Feasibility of knowledge graphs as a tool for data storage in production planning systems

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Keywords: knowledge graph, production planning, manufacturing, knowledge representation

1. Introduction

In today's manufacturing industry, production planning systems are becoming increasingly complex and require efficient procedures to manage with the ever-increasing process of increasing and increasing in their complexity. Production planning systems have relied on relational databases as a standard for data storage and management. However, as the amount and complexity of data have increased, these systems have proven to be inadequate in handling and visualizing the data. The limitations of these systems can lead to inefficiencies in the planning process, such as delays in decision making, inaccuracies in conclusions, and difficulties in forecasting and planning for the future. This is because the processes become more and more complex, it becomes harder to understand and visualize them using traditional table-based systems. We propose utilizing knowledge graphs as a solution to this problem. By structuring and organizing data and knowledge in a clear and accessible way, knowledge graphs can help streamline the analysis process and improve overall planning efficiency.

2. Methodology

In our proposed solution, we turn to the power of knowledge graphs to tackle the knowledge storage and management challenges in production planning systems [1–2]. By utilizing a knowledge graph, we can effectively store and represent a wide range of information related to the production process, from orders and production schedules via equipment usage to potential links/transaction prediction which is not possible with a table-and-rule-based system.

3. Results

In this study, we propose a method for modeling and optimizing the production process in a steel works. By utilizing artificially generated data represented in a 3-column format, we are able to simulate various scenarios and identify potential bottlenecks in the production process. The data consists of Material A, Material B, and the method of transition between the two materials in the tundish during the casting process, with a total of 30 cases for each material and 3 possible methods of transition.

The publication is co-financed from the state budget under the programme of the Minister of Education and Science called "Excellent Science" project no. DNK/SP/548041/2022

Doskonała Nauka
Ministry of Education and Science Republic of Poland
Republic of Poland

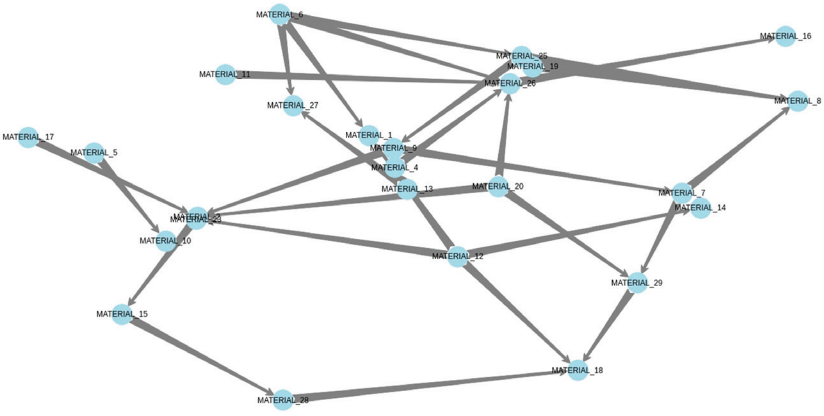

Figure 1. An example representation of possible transitions between melts of materials.

Table 1. Tabular representation of the shortest transitions (Dijkstra Algorithm) between materials.

	Node 1	Node 2	Path
0	MATERIAL_11	MATERIAL_26	['MATERIAL_11→transform_2', 'MATERIAL_26']
1	MATERIAL_11	MATERIAL_16	['MATERIAL_11→transform_2', 'MATERIAL_26→transform_2', 'MATERIAL_16']
2	MATERIAL_26	MATERIAL_16	['MATERIAL_26→transform_2', 'MATERIAL_16']
3	MATERIAL_9	MATERIAL_2	['MATERIAL_9→transform_1', 'MATERIAL_2']
4	MATERIAL_9	MATERIAL_7	['MATERIAL_9→transform_1', 'MATERIAL_7']
5	MATERIAL_9	MATERIAL_8	['MATERIAL_9→transform_1', 'MATERIAL_7→transform_1', 'MATERIAL_8']
6	MATERIAL_9	MATERIAL_29	['MATERIAL_9→transform_1', 'MATERIAL_7→transform_1', 'MATERIAL_29']
7	MATERIAL_9	MATERIAL_15	['MATERIAL_9→transform_1', 'MATERIAL_2→transform_2', 'MATERIAL_15']
8	MATERIAL_9	MATERIAL_28	['MATERIAL_9→transform_1', 'MATERIAL_2→transform_2', 'MATERIAL_15→transform_1', 'MATERIAL_28']
9	MATERIAL_9	MATERIAL_18	['MATERIAL_9→transform_1', 'MATERIAL_7→transform_1', 'MATERIAL_29→transform_2', 'MATERIAL_18']
10	MATERIAL_2	MATERIAL_15	['MATERIAL_2→transform_2', 'MATERIAL_15']

Table 2. Tabular representation of Jaccard similarity between materials.

source	target	score
MATERIAL_1	MATERIAL_24	0.2
MATERIAL_1	MATERIAL_21	0.66
MATERIAL_1	MATERIAL_23	0.5
MATERIAL_1	MATERIAL_17	0.2
MATERIAL_24	MATERIAL_21	0.166
MATERIAL_24	MATERIAL_25	0.166
MATERIAL_24	MATERIAL_10	0.25
MATERIAL_24	MATERIAL_17	0.14
MATERIAL_24	MATERIAL_22	0.25

Compared to traditional tabular data representation, our approach based on knowledge graphs offer several advantages, the major advantage is that they are able to capture the complex relationships between different entities in a much more intuitive and readable way. In the context of the production process, knowledge graphs can easily show the relationships between different materials and transition methods, and how they are interconnected.

References

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Acknowledgements. The authors acknowledge financial support from the Intelligent Development Operational Program: POIR.01.01.01-00-0996/19.