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Review for Doctoral Dissertation

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“Network Sience-based analysis of human factors in systems engineering”

The dissertation is of outstanding importance in the career of the doctoral candidate. The student proves his/her various qualities in this work and shows to the scientific community his/her abilities to do independent and high quality research. The reviewer shall evaluate the dissertation as it was a separate piece of scientific work.

In his doctoral dissertation, László Gadár develops three empirical approaches to address the role of human factors in production systems. In his first research project, he evaluates the role of skills by looking at the matching process between education specializations and occupations using a bipartite network modularity method. In his second research project, he analyses the role of ownership by analyzing the spatial modularity of ownership networks across Hungarian settlements. In his third project, he focuses on the role of human interaction by investigating multidimensional social networks in companies.

I learned from this dissertation. The topic accounts for the interest of a wide interdisciplinary community and promises important business and policy applications. The dissertation contains a variety of valuable and original methodological innovations developed by the candidate. The three empirical chapters have already been published in high-impact international journals. This is a very valuable piece of work and in my opinion, an outstanding doctoral dissertation.

The candidate has substantially revised the manuscript after the pre-defence. I can confirm that my comments have been addressed appropriately. As a major revision, the cohesion between the Introduction and the following chapters have been improved and results of the Chapters have been discussed more in detail.

I recommend that the dissertation shall be accepted and the candidate shall be awarded with the doctoral degree. In the following, I assess the general qualities of the dissertation that also include my remaining specific comments and questions.

General evaluation

1. Topic and research questions

The dissertation addresses an interdisciplinary topic: human behaviour in production systems. Research questions, similarly to the overall scope of the topic, are from a wide range of contexts. The common baseline of these questions is whether methodological tools of network science can be used to better understand human behavior in production systems. To answer these questions, the dissertation analyses labor market matchings between education programmes and occupations, spatial modularity of ownership networks across towns, and social networks within companies.

2. Results

Solid methodology is applied in each of the empirical chapters. Even more importantly, the network methods are further developed with own contributions. Each of the empirical chapters contains a large variety of interesting and important results.

Chapter 2 contains very interesting methodological developments in which the candidate offers modifications to the multi-resolution method of community finding algorithms. This enables the candidate to analyze the career path of university graduates using the bipartite graph of bachelor programs and occupations. A rich set of results is presented in this section that include identification of areas of the education-occupation mismatch. Contributions in the chapter are useful for education- and industry policy.

It seems to me in Figure 2.2 that occupation-education mismatch might have an interesting spatial distribution and therefore the industry structure and also the ownership structure in the region might influence it. For example, the spatial distribution of state-controlled services, in which job requirements are more strict on education than in large firms, can result in regional differences of labor market mismatch. Further questions, whether the role of ownership (eg. foreign-owned versus domestic firms) and wages have some role on the patterns of labor market matching would be interesting to investigate.

In Chapter 3, ownership data aggregated to town level is analyzed with network science tools and techniques of community detection. This chapter contains methodological developments to overcome the problem that distance decay in social and economic relations automatically yields spatial network communities. The candidate shows that gravitational models can remedy this issue. I think this method has many potential further applications in various spatial networks.

Chapter 4 is a great piece of methodological work and it is very nicely presented as well. The candidate offers a multilayer network approach to better understand the complex nature of interactions

and roles in companies. It applies frequent pattern mining that reveals statistical associations between network layers and characterizes leaders in social interaction.

The communication of the results is sufficient after a major revision, in which findings are discussed more in detail. In some cases, illustrations could have been further improved such that labels could be larger.

3. Literature review and references

The reference list is impressive and covers a wide range of related literature.

4. Structure

The dissertation contains an Introduction chapter, which is followed by three empirical chapters that stand on their own, and a list of Theses at the end. I find that after a thorough revision following the pre-defence, the final version of the Introduction appropriately motivates the dissertation and the coherence has been established between the motivation in the introduction and the actual empirical exercises in the following chapters. The Introduction is built around the topic of Industry 4.0, digital transformation, automation, which is the main stream of motivating the thesis. I admit that this is a very important topic, which should be better understood from the viewpoint of labor market matching, ownership structure and co-worker interaction. The version does a very good job in integrating these seemingly different areas of inquiry.

5. Language and style

Language use has been greatly improved in the final version of the dissertation and errors have been corrected. The style of the dissertation is appealing.

Thank you for the opportunity to review this thesis and congratulations for the great work.

Sincerely yours,



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