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Agent based model of effects of task allocation strategies in flat organizations

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HIGHLIGHTS

- An agent based model of a stylized, call-center-like organization is presented.
- The common practice of piling work on best performers is found to be effective.
- An equal distribution of tasks among agents is less effective.
- Power laws are found in transition times to an overload under variable global load.

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ABSTRACT

A common practice in many organizations is to pile the work on the best performers. It is easy to implement by the management and, despite the apparent injustice, appears to be working in many situations. In our work we present a simple agent based model, constructed to simulate this practice and to analyze conditions under which the overall efficiency of the organization (for example measured by the backlog of unresolved issues) breaks down, due to the cumulative effect of the individual overloads. The model confirms that the strategy mentioned above is, indeed, rational: it leads to better global results than an alternative one, using equal workload distribution among all workers. The presented analyses focus on the behavior of the organizations close to the limit of the maximum total throughput and provide results for the growth of the unprocessed backlog in several situations, as well as suggestions related to avoiding such buildup.

1. Introduction

The agent based models (ABM) have an established place in the analyses of the specific aspects of the social behavior, reaching back almost fifty years—one could mention here the classic work of Thomas Schelling on segregation [1]. The ABM work best in situations where human behavior characterized by a limited range of available behaviors, predictable individual activity decision processes and easy to describe interactions between the agents. A classical example of such approach is the field of opinion dynamics, in which the complex world of human societies is reduced to resemble magnetic interactions of atomic spins.

The workplace relationships do not, generally, fall into this category. This is due to their structurally complex nature: the combination of strongly varying economic and organizational constraints, differing roles and predispositions of the workers, and finally the time dependent factors, from external conditions to the changing individual goals and motivations. The internal complexity of the agents and the high number of the model parameters that are necessary for a detailed description of a typical workplace makes any analysis based on th ABM approach quite difficult. And when a specific complex model setup allows to match a specific situation, the generalization of the results remains questionable.

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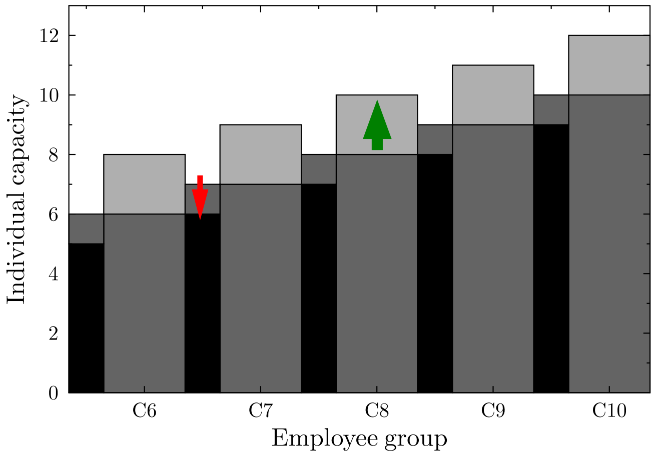

Fig. 1. Graphical presentation of the division of the organization into five agent groups with nominal work capacities of 6, 7, 8, 9 and 10. Hardworking agents (dark gray) are capable of putting in overtime, during which their capacity may be increased by two units (light gray, indicated by green upward arrow). The lazy agents (black) have their capacity permanently decreased by one unit, as indicated by the red arrow. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

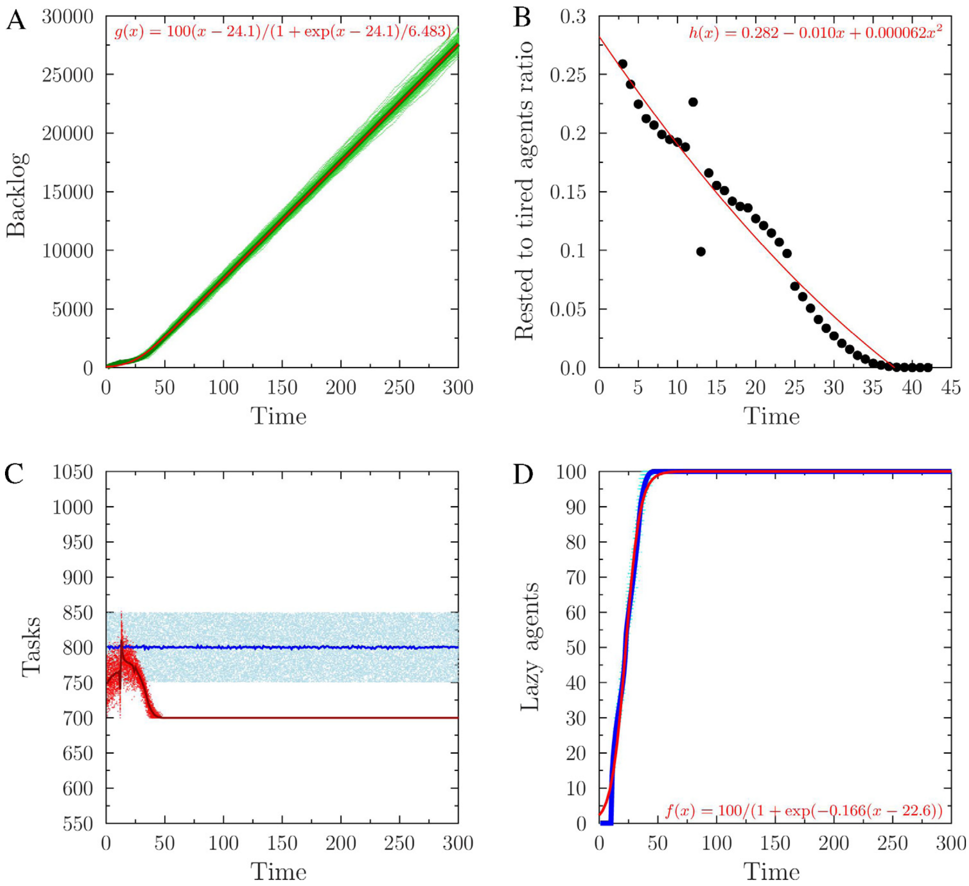

Fig. 2. Evolution of system parameters for the random task assignment scenario, $\Delta W = 50$ and $T = 10$. Panel A: growth of accumulated backlog. Light green points: individual simulations. Dark green line: average over 1000 simulation runs. Red line: fit with the function $g(t) = 100(t - T2)/(1 - \exp(-(t - T2)/l))$, with $T2 = 24.1$. Panel B: average ratio of the rested and tired hardworking agents per turn. Red line is a quadratic function fit. Initially the numbers of agents who get tired and who may rest during a time turn are quite close, but as the number of lazy agents grows (see panel D), more and more hardworking agents get tired. Panel C: Distribution of the workload. Light blue points: tasks assigned at time t, dark blue line—average over 1000 simulations. Red dots: tasks completed at time t. Dark red line is the average over 1000 simulations. Panel D: Number of lazy agents at time t. Light blue dots: results for individual simulations, dark blue line—average over 1000 simulations. Red line: logistic curve fit $f(t) = 100/(1 + \exp((t - T1)k))$ with $T1 = 22.6$. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)