2P) which does not use quorum and requires meeting acceptance by all personnel.

Figure 3(a) and Figure 3(c) show almost the same number of failed meetings by using P2P negotiation caused by the same calendar density setting of 20%-50%. Similar rate is also shown in Figure 3(b) and Figure 3(d), but with a higher number of failed meetings caused by a denser calendar, 50%-80%. Since the negotiation does not use the quorum, the result of P2P negotiation is not influenced by quorum setting. In another case, H2H negotiation has decreased the number of failed meetings in P2P negotiation. The result of H2H negotiation is influenced more by calendar density and followed by quorum setting.

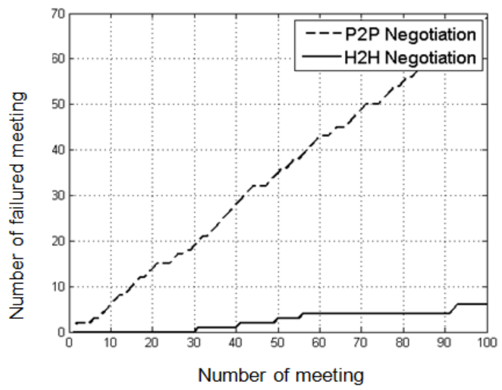

Figure 3(a). Number of failed meetings with 20%-50% calendar density and 50% quorum

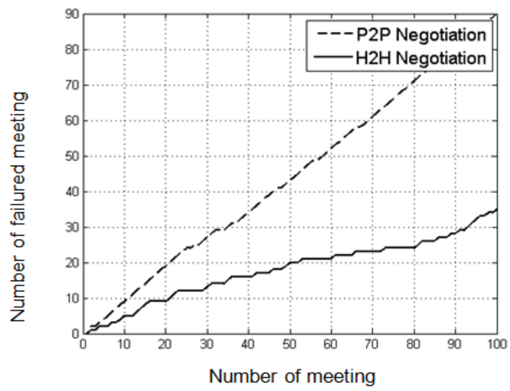

Figure 3(b). Number of failed meetings with 20%-80% calendar density and 50% quorum

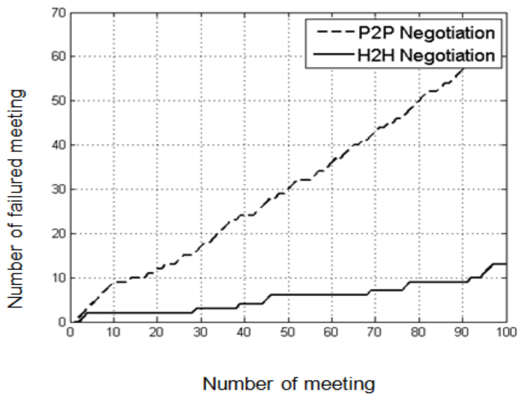

Figure 3(c). Number of failed meetings with 20%-50% calendar density and 80% quorum

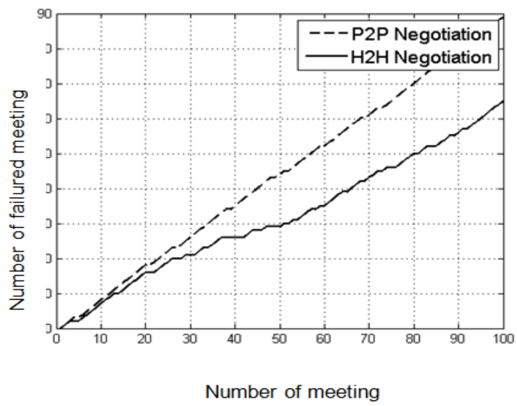

Figure 3(d). Number of failed meetings with 20%-80% calendar density and 80% quorum

The simulation is built for multiple meetings from different organization environments. The number of meeting failures increases as the number of meetings increases. Figure 4 shows the simulation results with the additional category of 50-80% calendar density. The meeting failure is an average of 30 iteration simulations. The simulation aims to quantify the influence of different complexity of the environment by calendar density and quorum setting.

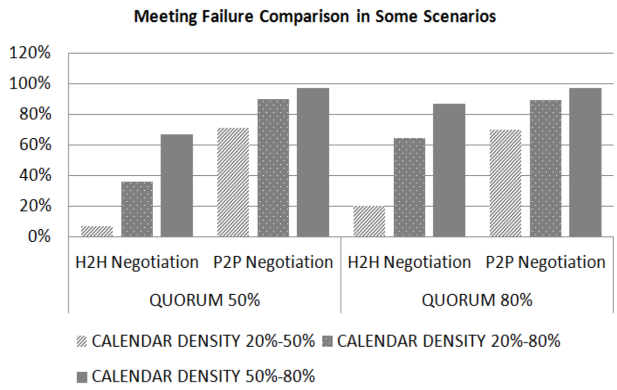

Figure 4. Meeting Failure with Some Scenarios

Based on Figure 4, the meeting scheduling with H2H negotiation has fewer failed meetings. Its number of meeting failures is affected by meeting quorum with increases below 30% for three scenarios. On the other hand, meeting failures increase for approximately 30% for different calendar density scenarios. Since quorum setting relates to the unassignment strategy and calendar density relates to the substitution strategy, accordingly the H2H negotiation can be optimized by setting the invited personnel member or by optimizing the search for substituted personnel.

Since quorum is set by a host, meeting failure can be avoided by using the loose quorum. However, calendar density which significantly influences the failure of a meeting depends on other meetings. Therefore, negotiation strategies are important to manage the conflict. This study describes the use of negotiation strategies to examine their usability in different scalability. Meeting scheduling without negotiation in simulation refers to the other scheme negotiations. Since this study uses the host-to-host negotiation scheme, the comparison to other schemes must be elaborated. The future works will explain about it.

5. Conclusion

This study explains the use of the unassignment strategy and substitution strategy in a host-to-host negotiation scheme for scheduling a meeting. The variable of quorum is consequently proposed to gain win-win solution between conflicted meetings; therefore, not every conflict can cause meeting failure. Based on the simulation results, calendar density has significant influence on both meeting scheduling without negotiation and with negotiation. Meanwhile, changing the quorum constraint only influences meeting scheduling with negotiation because in meeting scheduling without negotiation one conflict immediately causes meeting failure.

Acknowledgement

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References

[1] P Marshall, RI Whitfield, A Duffy, M Haffey, S Water. A new model for high value meetings. 2015.
[2] S Junuzovic, P Dewan. *Towards self-optimizing collaborative systems*. Proceeding of the ACM 2012 conference on Computer Supported Cooperative Work. 2012.
[3] B Marcinowski. Flexible meeting scheduling. 2014.
[4] EM Shakshuki, SM Hossain. A personal meeting scheduling agent. *Personal and ubiquitous computing.* 2014; 18(4): 909-922.
[5] H Lee. Your time and my time: a temporal approach to groupware calendar systems. *Information & Management.* 2003; 40(3):159-164.

[6] G Leshed, P Sengers. *I lie to myself that i have freedom in my own schedule: productivity tools and experiences of busyness*. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. 2011.
[7] E Crawford, M Veloso. *Mechanism design for multi-agent meeting scheduling including time preferences, availability, and value of presence*. IEEE/WIC/ACM International Conference. 2004.
[8] SJ Russell, P Norvig, JF Canny, JM Malik, DD Edwards. Artificial intelligence: a modern approach. New Jersey: Prentice hall. 2003: 679-688.
[9] E Ephrati, G Zlotkin, JS Rosenschein. *A non-manipulable meeting scheduling system*. Proceedings of the 13th international workshop on distributed artificial intelligence. 1994.
[10] J Cook. Mechanism Design and Veto Mechanisms for Sequential Meeting Scheduling. 2007.
[11] A Grubshtein, A Meisels. *Cost of cooperation for scheduling meetings*. Intelligent Distributed Computing III. Springer. 2009: 227-236.
[12] QW Lishuo Zhang. A Community Detection Algorithm Based on NSGA-II. *TELKOMNIKA Telecommunication Computing Electronics and Control.* 2016; 14(3A): 288-296.
[13] YHYN Jun Li. A Similarity Detection Method Based on Distance Matrix Model with Row-Column Order penalty Factor. *Bulletin of Electrical Engineering and Informatics.* 2014; 3(4).
[14] J Grudin. Groupware and social dynamics: eight challenges for developers. *Communications of the ACM.* 1994; 37(1): 92-105.
[15] SP McKechnie, JE Beatty, et al. Contemporary calendar management: Exploring the intersections of groupware and personal calendars. *Management revue, Socio-economic Studies.* 2015; 26(3): 185-202.
[16] L Palen. *Social, individual and technological issues for groupware calendar systems*. Proceedings of the SIGCHI conference on Human factors in computing systems: the CHI is the limit. 1999.
[17] F Wang. Adaptive meeting scheduling for large-scale distributed groupware. *BT technology journal.* 2003; 21(4): 138-145.
[18] B Marcinowski. Flexible meeting scheduling. 2014.
[19] R Megasari, K Kuspriyanto, EM Husni, DH Widyantoro. Towards host-to-host meeting scheduling negotiation. *International Journal of Advances in Intelligent Informatics.* 2015; 1(1): 23-29.
[20] PJ Modi, M Veloso. *Bumping strategies for the multiagent agreement problem*. Proceedings of the fourth international joint conference on Autonomous agents and multiagent systems. 2005.
[21] O Korjus, et al. Meeting scheduling assistant, automatic scheduling between heterogeneous calendar systems. 2012.