Coordination in Multi-Project Construction Environment

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Abstract—**Construction project manager spends a large portion of his time in communication with project stakeholders. This is why careful preparation of a detailed Project Communication Plan is mandatory. The Communication Plan will encompass communication pertinent to a particular project. This will satisfy the Project Owner. A contractor, however, will have multiple ongoing projects and may own some of them. The multiple project management is usually addressed with resource scheduling and planning. But, once the first shovel hits the ground, unexpected situations develop that might affect multiple projects: failing subcontractors working on several projects, transport fleet problems, concrete production plan scheduling, floating teams servicing multiple projects. Such issues should be addressed at a different corporate altitude, and usually by officials from different departments and different altitudes which is why traditional vertical hierarchy fails swift resolution. This paper describes a framework for horizontal, vertical and diagonal hierarchical coordination based on the model of Multidimensional Preemptive Coordination. A group of people, from different corporate sources and altitudes, coordinate a business problem via a private corporate social network. Multiple corporate social networks are coexistent. The system maintains vertical visibility and provides a verifiable audit trail of actions increasing corporate accountability at all levels.**

Index Terms—**Enterprise coordination, multi-project coordination, project coordination.**

I. INTRODUCTION

Communication is the backbone of modern construction enterprise and is critical to project success. Organizations that communicate more effectively have more success in meeting project goals, finishing on schedule and within budget. Among those that have implemented highly effective communications, 80% of the projects meet original goals versus only 52% of the projects in companies with minimal communication channels [1]. Those companies are also more likely to finish project on time (71% versus 37%) and within the budget (76% versus 48%). On average every two project out of five are not successful to meet their original goal and business intent, and poor performance on half of those unsuccessful projects is related to ineffective communication.

Project communication should not be limited to internal stakeholders. It should encompass everybody that comes into contact with the project, from executives, end users, project managers and their team. It might be profitable even to include a communication strategy for the public. PMI [2] suggest five steps to improve communication: position communication as strategic function, define the target, make it a group effort, integrate a variety of messaging media and

every once in a while get an external opinion.

With the increasing significance of communication for the success of the project, the project manager is spending more and more time in meetings with internal and external stakeholders, his own team, subcontractors, upper level management, preparing reports and resolving issues.

There are two different views to construction project management: the owner's view and the contractor's view. The owner's project manager has the responsibility to supervise and monitor the progress, coordinate possible project changes, approve work done and mediate disputes. His communication may also be intense but he is communicating at a higher altitude, and, in general, is not involved in every day operational issues. Contractor's project manager, on the other hand, is coordinating with a number of departments inside the enterprise, the suppliers, the subcontractors, floating corporate teams servicing other projects beside his own, his own team and upper management, as well as the owner's project manager and owner's interested parties. He prepares progress reports, requests for materials and equipment, his crew time sheets and addresses any unplanned event that emerges on the construction site. His schedule is overloaded with meetings, phone calls and emails and it is understandable that poor project communication might result in delays and disruptions that lead to poor project performance. Once the project starts, unexpected and unplanned events occur and he constantly has to extinguish operational fires.

This paper addresses the communication challenges that the contractor's project manager faces. It describes a framework that, based on problem tuned social networking, allows him to be in constant and continuous coordination with project stakeholders, be immediately alerted of new developments and approaching or missed deadlines anywhere in the enterprise that are pertinent to his project. Progress reports and issues posted to the corporate social network are immediately routed to predetermined stakeholders and propagated vertically to appropriate management. The problem oriented framework easily coordinates issues across multiple projects.

II. METHODOLOGY

The observations formulated in this paper are the result of author's inside and outside participation in project management for construction and other enterprises in former Yugoslavia, spanning over three decades. The insights were obtained during interviews with project managers, stakeholders' meetings and data analysis while introducing information technology procedures in estimating, scheduling and site management.

During this period, three distinct intervals were recognized, pertinent to three different environments and author's role in a

particular corporation. During the first interval, from 1981-1986, the author was CIO of a large facility and assembly corporation with an average of 40 construction sites yearly, both domestic and abroad, each lasting from few months to few years. In 1983, a multidisciplinary team was assembled to integrate estimating, bidding and site reporting into corporate information system. Team members led numerous comprehensive interviews with project managers and field personnel that were to reveal details of project business daily activities and its interaction with stakeholders in other corporate departments and projects.

From 1987 to 1990, the author was project manager in the largest electrical manufacturing and assembly company, leading a project of gas stations integration into the information system of country's largest oil company. The project was a joint venture with one of the largest European computer and software providers. During this time, the author led numerous meetings and interviews with joint venture project managers, head departments and engineers, gaining insight into interdepartmental coordination and multi-project environment in a large multinational company.

During the last interval, from 1992 to 2013, the author was the CEO of a software provider for construction enterprises. A total of 114, mostly construction companies, were processed, including two from the top ten construction companies in Croatia. The companies ranged from small with few concurrent projects to large ones with over thirty concurrent projects. The projects duration ranged from a month to few years and both single project and multiple projects per project manager were encountered. The software implementation mandated extensive communication with project personnel including their interaction with other stakeholders and projects.

III. TRADITIONAL PROJECT COMMUNICATION

A. Project Communication

Traditionally, project managers follow communication best practices described in Project Management Body of Knowledge [3] where a separate chapter is dedicated to processes which ensure successful project communication. The Project Communication Plan defines how the information is generated, collected, distributed, retrieved and disposed of. It is an essential part of any project and includes four distinct steps: communication planning, information distribution, performance reporting and stakeholders management. Planning is mostly done in the early phases of the project. The planning team will define who receives what information, how often, what media should be used and sender-receiver models. Information distribution and performance reporting are mostly one way information flows. Stakeholder management refers to the communication with the parties that have interest in the project and defines ways to resolve issues, change requests, corrective actions and updates or lessons learned that will become part of corporate knowledge database. Face to face meetings are recognized to be the most effective way to communicate with project stakeholders and resolve the issues. When the meetings are not practical or cannot be scheduled on time, telephone calls, electronic mail

and other tools are used. The number of stakeholders in an average construction project is such that the project manager spends a lot of his time communicating.

Leybourne, Kanabar and Warburton [4] calculated that in the case of four stakeholders in a project, there would be 66 communication paths. If there were 20 people on the project, the number of communication paths would rise to 190. The number of communication links could be reduced if the stakeholders could be grouped into subgroups, so that the project manager could communicate with the group as a whole, and further communication could be performed inside the subgroup. This implies that a new level of hierarchy is introduced into the communication channel. They conclude that "communication complexity can result in communications failure in large projects" and suggest subgrouping as a solution a project manager could adopt.

The communication complexity is not particular to large projects and its relation to delays and disruptions that lead to cost overruns has been established. In the performance review of cost overruns for Florida Department of Transportation – FDOT [5] a total of 102 projects were analyzed, having the budget of US$ 302.7 million. The purpose of the review was to understand to what extent are construction cost overruns avoidable and what actions can be taken to minimize the cost overruns and improve accountability for these problems. It was found that the total cost overrun was US$ 28.6 million (a 9.5% of the budget) with more than half of those (US$ 15.6 million, 5.2% of the budget) were classified as avoidable costs. About 1.4% of the budget (US$ 4.2 million) of avoidable costs represented plain waste of money. The analysis concluded that the responsibility for cost overruns was shared among consultants, third parties and FDOT staff. The reviewers recommended additional steps to hold the participants accountable, implying better and auditable communication.

A survey of owners led by Construction Management Association of America [6] gave insights to the importance of communication problem in construction projects. When asked "which changes would most significantly contribute to improving the quality of project delivery resulting in a greater number of successful projects" the owners, by far (over 60%), put "More effective communications" in the first place. When asked what practices they use to improve the communication, over 60% indicated four main practices: early team assembly and frequent meetings, provide clear contact for decisions and approvals, openly share project information, meet with service providers.

Although face-to-face meetings are declared as most effective and seem to be the prevalent choice of communication to resolve issues, as the number of stakeholders rise, time spent in meetings increases prohibitively. This nudges the meeting organizer to broaden the number of participants, arguably, to resolve multiple dependent issues at the same time. This approach shows some serious drawbacks. Romano and Nunamaker [7] performed an analysis of meetings which shows that in corporate America an average of 9.6 hours per week is spent in meetings and that this represents between 8% and 15% of the company personnel budget. Depending on the company size, an average 15 participants attend and the total cost of corporate

meetings is between US$ 50 million and US$ 70 million annually. The biggest drawback the study revealed was that 73% participants questioned meeting effectiveness due to poor planning, 11%-25% of time was spent on irrelevant issues, and 33.4% consider meeting time is unproductive. The majority of surveyed executives concluded that 20% to 30% of the meetings were not needed at all.

Meeting inefficiencies are echoed in the CMAA/FMI report [6], which establishes office tools, electronic mail and project scheduling software as de facto standard for collaboration and coordination in construction enterprises. It states that they fail to fulfill corporate expectations. The majority of participants perceive that project scheduling software is "used effectively now" and "could work," but highlighted "provide leadership for project collaboration" as number four out of 13 responsibilities that need improvement.

B. Multi-Project Communication

Managing multiple projects concurrently today is concentrated mostly to the planning phase. Little has been researched about emerging developments and issues during construction that might influence the performance of other concurrent projects.

Cohen, Mandelbaum, and Shtub [8] have researched critical chain methodology for planning, scheduling and controlling multi-project systems. The methodology explores the interaction between activities' precedence relations and resource constraints. They conclude that time buffers may not suffice to control multiple projects but that most reasonable controls would actually improve performance of an uncontrolled system.

Anavi-Isakow and Golany [9] propose constant number of projects in process and constant time in process as an alternative approach to the management of stochastic multi-project environments. They conclude that those methods result in easier monitoring of the projects in the system, easier forecasting of completion times and positive effects on productivity.

There is extremely scarce communication between construction projects today. Each project manager is focused on his own project and result delivery. As the resource availability is always limited by the real situation, they would strain to secure the resources for their own project regardless the needs of other projects. This is true even in the case of a single project manager managing multiple projects, a situation frequent in small companies. In such a situation, projects would be prioritized and resources distributed accordingly.

Multiple projects are coordinated on a corporate level (division, department) in regular monthly (bi-weekly, weekly) meetings but the transparency of a single project is tainted by project manager's subjectivity. Project managers tend to be protective about the projects they manage, they don't boost projects anomalies but they highlight its accomplishments. Malmendier and Tate [10] established a relation between managerial overconfidence and sub-optimal corporate investment decisions. This holds true on all managerial levels, which may lead to subjective, over-optimistic estimates about goal achievement. The author witnessed a situation where such practice led to corporate loss that was not even registered.

A small contractor had two construction sites, which were private housing projects, practically at the same location, just a mile apart. At one site the earth excavation activity produced gravel and small boulders that were transported to a public depo. At the other site, such a material was needed to level the ground and was purchased and transported from a corporate supplier. The schedules, by chance, overlapped, although initially diverged in time, but could result in significant savings had there been enough project transparency and awareness at the proper corporate altitude. One of the project managers was aware of the situation, but, when asked by the author why he didn't volunteer the information vertically, said that he minded his own business. This is a frequent situation in contractor companies, as the pressure to deliver results on time, coerce each project manager to "play it safe". No apparent damage was done, as each of the projects proceeded according to their planned schedules.

This episode illustrates that in real life new developments emerge that cannot be foreseen by preceding planning and should be handled by transparency and prompt vertical awareness. Furthermore it uncovers the financial significance of missed opportunities and underlines the importance of multi-project coordination. Unexpected developments, failure to respond quickly and delays due to lack of swift communication, may cause notable financial consequences.

A research on causes of cost overruns in large transportation projects [11] revealed the fact that cost overruns were not caused by a single catastrophic event, but, rather, by numerous small disruptions and delays that were undetectable until their cumulative financial effect became significant. The sample of the study was substantial, 258 projects in 20 countries (America, Japan, Europe and 3rd countries) worth approximately US$ 90 billion. The analysis showed that 84% of the projects were late and that average cost overruns were 28% of the budget. The study further showed "very high statistical significance" of cost escalation dependence on the length of the implementation phase, which was due to delays and avoidable errors.

IV. CONTINUOUS COORDINATION

Communication represents the nerve system of enterprises of all sizes, across all industries. The success of a company depends heavily on the ability of the management to implement effective organizational structure with fluid communication of information both horizontally and vertically [12]. This is true on all corporate levels. The growing complexity of contemporary business life, the number of emerging issues that need project manager's attention, demands more communication effort and more collaboration with project stakeholders, which, in return, results in less time to address daily construction details. The project manager is overwhelmed with events that make him prioritize and disregard small inconsistencies. This results in unnoticed delays and disruptions that ultimately lead to schedule delays and cost overruns which proved to be quite common and constant over last 70 years [11]. Traditional autocratic top down management directive enforcement

proved insufficient to cope with new business realities. Both scholars and practitioners became aware of the changed business environment and began to search for alternative ways to improve project management.

McDonald [13] defines six forces that will influence the change in corporate management practices. The imperative of business sustainability and the tumult of global markets are global in nature and a consequence of changed business environment. The decline of organizational hierarchy emerged due to poor performance of traditional organizational breakdown structure in new business circumstances. It is evident that swift reaction to emerging issues is possible only if the responsibility is delegated to the operational level to a larger extent. The organizational hierarchy, however, will not disappear, because corporate management would become chaotic, but its structure will gradually change from divisional (departmental) to problem oriented management. The virtualization of work, open source work practices and the rise of Generation Y values address new opportunities due to new technology.

Leybourne, Warburton, and Kanabar [14] investigate those principles further, in the context of project management. McDonald's [13] six forces have strong correlation to existing project management, which suggest that modern project management has already starting to move towards, what they call "Project Management 2.0". They observed trends in project management which show that the shift to new project management ways has already began. The rise of the generation Y resulted in a new kind of stakeholder relationship management with strong social networking component. The XY generation behaves more like entrepreneurs and it is often expected that they improvise to resolve issues as they arise. McDonald's [13] "virtualization of work" is related to virtual teams in project environment and "tumult of global markets" to global projects. The "decline of organizational hierarchy" necessarily leads to "redefinition of the role of the project manager" as the decision making is lowered to the operational level.

This shift in project manager's behavior may not help project manager's burdened schedule. On the other hand, the number of stakeholders is not likely to decrease and more responsibility at the operational level will tend to increase the number of issues that the project manager has to manage. The project manager will be forced to delegate responsibility to lower operational level which will make it more difficult to stay "on top" of the problems. Virtual meetings are almost as difficult to organize, as are face-to-face meetings, because of the participant's schedule congestion. In construction, a resolution of an emerged issue often demands a group of people from different departments and corporate altitudes that are inherently outside project manager's scope of influence, and hence, cannot be characterized as "virtual team".

Consider a project with delayed concrete pouring activity due to weather conditions. The reschedule of the activity should be coordinated probably with Concrete Production Plant and Transport Fleet involving officials from different enterprise altitudes. This might even trigger rescheduling concrete delivery to other projects. Such kind of business problem cannot wait for corporate meeting at the headquarters next week or in two weeks. Today it would be addressed by telephone calls, electronic mail or social networking tools. However, it is important to recognize that this is not a "team collaboration" but a joint effort that a group of corporate professionals invest in solving a particular business problem. Similar issue in another project or the same issue at a different point of time, or different project stage, might involve different professionals, so we should be talking about problem or topic collaboration.

Enterprise Social Collaboration (ESC) quickly gained popularity and first surveys revealed a number of advantages that adopters of the new technologies enjoyed. Borg [15] surveyed 629 organizations that used social media and next generation communication technologies (integrated voice, mobile, video, instant messaging / chat and presence). ESC adopters showed significant business performance advantages over non- users: they had 71% higher operational efficiency, 51% greater on-time project delivery, 30% higher customer retention and 28% greater success in accessing business information within the required time frame.

At the same time, less attractive characteristics of corporate social media came out to the light of the day. Castellina [16] researched the adoption of social business practices in ERP systems and their integration into corporate everyday life. As expected, the enterprises that adopted new technologies performed better in a variety of Key Performance Indicators (KPI), but the research revealed a number of challenges. The survey involved 344 respondents and 46% indicated that "data is too siloed to effectively share knowledge across the enterprise". Another 37% declared they lacked infrastructure and tools to quickly and easily share pertinent information and another 34% said they were unable to convert collaborative data into business execution. The inability to aggregate too many voices into a single solution to problems was selected by 21% of the respondents. All those challenges indicate that data overload is a serious downside effect of the social approach to business problem resolution.

Bruno *et al* [17] researched key challenges for enabling agile Business Process Management (BPM) with social software, which has the following four features: weak ties, social production, egalitarianism and mutual service provisioning. Social production breaks with the paradigm organizational hierarchical structures. They concluded that the success of this approach is highly dependent on business rules defined, which, on complex business systems, might be difficult to articulate.

Social network capabilities applied to issue management evidently shows advantages over traditional hierarchical top down directive enforcement. If we could constrain the visibility of the participants to problem at hand, we could achieve a highly focused group of professionals concentrated on the issue resolution. They would need to have their private social network wall (or topic wall) where they could constantly post progress, new developments, discuss alternatives and possibly resolve the issue before meeting in person. If face-to-face meeting was still necessary, the participants would be better prepared. As no synchronized schedules are necessary, the participants can coordinate at any time, ultimately achieving *continuous coordination*.

This paper proposes such a framework where a business problem is addressed by multidisciplinary group of

professionals interacting on a social network topic wall. Each topic can generate subtopics with different participants creating a thread of hierarchically delegated chain of responsibility that trespass departmental limits. There are multiple threads coexistent in the enterprise, each one creating a new closed problem oriented corporate social network. Each participant interacts at the altitude he was introduced, with optional visibility into the depth of the thread. Each participant's activity is automatically pushed into the visibility horizon of his upper management, so that problem transparency is maintained and Organizational Breakdown Structure observed. When a thread is closed, it becomes part of the corporate knowledge base. The framework is based on the model of Multidimensional Preemptive Coordination.

V. MULTIDIMENSIONAL PREEMPTIVE COORDINATION

The model of Multidimensional Preemptive Coordination was first described by Bacun [18] as a model of corporate wide communication infrastructure to face emerging business problems and report progress. The system maintains an auditable trail of work done and alerts of approaching or missed deadlines. It forms a collaborative platform that enhances accountability across the enterprise, at all altitudes. It is problem or issue oriented and allows creation of multiple topic sublevels that are not constrained by organizational structure. The model was extended to allow stakeholders external to the company to participate in discussions in a safe way [19]. External participants are introduced at a particular altitude of the topic, and are allowed to view only subtopic levels.
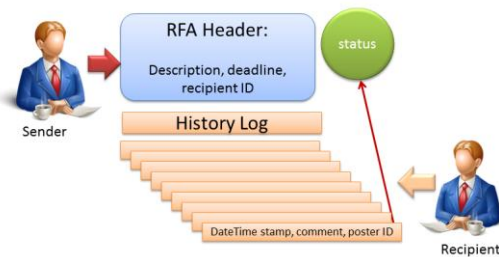

Fig. 1. Simple request for action (RFA).

In the simplest form, a Sender issues a Request For Action (RFA) to the Receiver as in Fig. 1. The request has a header and history log. The header, among other data, contains a description, deadline and status. The scope of a RFA, as well as closure, is governed by the Sender. The Receiver cannot change the header data, except for the status. The status options are definable on a corporate level and should represent real business states. Both the Sender and the Receiver may change the status, signaling the other party of new developments. The system will change the status in case of approaching or missed deadlines or other detected system events automatically. The alert window is set in the header.

The receiver will post progress, notifications and new developments in the history log. The system will assign a time stamp and a unique identifier to the post. The Sender may also post to the history log, discussing developments particular to the problem, but neither can delete log entries. The sender may invite other participants into the discussion from any altitude or department or even external to the company. Any invitee may post into the log at the level he was invited. The history log is private to the participants, updated by system notifications and becomes an auditable topic billboard of multidisciplinary group of professionals, focused to solve a particular business problem.

Whenever multiple departments are involved, the issue of vertical coordination immediately surfaces. The model allows the definition of Organizational Breakdown Structure and participant's log into the system establishes his position in the hierarchy. A received RFA immediately enters into the visibility horizon of the recipient's supervisor. The supervisor may participate in the discussion and may assign the request to another subordinate, but the system will log such a change. A post or status change will immediately propagate vertically across corporate hierarchy for each participant.
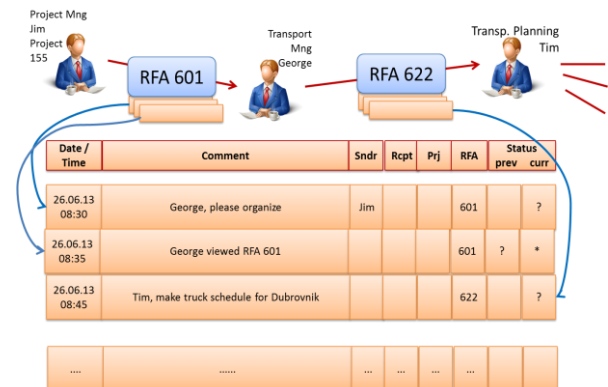

Fig. 2. Linked requests for action.

In real corporate life, the recipient will often need further assistance from a subordinate or professional in another department. The project manager may issue a RFA to the transport manager who would issue u new RFA to transport planning. The system will link both requests as shown in Fig. 2. Both history logs will be integrated into a single topic wall but each participant will have a tailored view at the level he was introduced into the topic (the received RFA) and eventual subtopics he started.

Each Sender may decide to be alerted of new posts one level deep only, which is the default, or to a particular sublevel depth for each sublevel thread. He may decide which statuses will be propagated to his level unless the upper management decided the status change propagation is mandatory.

A particular individual is participant in multiple topics. All new posts from topics he participates in are presented chronologically as his News Wall, which is tailored to his horizon of visibility. Any comment, progress report or status change made by anyone in the enterprise, is immediately visible on his News Wall, provided he is a topic participant, the post is at the appropriate topic level and is allowed by his choice of depth visibility. He can further filter the News Wall

by date, topic, participant or status. From the News Wall he can easily participate in any topic by selecting the post and respond to it. The system will time stamp it and route it to the appropriate history log.

A topic may be small, like a single RFA, or large thread of RFA subtrees but is always oriented to solve a particular business problem. A topic, in effect, is a problem oriented corporate social network that doesn't conform to rigid corporate structure, whereas, at the same time, complies to the Organizational Breakdown Structure and keeps the management in the loop. Deadlines are used to alert both vertically, horizontally and across topic hierarchical structure. Multiple networks are coexistent in the enterprise whereas the information routing, alert propagation and audit trail is maintained by the system.

Emerging challenges are easily faced. When an event that needs attention is observed, a RFA is issued and participants assigned that can immediately collaborate on resolution. Steps are logged by the system which might be very important, especially in construction projects, where a particular improvisation might be hidden from view by site progress.

VI. Multi-Project Coordination

The model of Multidimensional Preemptive Coordination easily faces real life situations that affect multiple projects. As it is problem oriented network, it seamlessly crosses departmental boundaries as shown in Fig. 3. If a participant feels that he needs professional assistance from another department or project to resolve an issue, he will invite him into a subtopic. If his boss feels other individuals need to be kept in the loop, he will invite them into his subordinate thread. The invited professional will immediately be notified of the invitation on his News Wall and he would be able to respond when it is most convenient. Should he not acknowledge the participation, the Sender will be alerted. The model allows quick assembly of the right group of professionals, immediate propagation of new developments across the enterprise and an audit trail of actions taken.

In the above example of forced reschedule of concrete pouring activity, the project manager would issue a RFA to the production planner at the Concrete Production Plan. The production planner would issue a RFA to transport planner in the Transport Division. The upper level management in Concrete Production Plant and Transport Division as well as Projects Division would be notified of new development and would become participants of this topic. If the new concrete delivery schedule would influence the delivery to other projects, those projects managers could be invited into the topic and participate in the emerged problem.

The full multi-project potential of Multidimensional Preemptive Coordination comes into view if we take the above situation a step further, as is often the case in real business life. Suppose the new concrete delivery schedule mandates reordering of the gravel for concrete production. In that case, a RFA would be issued to Procurement Division and another one to the gravel supplier. If the supplier cannot meet the deadline, he would then post the reason in the history log and change the RFA status. This change would be visible

to both the project manager and production planner in Concrete Production Plant. If supplier's deadline was missed, then the system would flag the RFA and the missed deadline flag would be propagated through the thread and participant's vertical organizational management structure. Project stakeholders would know that something has happened that might endanger the standard project workflow and that some kind of action was needed. They could discuss the possible outcomes immediately, without meeting, by posting to their News Wall. Each participant could engage into the discussion at the most convenient time, so no schedule synchronizations would be needed. The system would maintain an audit trail of actions taken. When the issue is resolved, the project manager would close the thread, marking it finished and the thread wouldn't be visible on the News Wall. He, as RFA owner, might decide to reopen the thread, but this would also be logged in the history log.
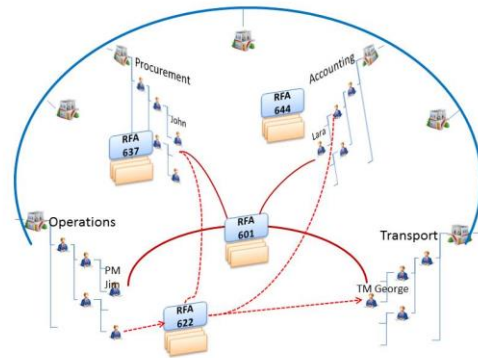

Fig. 3. RFA accross deparmental boundaries.

The described sequence of events would not render meetings superfluous, but it would definitely decrease their number and accelerate issue mitigation. If the face to face meeting was still necessary, the participants would be better prepared. Since the chain of responsibility would be established through the topic thread, it is unequivocally clear who had to do what until when.

This framework is ideal to confront unplanned events which, in construction projects, are quite abundant. Issue resolution that project managers are often forced to improvise, are documented in the history logs. When an issue emerges, a responsible employee is assigned and relevant professionals invited to participate. Responsibilities are delegated through subtopic RFAs and problem focused alert infrastructure is created. The history logs reveal the engagement of each participant so that enterprise wide accountability is established. Such private, problem oriented corporate social networks would be born and die as needed.

The life span of the social network topic doesn't need to be short. One could easily imagine a constant Concrete Production Plant roster, a news feed, where new developments in concrete production would be posted and discussed. Not every project manager needs to be a part of this discussion, just the ones that have concrete pouring activities in their project schedule. Moreover, he needn't be a participant all the time, but only a little time prior and during

the activity. The project manager could easily tailor his alert environment and be sure all pertinent posts would show on his News Walls.

VII. CONCLUSION

Coordination in multi-project environments of today contractor is limited to preconstruction planning, multi-project scheduling or resource allocation. Project Communication Plan addresses communication of a single project with both internal and external stakeholders. When the works start, unexpected and unplanned events occur. Their resolution often mandates actions from different corporate departments which fall out of project manager's influence. The project manager is inundated with communication which causes disruptions and delays not only to his project, but other projects too. This paper describes a problem oriented framework based on Multidimensional Preemptive Coordination, where a multidisciplinary group of professionals continuously collaborate in a private corporate social network environment across multiple projects. A professional is participant to multiple coexistent business problem networks and is alerted through posts to his own tailored News Wall of new developments in topics he participates in. The system propagates alerts not only horizontally and vertically through Organizational Breakdown Structure but also through topic thread trespassing multiple corporate departments and eventual external stakeholders. The system maintains auditability through topic history logs and establishes accountability across the whole enterprise.

REFERENCES

[1] PMI. (2013). Pulse of the profession in-depth report: The essential role of communications. [Online]. Available: http://www.pmi.org/-/media/pmi/documents/public/pdf/learning/thought-leadership/pulse/the-essential-role-of-communications.pdf

[2] PMI. (2013). Communication: The message is clear. [Online]. Available: https://www.pmi.org/business-solutions/white-papers/communication-clear-message.pdf

[3] ANSI, *A Guide to the Project Management Body of Knowledge*, PMI 99-001-2004, 2004, pp. 221-236.

[4] S. A. Leybourne, V. Kanabar, and R. Warburton, "Understanding and overcoming communications complexity in projects," *PMI Global Congress-North America, Washington, DC.,* 2010.

[5] S. M. Ahmed, A. Salman, M. Castillo, and P. Kappagantula, "Delays in construction: A brief study of the florida construction industry," in *ASC Proc. the 39th Annual Conference Clemson University*, 2003, vol. 10-12, pp. 257-266.

[6] CMAA/FMI, *Fifth Annual Survey of Owners 2004, Preliminary Report*, 2004, pp.14-28.

[7] N. C. Romano and J. F. Nunamaker, "Meeting analysis: Findings from research and practice," in *Proc. the 34th Hawaii International Conference on System Sciences*, 2001.

[8] I. Cohen, A. Mandelbaum, and A. Shtub. "Multi-project scheduling and control: A process-based comparative study of the critical chain methodology and some alternatives," *Project Management Journal*, vol. 35, pp. 39-49, 2004.

[9] S. Anavi-Isakow and B. Golany, "Managing multi-project environments through constant work-in-process," *International Journal of Project Management*, vol. 21, no. 1, pp. 9-18, 2003.

[10] U. Malmendier and G. Tate, "CEO overconfidence and corporate investment," *The Journal of Finance,* 2005.

[11] B. Flyvbjerg, M. S. Holm, and S. Buhl, "What causes cost overrun in transport infrastructure projects?" *Transport Reviews*, vol. 24, no.1, pp. 3-18, 2004.

[12] L. E. Bernold and S. M. AbouRizk, *Managing Performance in Construction*, John Wiley & Sons, 2010, pp. 339-39.

[13] P. McDonald, "It's time for management version 2.0: Six forces redefining the future of modern management," *Futures*, vol. 43, pp. 797-808, 2011.

[14] S. A. Leybourne, R. Warburton, and V. Kanabar, "Is project management the new management 2.0?" *Organisational Project Management*, vol. 1, no. 1, pp. 16-36, 2014.

[15] A. Borg, *Enterprise Social Collaboration: The Collaborator's Advantage*, Aberdeen Group, 2013.

[16] N. Castellina, *Solving Social Challenges with Social ERP*, Aberdeen Group, 2013.

[17] G. Bruno, F. Dengler, B. Jennings, R. Khalaf, S. Nurcan, M. Prilla, M. Sarini, R. Schmidt, and R. Silva, "Key challenges for enabling agile BPM with social software," *Journal of Software Maintenance and Evolution: Research and Practise*, vol. 23, pp. 297-326, 2011.

[18] D. Bacun, "Multidimensional preemptive coordination in construction," in *Proc. the 1st International Conference on Management, Marketing, Tourism, Retail, Finance and Computer Applications (MATREFC'13)*, 2013, pp. 182-187.

[19] D. Bacun, "A model of multidimensional interdisciplinary corporate coordination in construction," in *Proc. the 2nd International OFEL Conference on Governance, Management and Entrepreneurship*, 2014, pp. 54.

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