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"The Evolution of C2: Where Have We Been? Where Are We Going?"

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Title:

Organizational Modeling and Simulation in a Planning Organization Final Results

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Abstract

A team of researchers from the Air Force Research Laboratory, Northrop Grumman and Stanford University have conducted organizational research over the past few years; out of this research has grown modifications to simulation software that was utilized by the team to study a planning organization. This paper describes the results from studying organizational change using simulation software, and comparing results against a revised software package to the original design.

This line of research was started by the Virtual Design Team (VDT) research group; initiated at Stanford University in the late 1980s to help managers design organizations and work processes for executing fast-track development of complex products [2]. VDT is an agent-based computational model of a project team and a set of work processes they are attempting to execute in a concurrent manner. VDT has been successfully used to model work activities, communications, and exception handling within traditional organizations working on projects in areas such as construction, aerospace, consumer product development, and healthcare [3]. From the VDT work Stanford University built the Project Organization Workflow model for Edge Research (POWER) software [1]. This software was used to study Edge organizations. The current laboratory, Stanford University, and Northrop Grumman team modified the POWER software and developed Project Organization Workflow model for Information Development (POW-ID), used to develop the models and results shown in this paper.

Introduction

The Air Force Research Laboratory, Northrop-Grumman and Stanford University conducted organizational research in a command and control planning organization over the past few years. This research studied how organizational simulation can help decision makers first understand the organization, and then they would be provided with alternate structures and the pluses and minuses to implementing each change. The simulation tool was one of many used to study this organization and help them through a major re-organization period. The main focus of this paper will be to express the outcome of the research that was conducted. This planning organization conducts numerous course of action developments on a daily basis. The development of the course of action is a long process with numerous steps.

The focus of this paper was to test possible alternatives to operations in the simulation model, examine the results, and use the information to inform decision makers of the alternatives to operations that would result in the best return. Numerous changes can be attempted in the model before implementation, giving leadership options of what alternatives to operations make the most sense and can have the largest return.

Process maps were used to kick-off the start of the modeling and simulation effort and were provided by the customer. Organizational model development continued with conducting interviews of subject matter experts at the customer location. Model development followed the interview process then verification and validation of the model was conducted. Finally, results were generated and briefed to the leadership. This type of modeling and simulation has been attempted in more traditional design and production projects. The application of this tool and methodology is the first of its kind to be applied to a planning organization, meaning the work is cyclical in nature. Different from design and production work where projects are designed, drawings developed, facilities built and manufacturing of the widgets started; planning involves reviewing requirements, deciding on courses of action (COA), communicating those COAs, monitoring its execution, and re-planning of requirements on an as needed basis. The customer group does this for numerous requirements every day. The basis of this research comes from work performed by Stanford University by Dr Raymond Levitt [2]. Their work is based on twenty-plus years of research of various organizations thus building a baseline from which other organizations can be studied.

Background

The research team looked at several ways to assist this command and control organization with this significant reorganization. One tool that was investigated was organizational simulation. The Stanford University team members have had the most history studying organizational development. Their work started in late 1980's and has continued to present day. For this project the research team investigated modifications to the existing VDT design for application to this command and control (C2) environment. This environment called for developing information flow modeling options [4]. The changes implemented focused on three key areas (1) delays from exception handling, (2) time zone issues, and (3) overall user interface changes. The research team implemented these changes into POW-ID. This software can continue activities while waiting for answers to exceptions, runs on a 24/7 time frame and has a new user interface [4].

Methodology

This section will address the approach to the overall application that the software changes were applied. The results show how the changes in the organizational structure were addressed. The problem to be addressed through this research is to make organizational changes that lead to better COA development output for the planning staff. This is only one tool that has been used. Surveys, integrated process teams, and lean six-sigma studies were also used but are not part of this paper. Introductory meetings were held to discuss the environment and the possible outcomes of the modeling effort. Next several data collection trips were conducted. The process started with the examination of the process maps provided by the customer. These maps provided a background from which to begin model development. From the direction of the leadership, the initial model development focused on course of action planning within a particular customer group. Next the team conducted interviews of the organizations to define the current process, inputs and outputs for various processes, communications links, meetings attended, interaction with the hierarchy, and systems accessed. Once all input was captured in the model, model verification and validation was accomplished through follow-up interviews. Figure 1 shows a representation of the COA process providing the tasks performed to include the management activities that are important to balance the workload and coordination times. The model has continued to be updated per the direction of customer leadership to include additional processes.

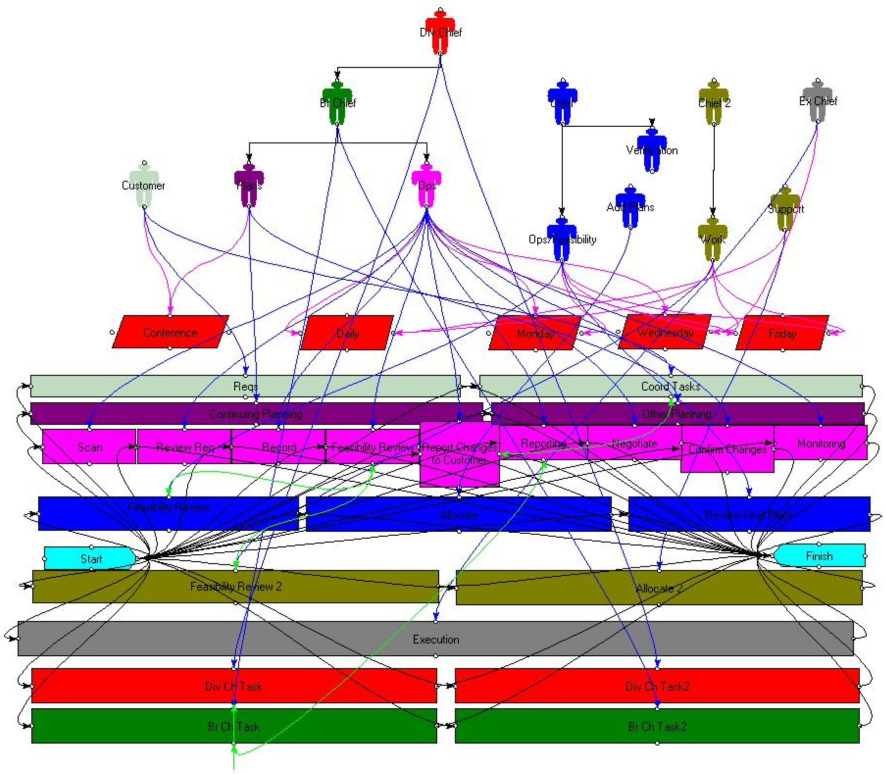

Figure 1 Study Model

Alternatives to operations tested

The following alternatives to current operations were tested in the model:

Table 1 Alternative Models

Proposed Alternatives to Current Ops:	**Description:**
Integrated product team	Combine multiple groups into one large team (The thought was to gather multiple groups from across cell to create a group that all the work in sync with their co-worker, thus alleviating the need to communication and decreasing the rework and redundancy since everyone would know the current group activities.)
Integrate Plans and Ops	Combine the work and people of the two groups

Model Assumptions: Several assumptions were made in building the model, the following describes these assumptions.

- Work was built as 180 days worth of activity all being conducted in parallel. This provided a unique view of the work since it cannot be seen as a traditional part A attaches to part B activity. Therefore the output must be viewed this way too. Meaning that the overall work completed is not the key indicator rather the amount of rework communication and decision wait time was more closely examined.
- Skills were not modeled at this time; the model assumes all personnel have the same skill level. While is does not reflect the true state, it does allow for these results to give indicators where more analysis can be accomplished.
- Certain tasks, for example under the branch chief position, can be considered as place holders to occupy that positions time so that they are not available to answer questions and respond to emails. This gives the model better realism since in day-to-day operations they are not always available to answer questions.

Results

The following set of figures compares the output from POWER and POWID. This comparison shows that the modified software does continue to well represent the study organization. There are only slight differences in rework and communication delays which in our opinion are better representative of the actual environment.

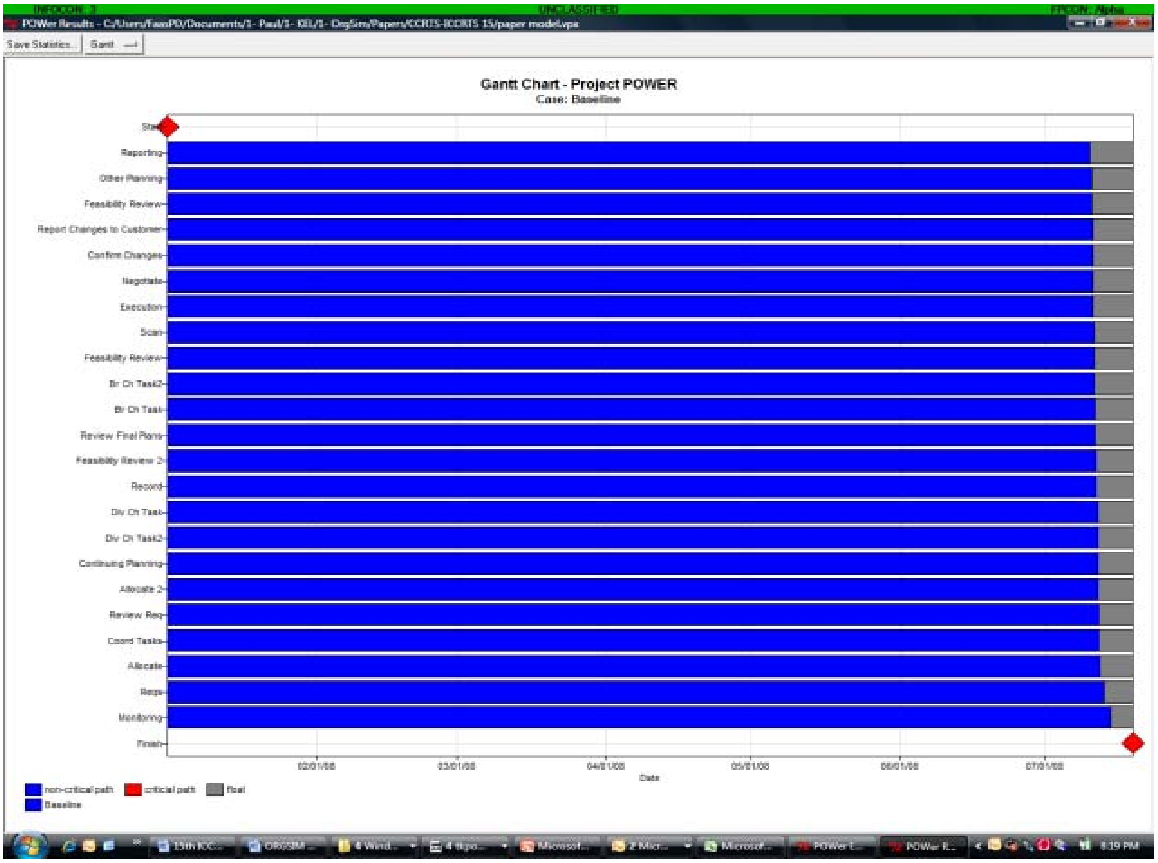

Figure 2 POWER Gantt Chart

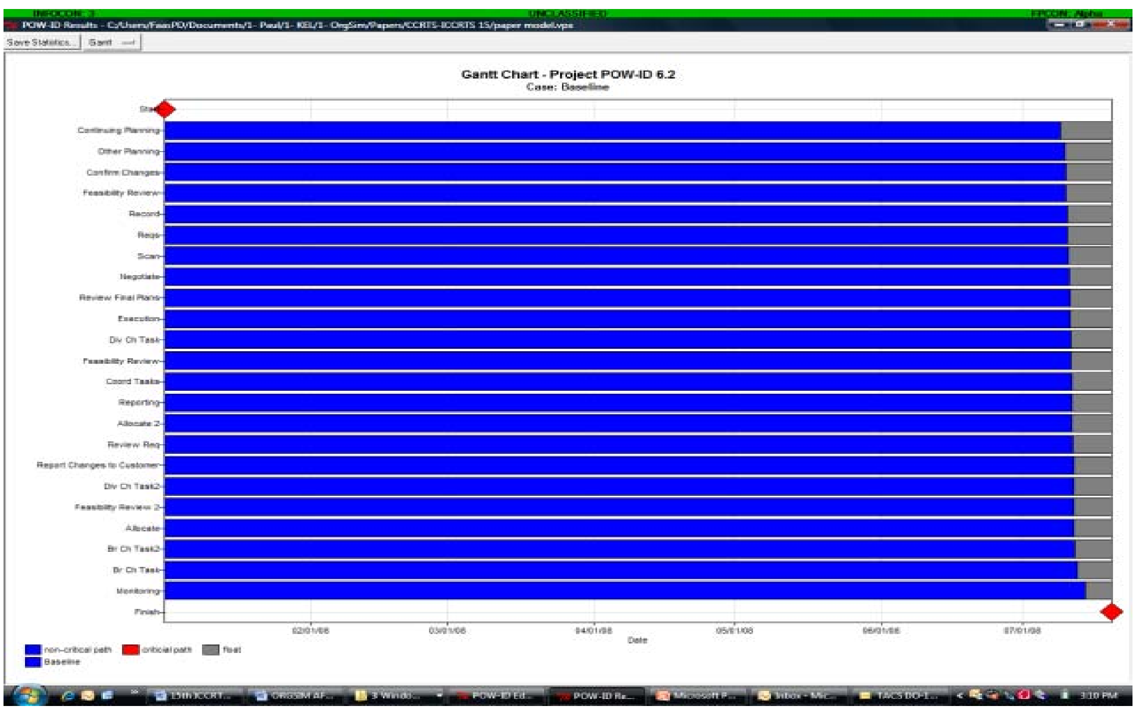

Figure 3 POW-ID Gantt Chart

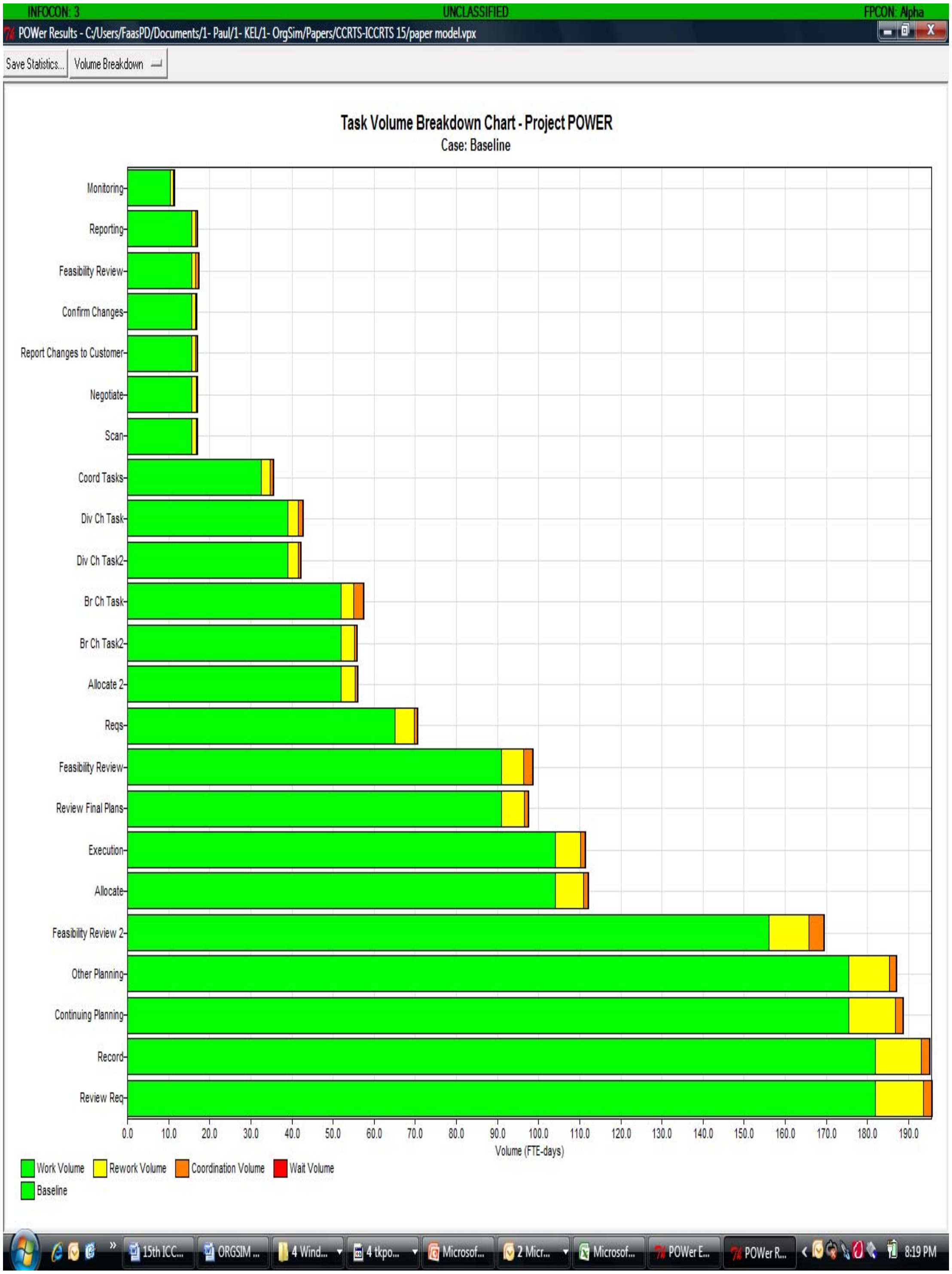

Figure 4 POWER Volume Breakdown Chart

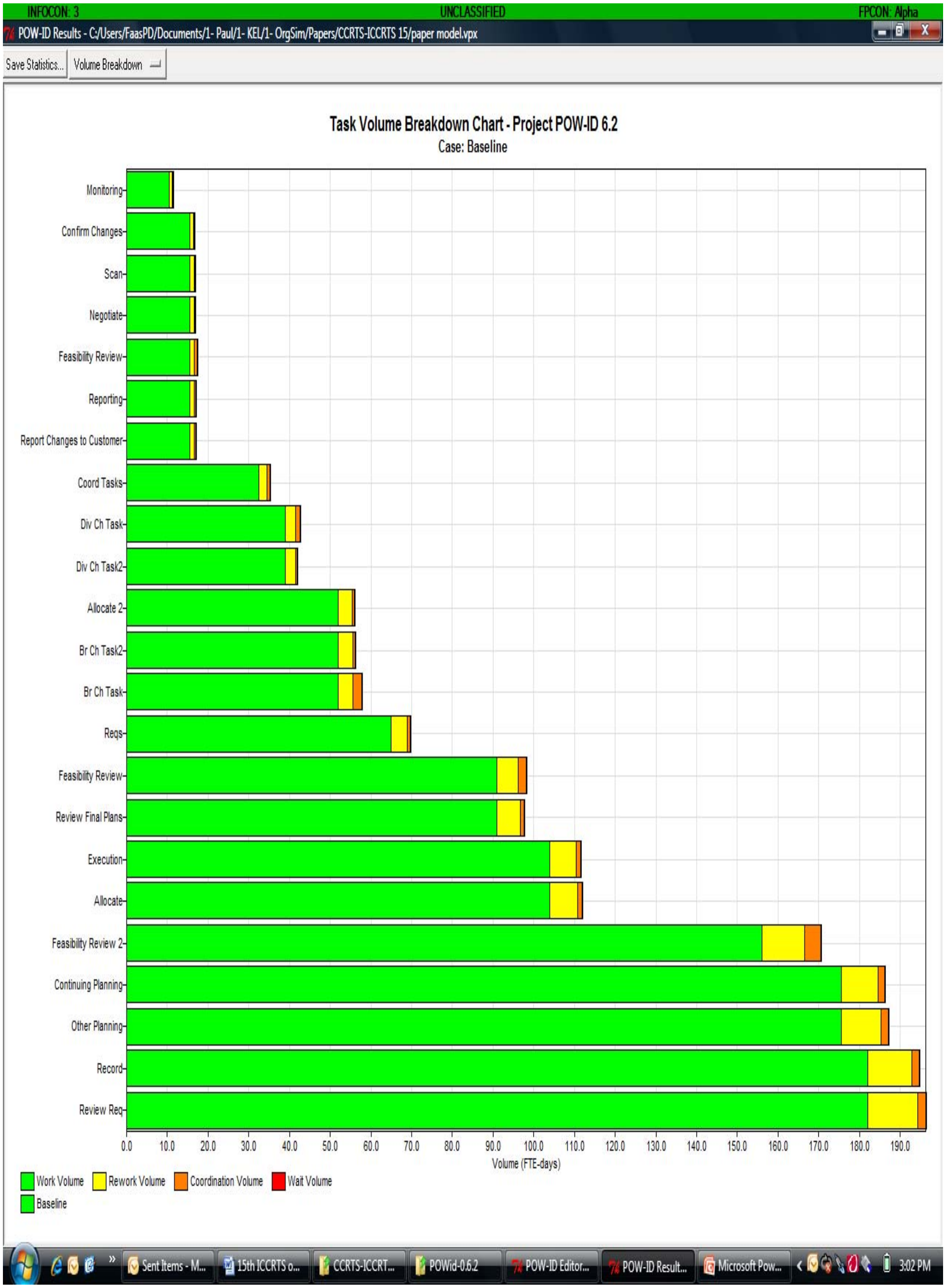

Figure 5 POW-ID Volume Breakdown Chart

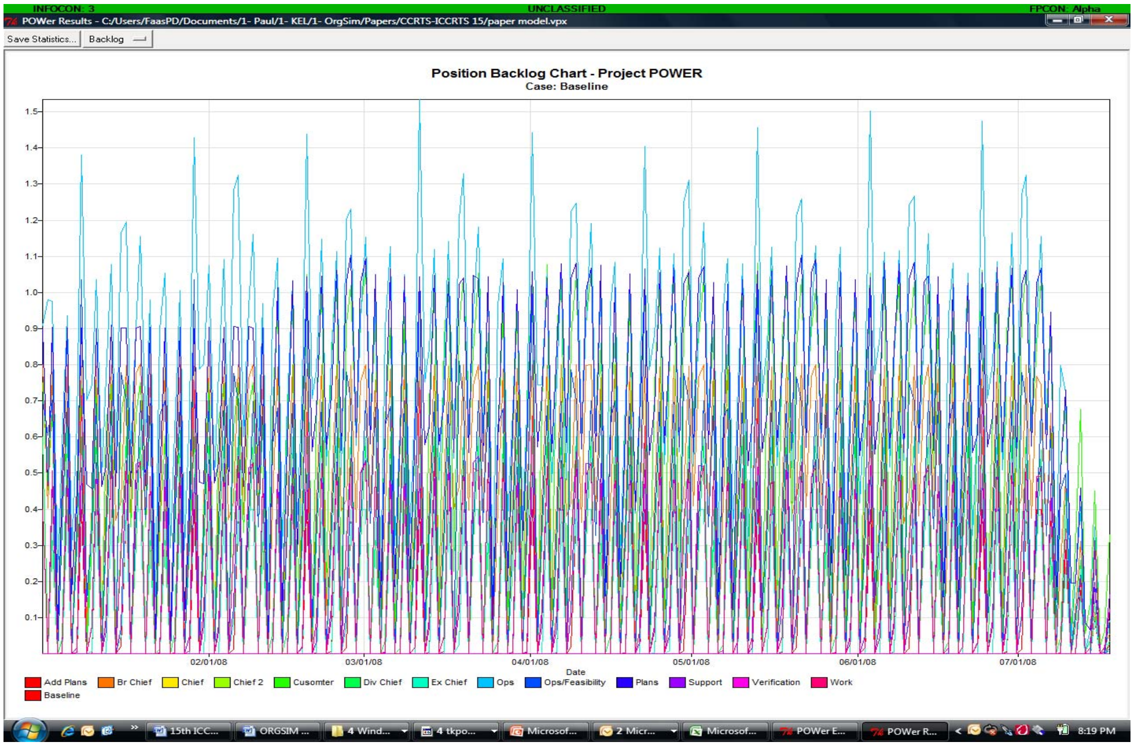

Figure 6 POWER Backlog Chart

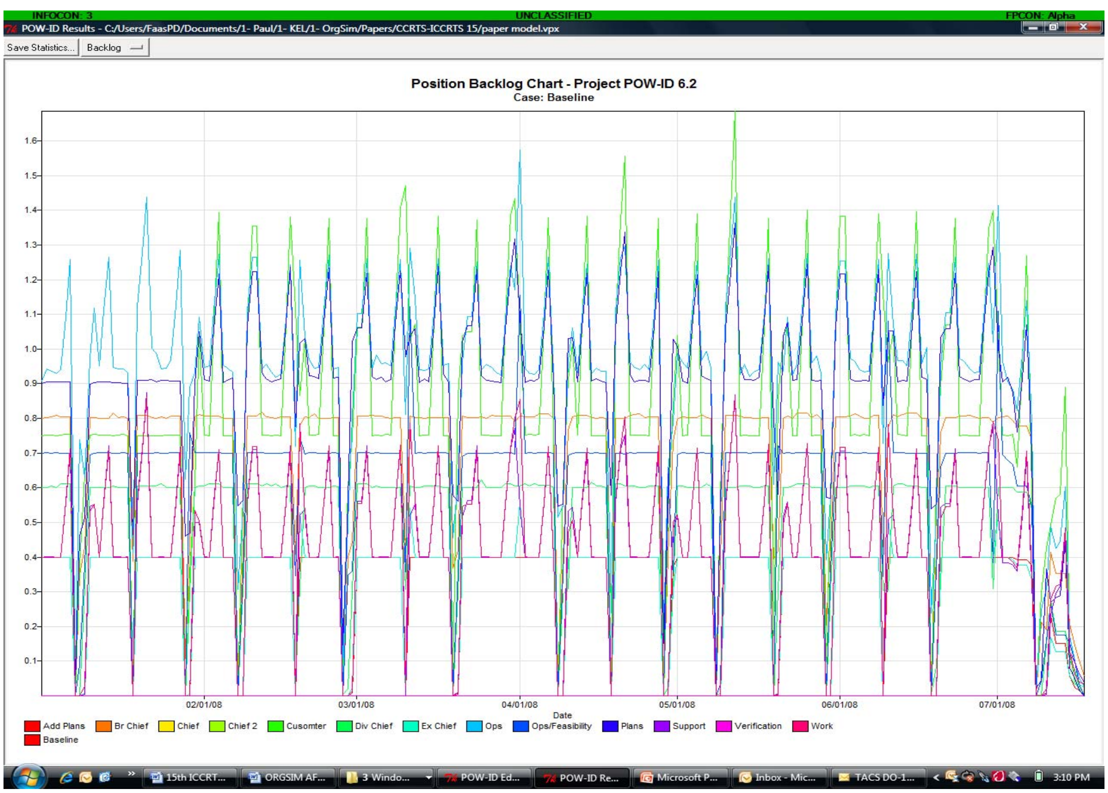

Figure 7 POW-ID Position Backlog Chart

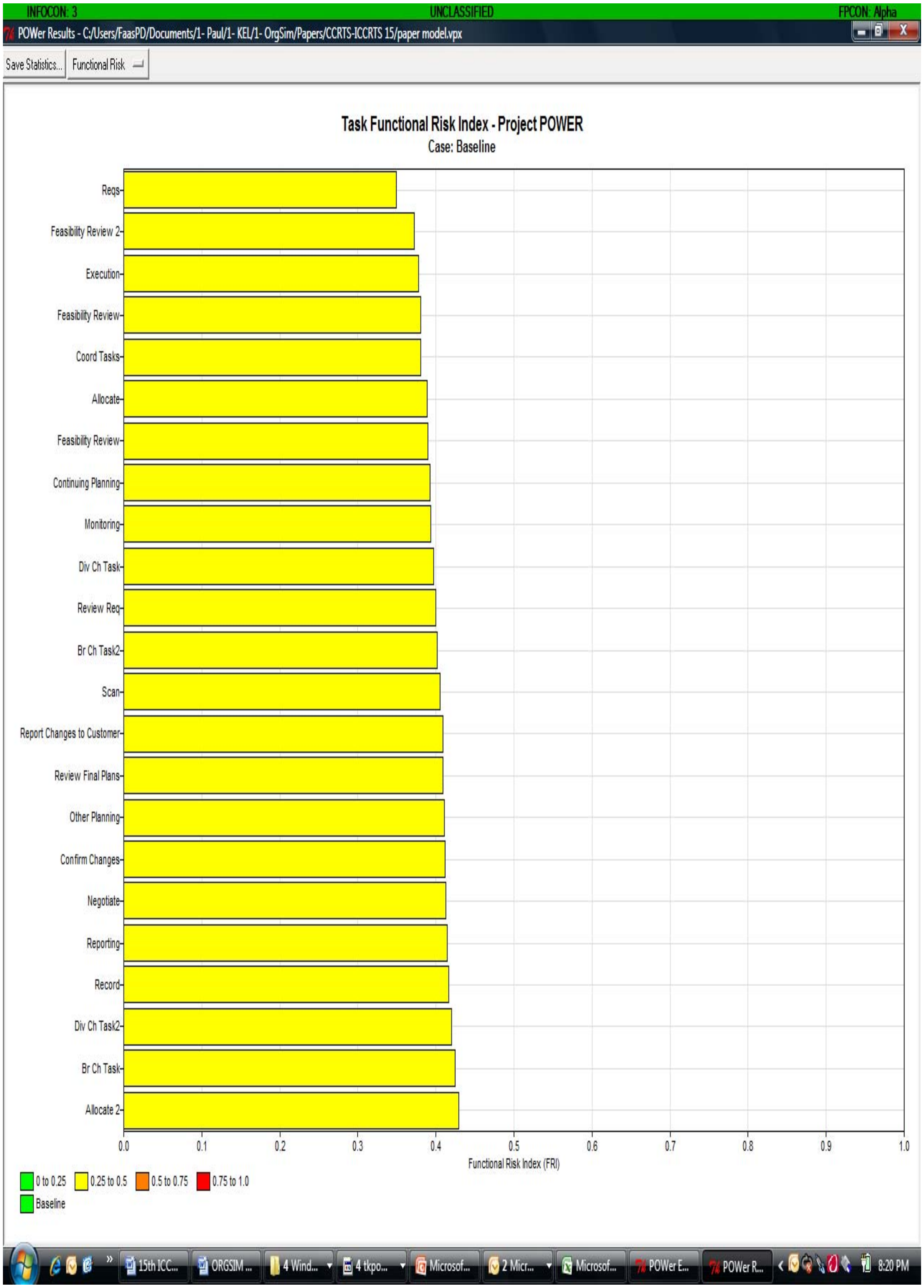

Figure 8 POWER Risk Index

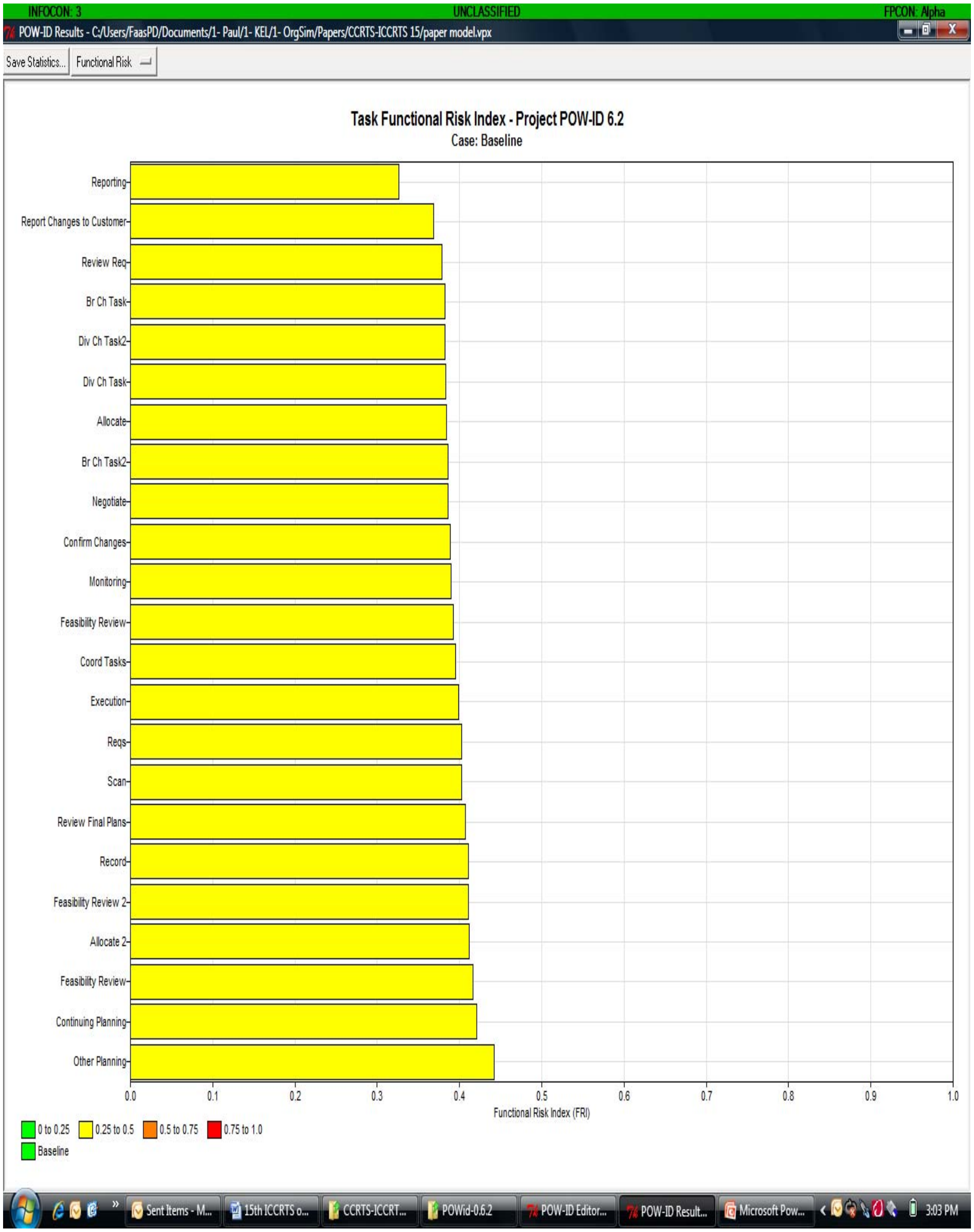

Figure 9 POW-ID Risk Index

The next set of results show comparisons from the two interventions attempted. The reduction in work is not a true reflection of less work but a spread of the work to additional workers gained by combining groups. The reduction in rework and communication delays is important to note. The feeling is that by combining the groups better work productivity and better communications will occur.

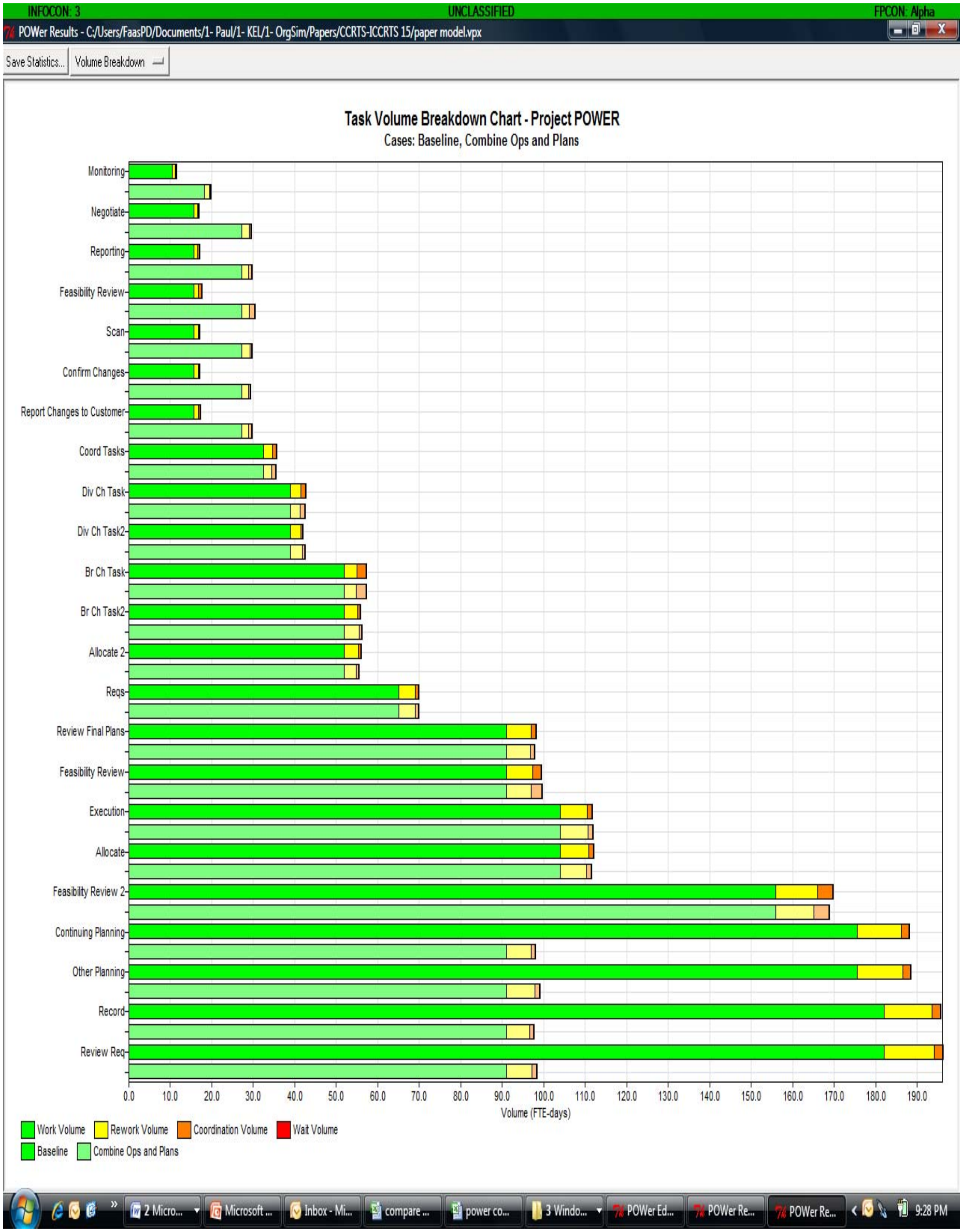

Figure 10 POWER Volume Breakdown Chart

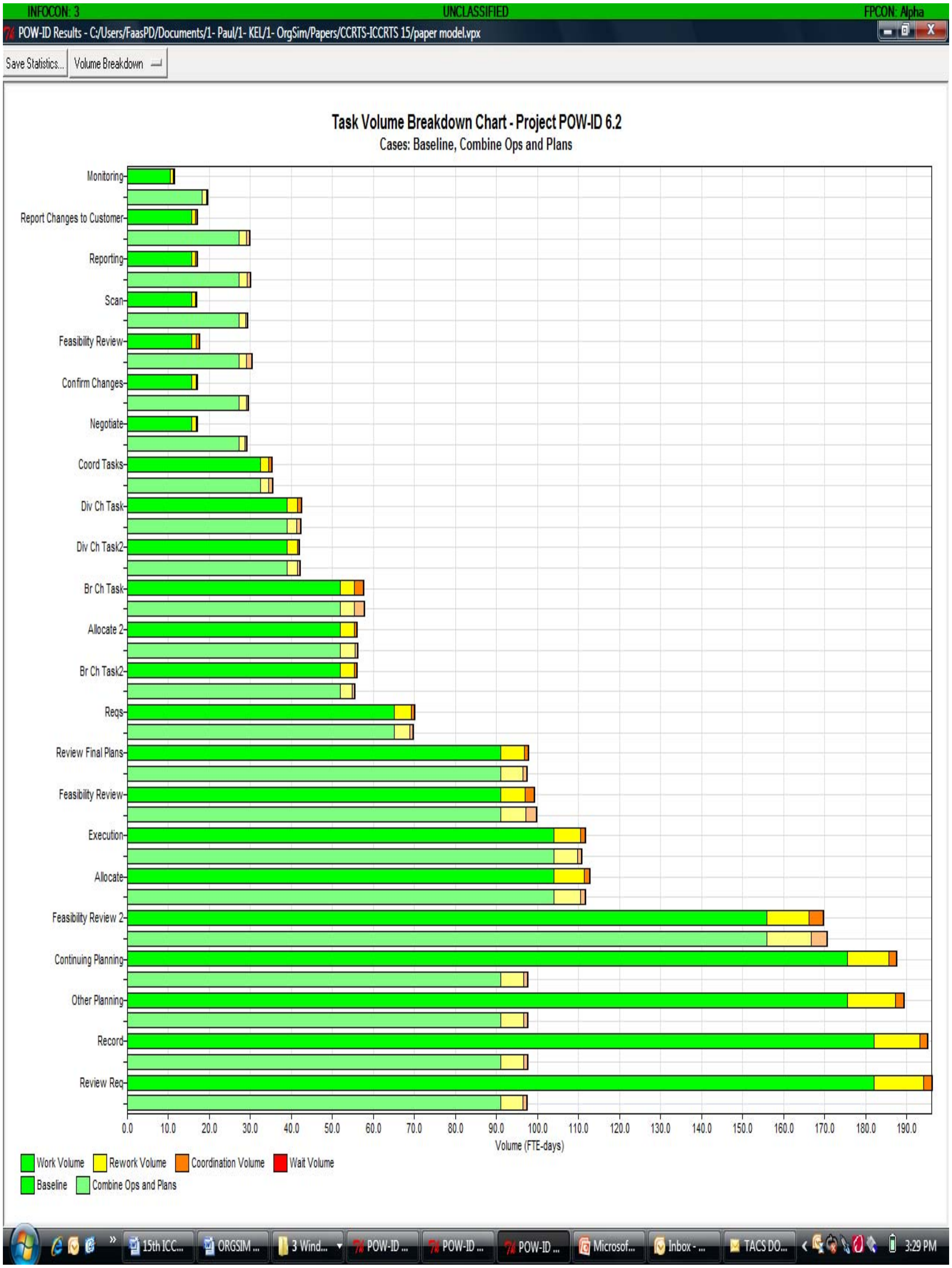

Figure 11 POW-ID Volume Breakdown Chart

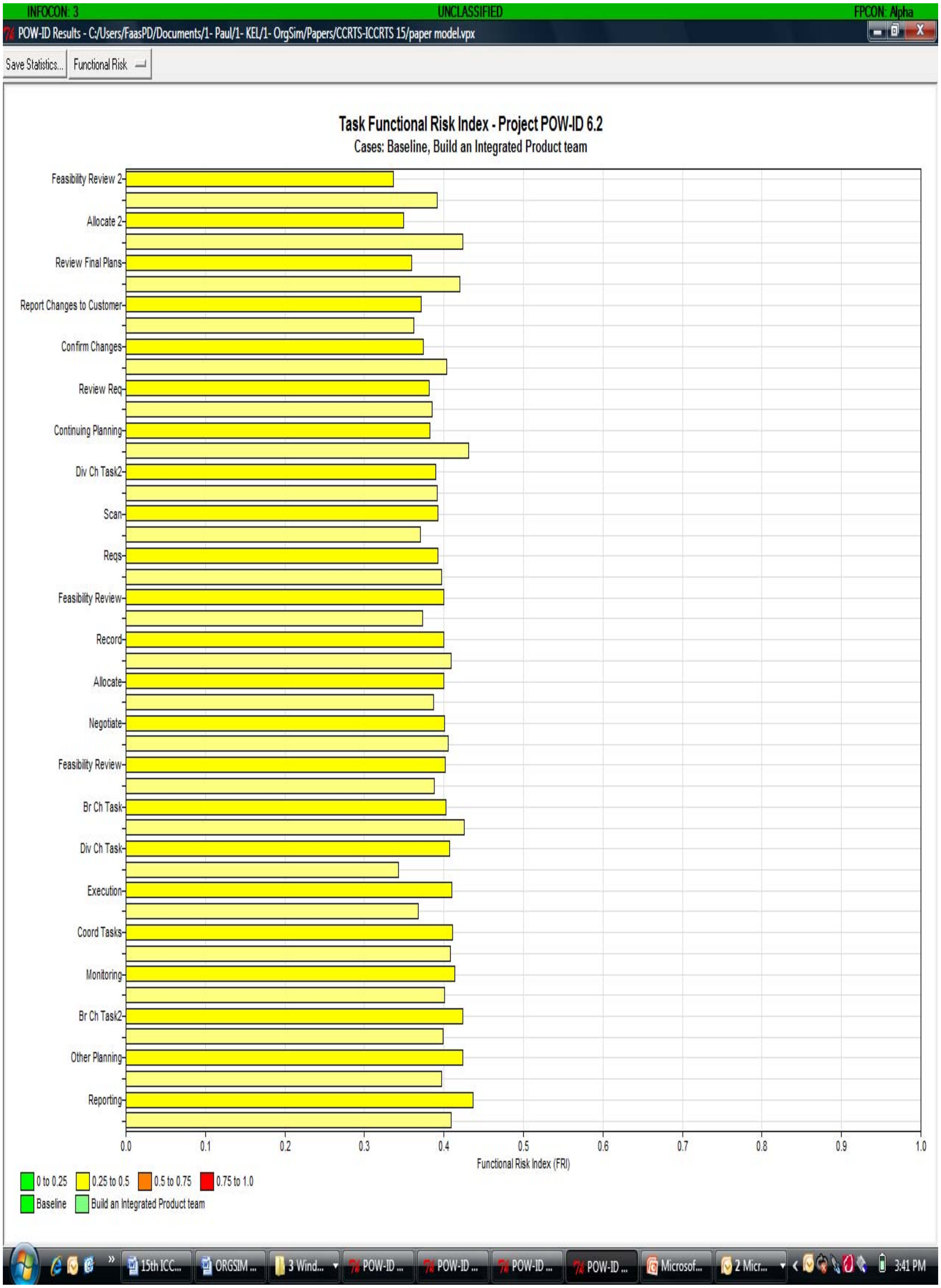

Figure 12 Risk Comparison Chart

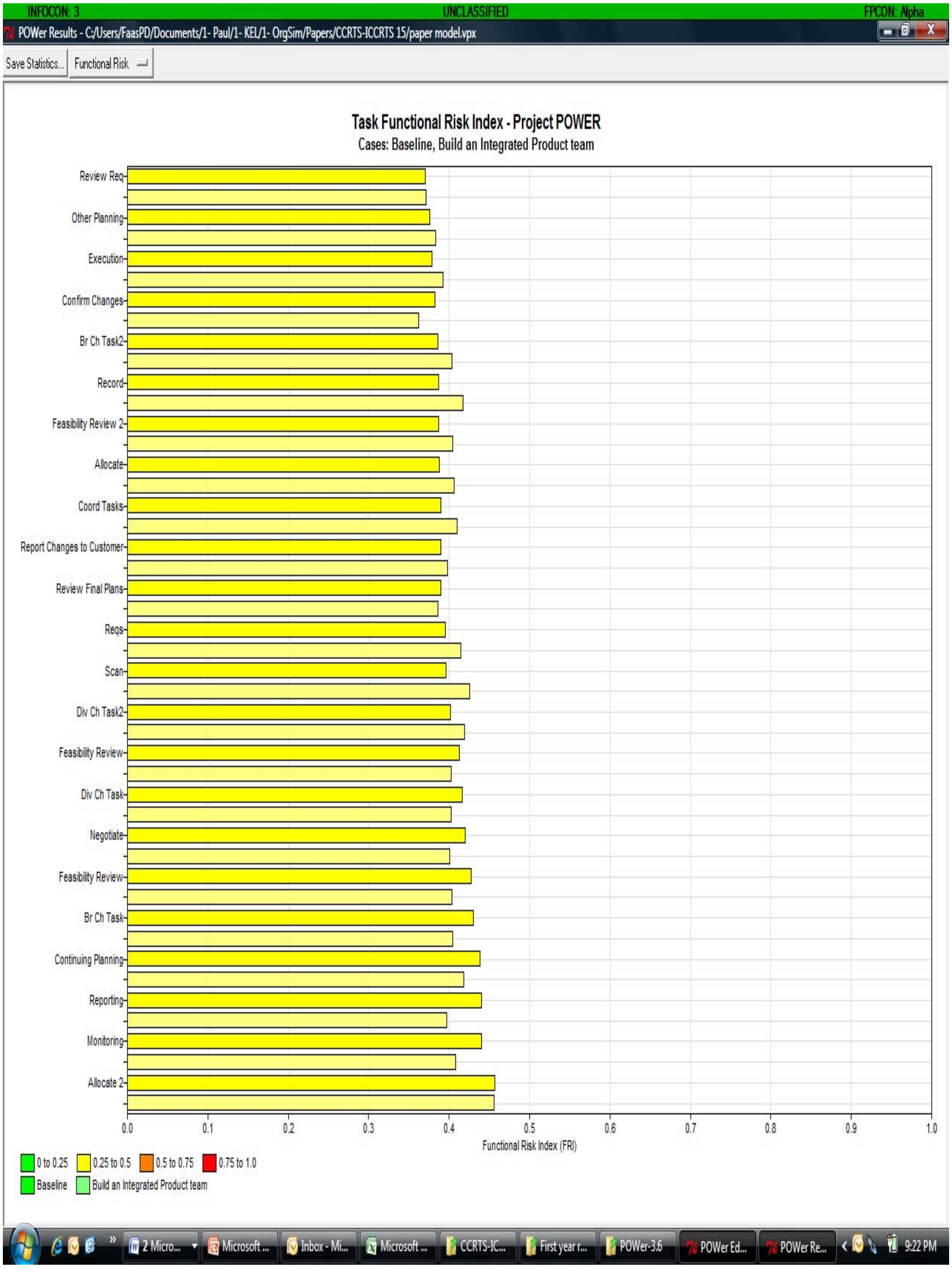

Figure 13 Risk Comparison Chart

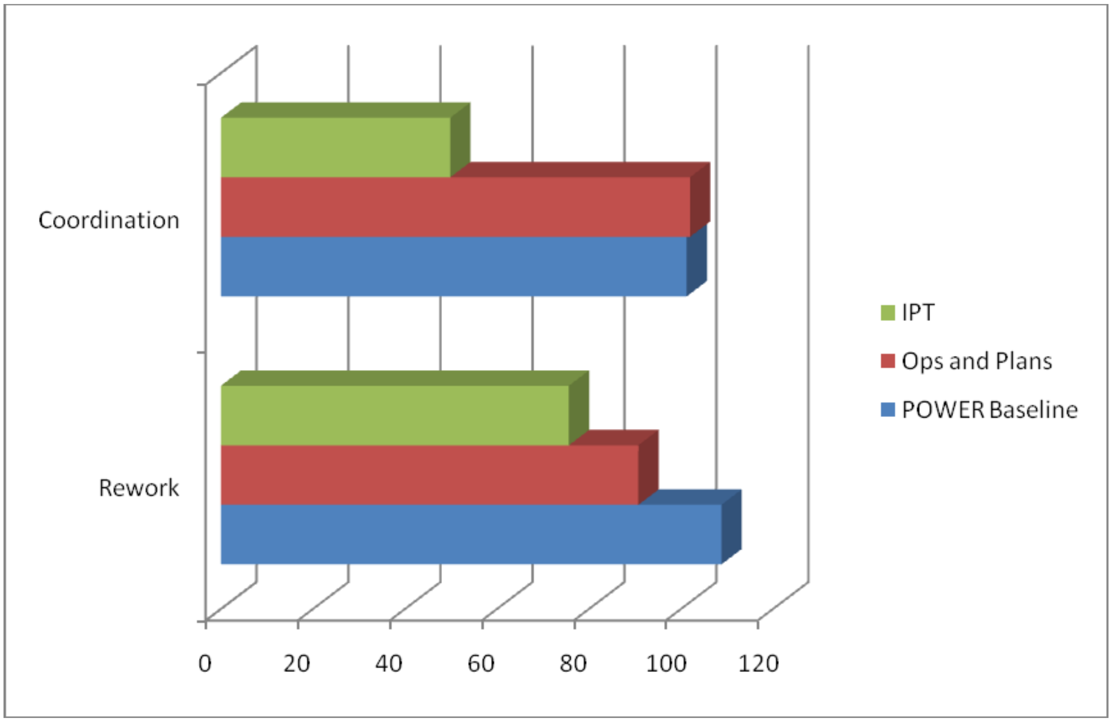

Figure 14 POWER Overall Comparisons Chart

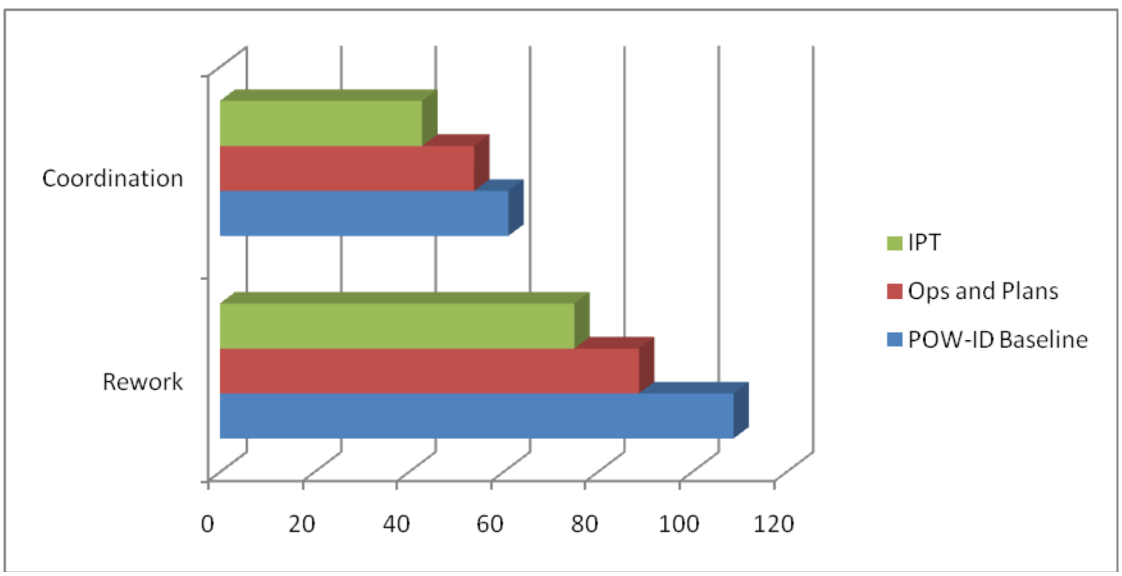

Figure 15 POW-ID Overall Comparisons Chart

The simulation runs show combining the group into a collaborative organization reduces some of the risk but mostly the coordination factor. The suggested operational alternatives that were tested showed a range of changes some significant to minimal levels. The table below details the suggested operational alternatives tested, the projected impact and the possible implementation risk (i.e., the risk associated with implementing the alternative operation). The implementation risk is a qualitative assessment based on the output from the simulation and working knowledge of the processes obtained through the interview processes and the original process models provided. These assessments are indicators of possible issues if the subject scenario would be attempted in the new organization. If it was decided to pursue a certain scenario, further analysis would be in order, to provide a better understanding of the risks and how to mitigate such risks.

Table 2

	Scenarios Tested	Impact	Reason	Implementation Risk	Reason
1	**Integrated product team**	**High**	**Less Rework Less Coordination**	**High**	**Change spans multiple orgs**
2	**Integrate Ops & Plans**	**High**	**Lower Coordination Risk**	**High**	**Training issues**

Discussion

The suggested combining of groups looked at two possible combinations. First, a combination of plans and operations groups within the cell allowing for more synergy around the planning and implementation. The thought was that if individuals that would be in this new group were able to hold on to the COA all the way through execution that they would not require additional rework and coordination. The second combination of groups would be across the planning and operations cells as described before plus include the other offices that sit within the new group. This large group would work together on the processes and all parties would be in sync to actively work each COA through execution thus providing even better coordination and less rework than the previous group combination. The figures 10 & 11 show that the rework and coordination is reduced when these groups are combined. Figures 14 & 15 confirm the reduction in the overall results of rework and coordination. This also shows that the POW-ID software reflects better handling of the coordination hours spread across the three cases. This gives more confidence in the software output. The belief is that coordination will take place within those groups thus the need for email, phone talks and fax will decrease. Also, the risk was decreased for the coordination required to complete certain tasks again a positive outcome of the alternate operations attempted. If the groups were to be combined, all the processes can also be examined for possible combination of activities, for example if plans needs to know something specific about a pending COA they could ask the expert within the group whether that was feasible before planning it a certain way only to discover later in the process that it was not feasible. This combines a couple of current activities into one task ultimately saving time and providing a better product in the end. Another scenario may include asking another subject matter expert to review multiple solutions while a COA is still in the early planning stages that are possible based on certain assumptions and the planner would receive feedback on why those assumptions may not work given the time of season, place that the need to be moved to, or several other issues.

Conclusion

The Organizational Effectiveness Modeling and Simulation tool has proven to be extremely useful by providing measured impact of possible alternative operations. This information can be provided to the leadership, which can be used for informed decision making while moving forward with the new organization.

References

[1] MacKinnon, Douglas, Raymond E. Levitt, and Mark Nissen. "Knowledge as Inventory: Near-Optimizing Knowledge and Power Flows in Edge Organizations." Proceedings of the International Command & Control Research Symposium, McLean, Virginia, USA, June, 2005.

[2] Levitt, R. E. (2004). Computational modeling of organizations comes of age. *Computational and Mathematical Organization Theory*, *10*(2), 127-145.

[3] MacKinnon, D.J., Levitt, R.E., & Nissen, M.E. (2006). Modeling skill growth and decay in edge organizations: Near-optimizing knowledge and power flows (Phase Two). *2006 Command & Control Research & Technology Symposium*, San Diego, CA.

[4] Faas, P. D. et al (2009). Organizational Modeling and Simulation in a Planning Organization 14th International Command and Control Research and Technology Symposium Washington DC Paper ID #183