

A LABELED GRAPH APPROACH TO SUPPORT ANALYSIS OF ORGANIZATIONAL PERFORMANCE¹

Mark Hoogendoorn ^a Jan Treur ^a Pinar Yolum ^{a,b}

^a *Vrije Universiteit Amsterdam, Department of Artificial Intelligence
De Boelelaan 1081a, 1081 HV Amsterdam*

^b *Bogazici University, Department of Computer Engineering
TR-34342 Bebek, Istanbul, Turkey*

Determining the performance of an organization is a must for both human and multi-agent organizations. The performance analysis allows organizations to uncover unexpected properties of organizations and allow them to reconsider their internal workings. To perform such an analysis, this paper represents organizations as labeled graphs that capture, not only the interactions of the entities, but also the characteristics of those interactions, such as their content, frequency, and so on through labels in the graph. Algebraic representation and manipulations of the labels enable analysis of a given organization. Hence, well-known phenomena, such as overloading of participants or asymmetric distribution of workload among participants can easily be detected.

Usually the graphs-based representations of organizations have no labels or simple labels; such as a number that denotes the strength of a link. However, in real organizations edges denote different types of relationships with different properties. To represent such relationships, a more complex structure of the labels is introduced and the structure is formalized with an algebra. In the approach, edges cause a workload (i.e. one node requests another node to perform a certain task) and nodes carry a workload (i.e. a node performs the requested task). Labels on edges formally specify the task the node has to perform, including its subtasks, and the workload caused by one such request during a certain interval. Nodes are labeled with capacities, a certain node can perform a certain amount of a particular task during an interval.

Based on these formal labels, calculations are presented that express notions of workload (how much work there is to be performed, see e.g. [1]), load (how does the workload relate to my capacity) and overloading (too much work to be performed compared to my capacity).

The labeled graph approach can be used in two ways. One, the graph is used externally to analyze the organization. Organization designers or analyzers can study the graph to understand the shortcomings of the organizations and to restructure the organization as they see fit. This usage of the graph does not concern the participants of the organization. The analysis is performed outside the organization. Two, the graph is used internally by the participants of the organization to reason about their and others actions. In other words, the participants use the graph during the execution of the organizations to operate more effectively. This paper mainly deals with the first usage of labeled graphs.

To show how the proposed method can be used in practice, its application in the incident management domain has been studied. An implementation of the approach has been created in PROLOG for this purpose. Thereafter, a simulation has been performed of the events that occurred during the rescue of passengers on board of a plane that crashed in the sea in the Netherlands in 1996 (see also [2]). To enable a simulation, roles and communication channels between these roles have been identified within reports that exist of this particular disaster, and are represented in a graph structure according to the presented approach. The edges and nodes have been labeled by an expert in the field. To make the simulation more understandable for these domain experts, a visualization tool has been created that graphically shows how much work is being transferred

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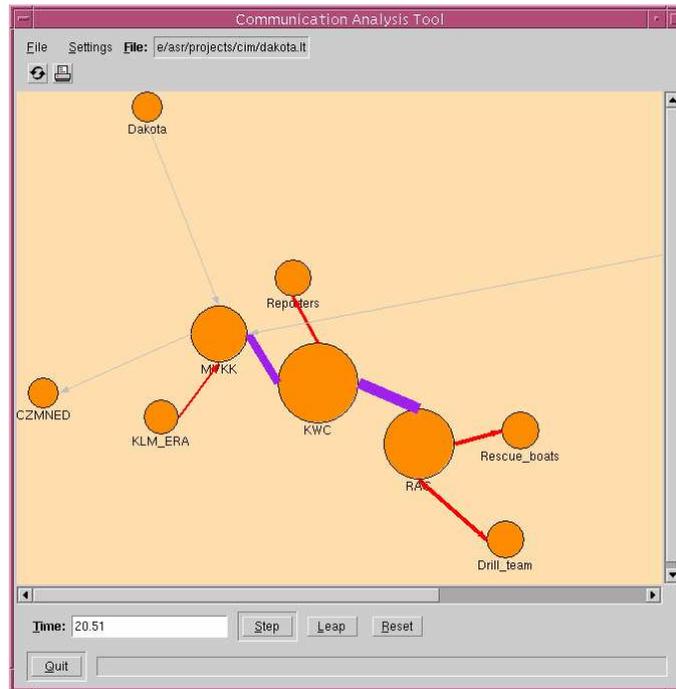


Figure 1: A screenshot of the visualization tool

between different nodes within the graph, and represents the load for each of these nodes. Figure 1 shows a screen-shot of the visualization tool. The radius of a node is increased in case the relative workload increases, so the bigger the node the heavier the load on that specific node. Further, work delegations that are intensively used are highlighted as well by turning red in case of a lot of activity (or in case of a huge amount of activity purple). According to the incident reports of the Dakota disaster one specific role was heavily overloaded which was the role of the Coastguard (KWC), and this can indeed be observed when running the simulation. Many nodes are transferring work to the Coastguard, such as the reporters of the press agencies, the Regional Alarm Central (RAC) and the military airport (MVKK). The Coastguard has a large capacity for handling all this work, but is unable to handle all requests, resulting in certain tasks not being performed.

References

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