Modeling & Simulating Cooperation in Organizations

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Introduction

• Stress has a significant effect on performance of organizations

• Approx. 75% of employees regularly experience psychic and somatic symptoms of stress

• In 2014, the cost of stress to US economy has been estimated as 300 billion USD
Stress and performance

• Most commonly, the relationship between task performance and stress is understood as \( \cap \) -shaped.

• However, many empirical studies showed that the relationship may be either positively or negatively linear, or even no relationship at all.

• To study this phenomena, we have decided to develop a model and perform \textit{in silico} studies that allow to eliminate effects of sample, context, selected methodology or other effects that are present in \textit{in vivo} studies.
The model

• Laboratory of Search and Dialogue, Masaryk University

• NetLogo Environment for modeling and simulations of complex systems

• Multi-variable agent-based model using spatialized prisoner’s dilemma game
Prisoner’s dilemma game

- Standard setting from game theory to study aspects of cooperation
- Can cooperation be a logical choice even for rational agent?

- To cooperate or to defect?

- Short term vs. long term

<table>
<thead>
<tr>
<th></th>
<th>Alice</th>
<th>Bob</th>
</tr>
</thead>
<tbody>
<tr>
<td>confess</td>
<td>5 5</td>
<td>5 5</td>
</tr>
<tr>
<td>silent</td>
<td>10 0</td>
<td>0 10</td>
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</table>
PDG in our model

- Employees exchange certain part of their work
- Whether the work is delivered as promised is a subject to PDG
- Employees use strategies that are well known in the PDG context

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Label</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defect</td>
<td>D</td>
<td>Always defects</td>
</tr>
<tr>
<td>Cooperate</td>
<td>C</td>
<td>Always cooperates</td>
</tr>
<tr>
<td>Tit for Tat</td>
<td>T</td>
<td>Repeats partner’s last move.</td>
</tr>
<tr>
<td>Tit for two Tats</td>
<td>T2</td>
<td>Defects ifdefected in both last 2 rounds, otherwise cooperates.</td>
</tr>
<tr>
<td>Tit for Tat – Naïve</td>
<td>nT</td>
<td>Repeats partner’s last move. There is a probability for cooperation</td>
</tr>
<tr>
<td>Peacemaker</td>
<td>P</td>
<td>if defected.</td>
</tr>
<tr>
<td>Pavlov</td>
<td>U</td>
<td>Initiates with cooperation. Then repeats last own action when won and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>switches action when lost last round.</td>
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<tr>
<td>Unforgiving</td>
<td></td>
<td>Once defected by a partner, always defects. Otherwise cooperates.</td>
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Stress

• 3 sources of employees’ stress:
  • PDG
  • Effort
  • Management evaluation

• Stress regeneration
Management Module

• Management evaluates employees on monthly basis
  • Insight into cooperation
  • Insight into performance
  • What to prefer
  • Intensity of reaction
Visualization of the model
The model interface
Results from pilot experiments

• Focus on cooperativeness performs better than focus on performance
• Focus on performance never exceed 40% of performance, when compared to best setting
• Lowest performance is observed when employees are rewarded randomly
Future work

• Social network model
• Growth model
• Improving fluctuation algorithm
• Improving employees’ productivity

• Field study to set parameters closer to reality