SOPRONI EGYETEM

FAIPARI MÉRNÖKI ÉS KREATÍVIPARI KAR

AZ ALKALMAZOTT MŰVÉSZET LÉTMÓDJAI ÉS A KREATÍV IPAR KIHÍVÁSAI NAPJAINKBAN

Faipari Mérnöki és Kreatívipari Kar Tudományos Kiadványa

Szerkesztette: Márfai Molnár László és Pásztory Zoltán

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Műszaki szekció

Foregin languages section

Small and medium-sized enterprises (smes) in Hungary: industry 4.0 trends and challenges

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Abstract
Purpose – Nowadays there is a huge rivalry between the enterprises and many of them tries to implement Industry 4.0 technologies, because its solutions can provide competitive advantage. This article summarises the results of 3 years period research work of the authors (Suri et al. 2019, Fazekas 2022) and tries to present the current situation of these implementations in Hungary. The paper also compares the Hungarian trends and challenges with other European countries.

Keywords: Industry 4.0 trends, Industry 4.0 challenges, Hungarian SMEs, Digitalization possibilities, Digital transformation, Master thesis summary

Introduction

The article presents the implementation degree of industry 4.0 by Hungarian SMEs. Additionally, it includes trend descriptions, influencing factor and appearable challenge collections. The aforementioned data's are built up on a national public financial founding (GINOP 113) which was announced in 2019, with the name: SME's industrial digitalisation (Industry 4.0) related development support. This support is the main reason of the master thesis and article creation.

The paper's main goal was to present the Hungarian SMEs industry 4.0 implementation progress and the industry 4.0 related challenges and trends. To reach these goals 12 Hungarian companies in the production sector were surveyed and also the relevant literature was analyzed.

During the creation of the paper the following hypotheses were set up:

- The industry 4.0 implementation progress is relatively low by the Hungarian SMEs, but it is in a fast-growing phase

- There are favored industry 4.0 segments by the Hungarian SMEs
- There are many industry 4.0 implementation progress influencing factors such as: net revenue, employee number, industry segment, geographical arrangement, degree of organizationqq
- The enterprise size increase (employee number) comes with the increase of the degree of organization. These are the causing the biggest impact by the industry 4.0 implementation progress.

Basic considerations

Industry 4.0's definition is well known and widely accepted, but by the segmentation of it there are many different methods. One of the segmentation methods is from the Boston Consulting Group (BCG) which is showed in figure 1. It is important to mention, this figure presents only the technology related segments.

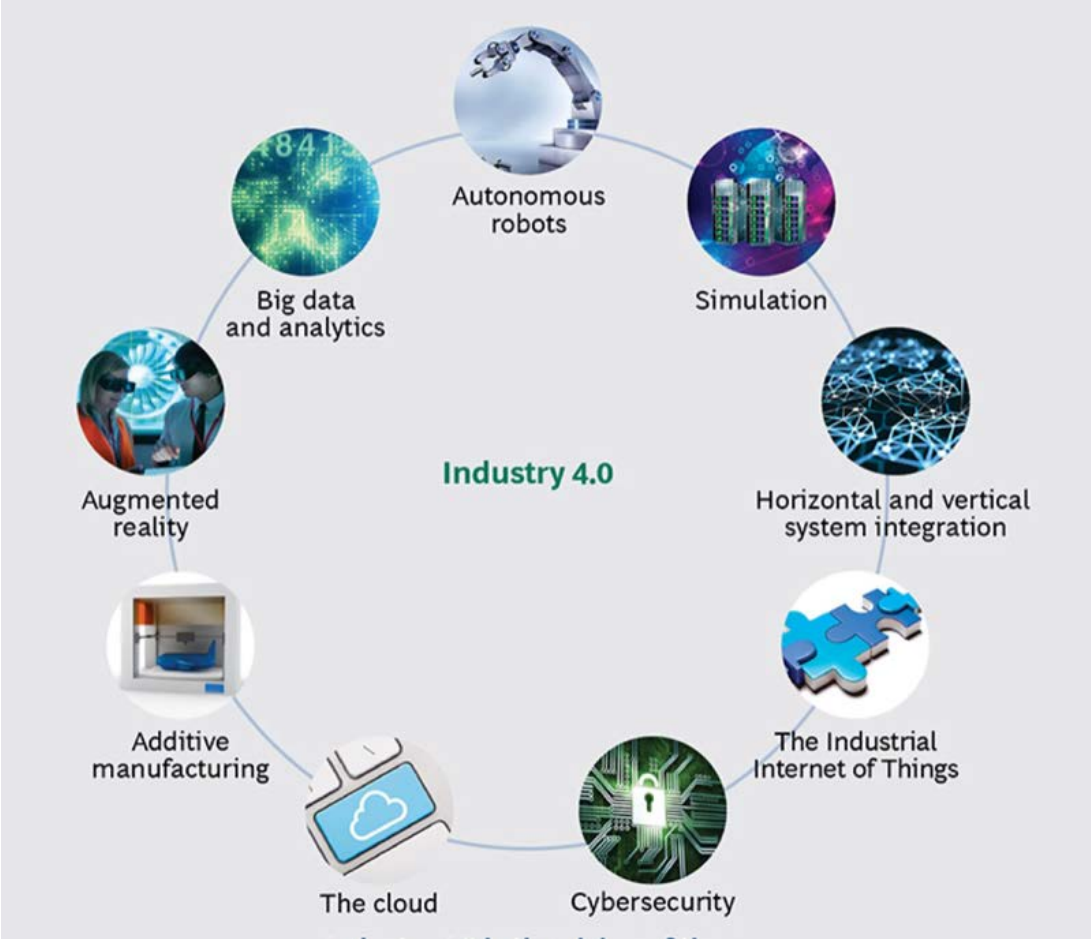


Figure 1. Industry 4.0 segments
Source: Rüßmann, M., Lorenz,M., Gerbert, P., et al. (2015). Industry 4.0:The Future of Productivity and Growth in Manufacturing Industries and BCG

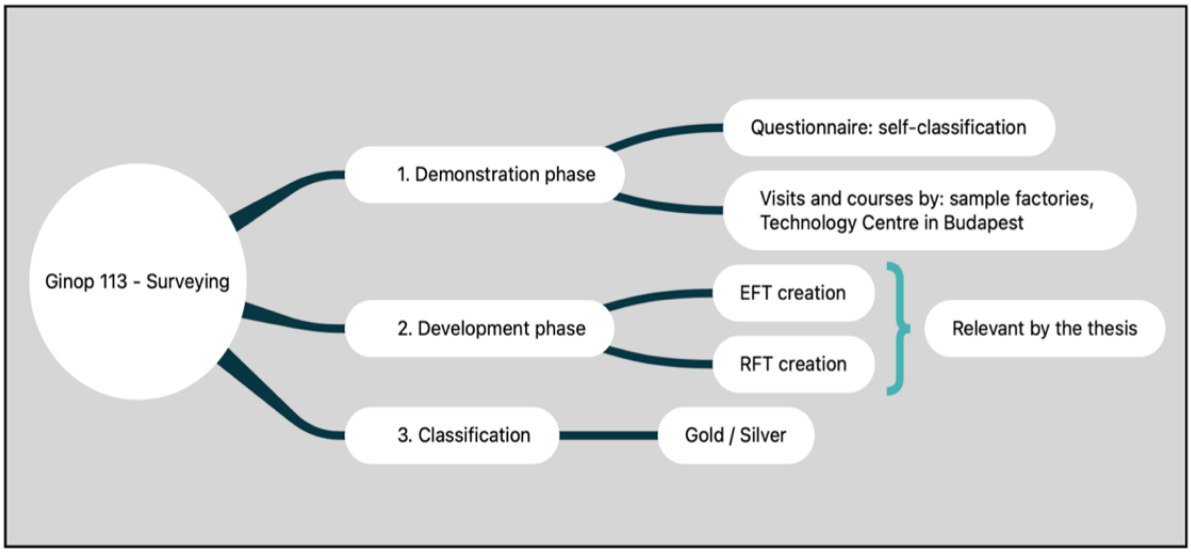


Figure 2. GINOP project build-up
Source: Fazekas (2022)

The GINOP 1.1.3 support (which was mentioned in the introduction) built up from several steps and two of them were used by this analysis. These two steps are the so-called EFT and RFT (explanation above) creations.

To categorise the pieces of information from the EFTs and RFTs the BCG's segmentation method was used.

The EFT and RFT documents' base are the so called A3 document:

To understand the main build-up of the A3 logic figure 3 was created. As it shows it has seven steps.

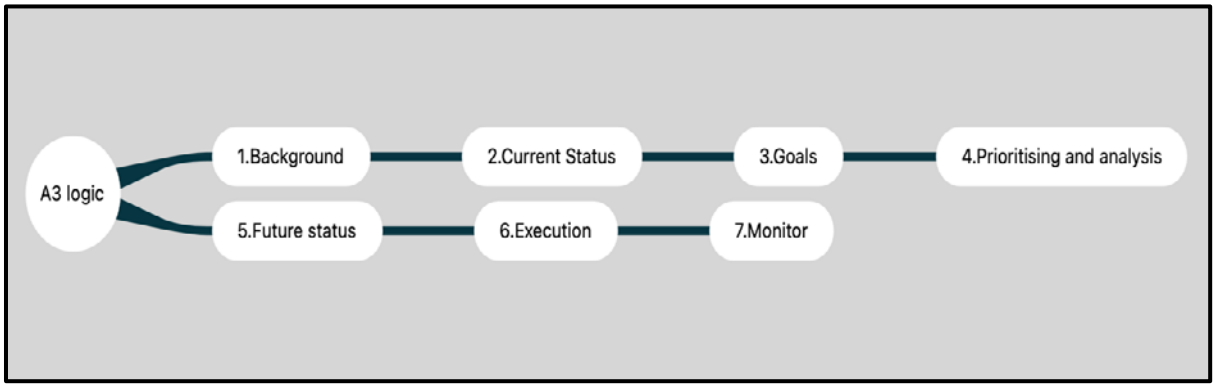


Figure 3. A3 logic's structure
Source: own creation inspired by: Mohd Saad,N., Al-Ashaab, a., Maksimovic, M., et al (2013) A3 thinking approach to support knowledge-driven design

A3 logic presents and solves problems with the help of visualisation in a well-structured way.

The aforementioned “Egyszerűsített Fejlesztési Terv” (EFT)’s English meaning is Simplified Development Plan. It is a preliminary document, which is created by the surveyed enterprise and its goal is to provide information for the RFTs.

Figure 4 presents an example EFT document. It is one of the surveyed enterprises EFT and contains private information, that is why it is not readable, but it shows the structure of it.

The SMEs learned the basics of the EFT creation, by the demonstration phase during the GINOP project; that is why these documents are a product of the enterprises with the support of a mentor.

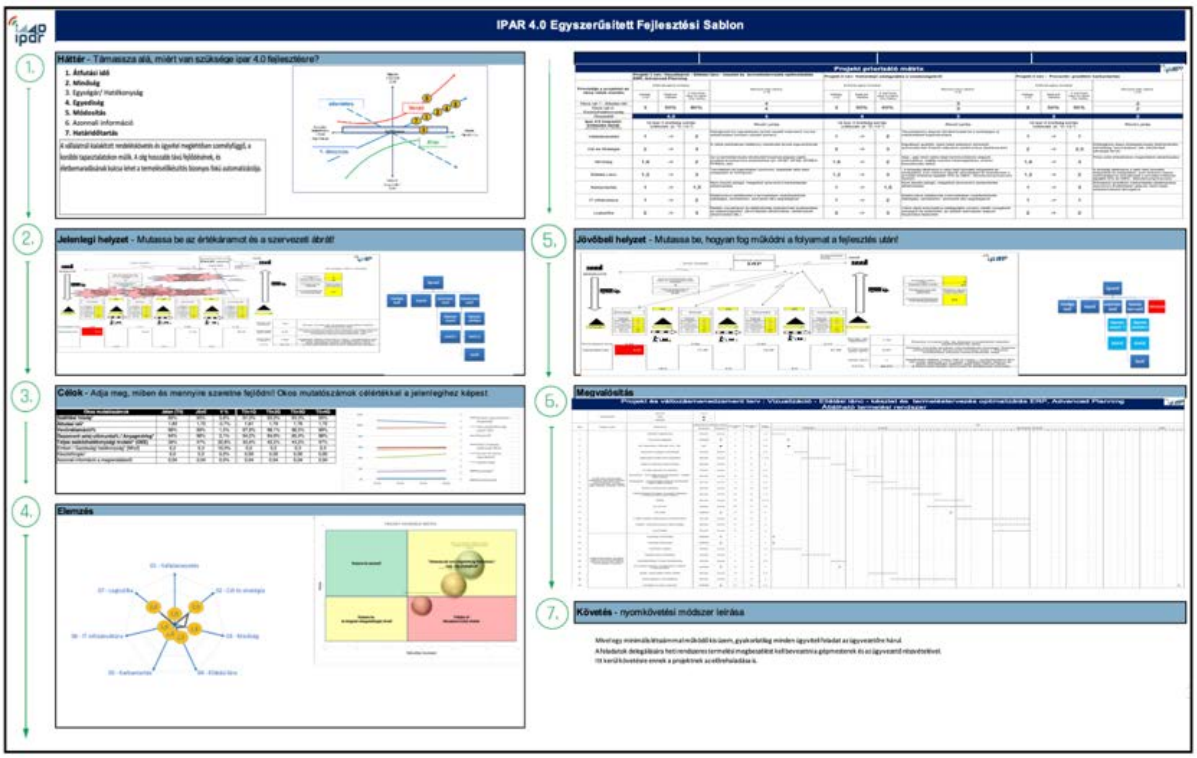


Figure 4. EFT example
Source: own creation, inspired by: Mohd Saad,N., Al-Ashaab, a., Maksimovic, M., et al (2013) A3 thinking approach to support knowledge-driven design

From the EFTs professional industry consulting firms created the so-called RFT documents which means Detailed development plan. These documents are also following the A3 logic and we can consider them as expansions of the EFTs with additional figures, suggestions, and calculations.

During the comparison of the RFT results and the trend creation the surveyed enterprises got a numeric code to provide them encryption.

To create an adequate comparison of the enterprises it was necessary to establish categories and indicators for them. These are the following:

- Number of employees
- Net revenue in 2021
- Field of industry
- Geographical arrangement: region within Hungary
- Industry 4.0 progress: this own indicator presents the forward movement of the industry 4.0 implementation of the enterprise in a percentage. This percentage comes from measure points:
- A fully implemented Industry 4.0 segment worth 3 points
- A partly implemented Industry 4.0 segment worth 2 points
- A planned (within 2 years) Industry 4.0 segment worth 1 point
- A not implemented and not planned segment worth 0 points.
- Degree of organization: this indicator is also own created and comes from the professional consulting companies' judges. These companies created a scale from 1-5, which symbolised presented how well organised is a company. (1 was the lowest score and 5 the highest.)

By the degree of organisation, there is a clear confine, by the number of 50 employees. Above 50 employees it is unavoidable to expend resources to control the organisation, e.g., create departments such as human resource department etc. In many countries, if a company employed its 50th employee then it comes with legal changes too. (Chelsea, 2022)

Results and discussion

Table 1. presents the results of the surveyed enterprises with the aforementioned categories and indicators.

From the table 1's data is created figure 5. which summarizes the industry 4.0 implementation trends by the surveyed enterprises.

Enterprise Number	Employees between	Net revenue between (mio EUR)	Industry	Region	I4.0 progess (%)	Degree of organi-sation	I4.0 implementation
1	12-50	1-5	Packaging	Közép-Dunántúl	44,4	2	
2	1-11	0-1	Textile	Észak-Alföld	18,5	2	
3	101-300	1-5	Metal-working	Dél-Dunántúl	37,0	4	
4	101-300	5-15	Metal-working	Dél-Dunántúl	55,5	4	
5	12-50	1-5	Metal-working	Közép-Dunántúl	37,0	4	
6	51-100	1-5	Textile	Nyugat-Dunántúl	29,6	4	
7	1-11	0-1	Packaging	Nyugat-Dunántúl	22,2	1	
8	51-100	5-15	Plastic	Észak-Alföld	70,3	2	
9	1-11	0-1	Textile	Nyugat-Dunántúl	33,3	2	
10	12-50	0-1	Metal-working	Közép-Dunántúl	40,7	3	
11	51-100	5-15	Metal-working	Nyugat-Dunántúl	51,8	5	
12	101-300	5-15	Plastic	Közép-Dunántúl	66,6	5	

Table 1: The main features of the surveyed companies

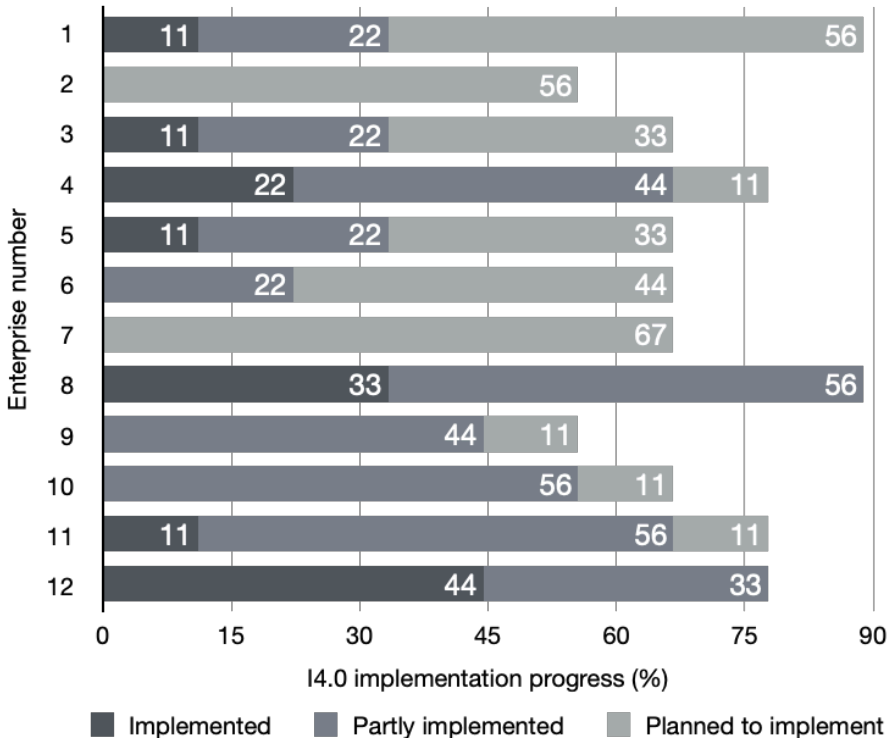


Figure 5: Summary of the I4.0 trends by the surveyed enterprises.

Figure 5 shows, there are significant dissimilarities between the surveyed SMEs, however the summarised Industry 4.0 implementation progress average is over 71%. The differences by the companies can be explained with the effects of capabilities and influencing factors. This research founded five noteworthy capabilities and influencing factors, which are presented in the next parts of the article.

1) Net revenue: the net revenue's impact on the industry 4.0 implementation is presented in figure 6. As it shown with the increase of the net revenue the industry 4.0 implementation progress also increases. It can be an interesting question, that the higher net revenue causes the higher Industry 4.0 implementation, or the higher degree of Industry 4.0 implementation causes the higher net revenue. This research confirmed only the following assumption: by enterprises with lower revenues, the number of planned and partly implemented I4.0 segments are higher and the fully implemented segments are lower than the SMEs with high net revenues.

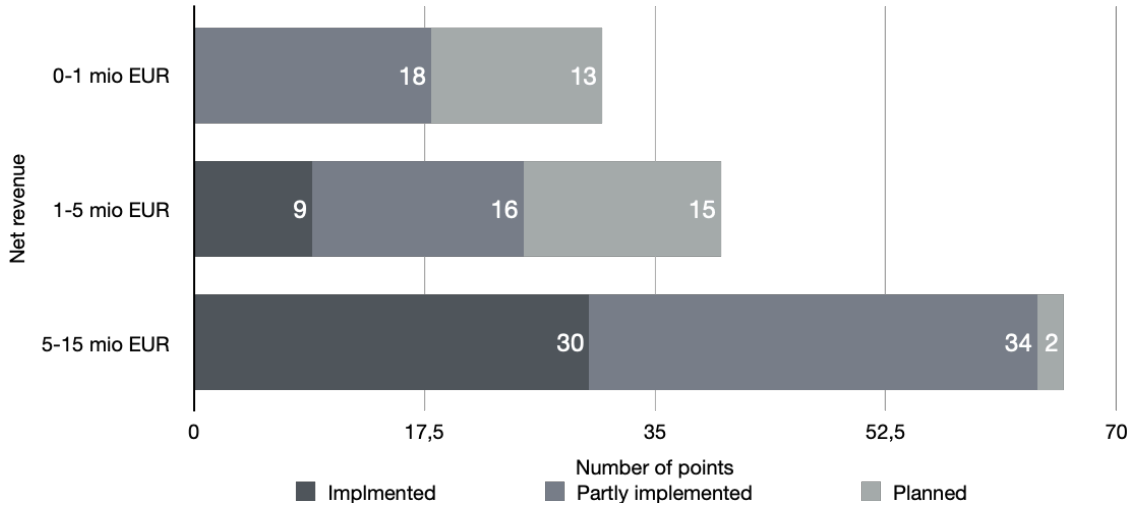
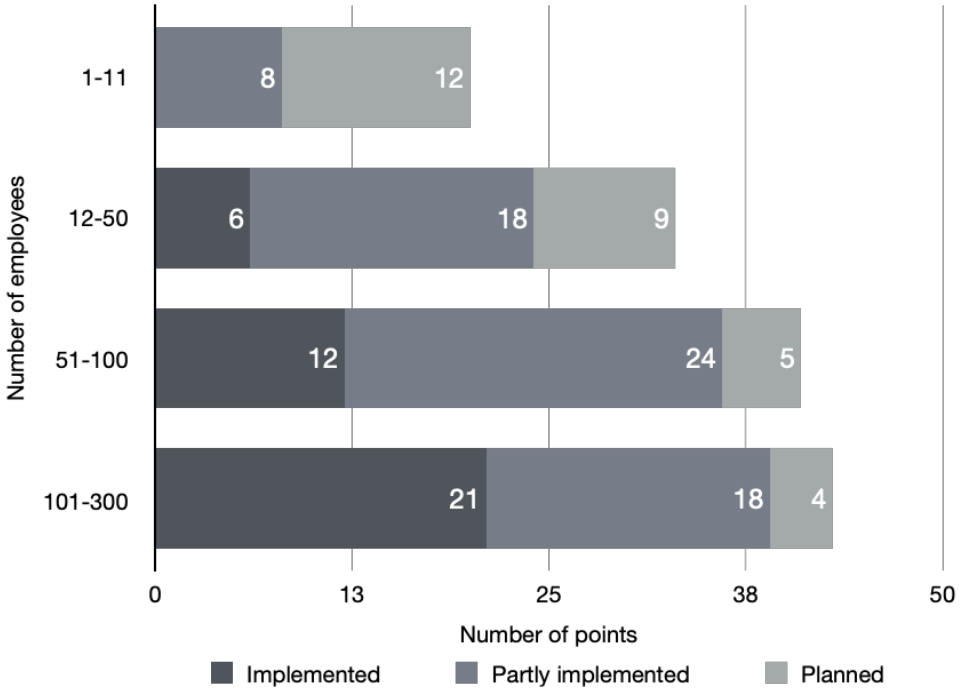


Figure 6: Net revenue and implementation comparison

2) Employee number: during the research a relation between the enterprise's employee number and the degree of Industry 4.0 implementation also was founded. This relationship is presented in figure 7. This illustration's result is very similar as the previous net revenue-based inspection.

3) Industry segment: the field of industry is also a relevant capability of the SMEs during the comparison of the industry 4.0 implementation progresses. Figure 8 presents which Industry segments are preferred by which industry fields.



4) Figure 7: I4.0 points related to employee number

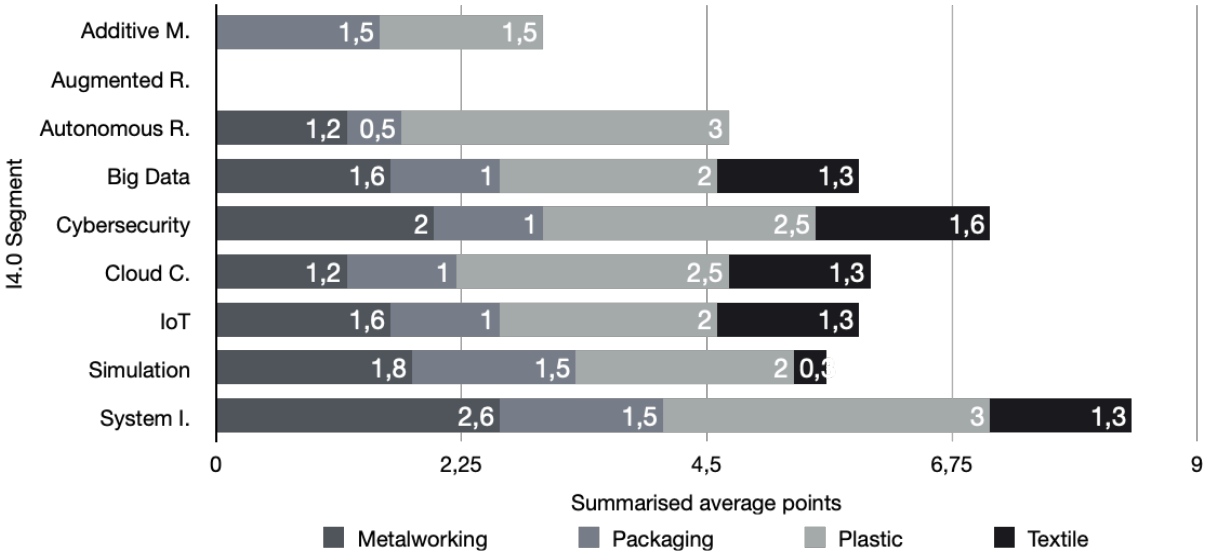


Figure 8: Relation between I4.0 segments and industries Source: own creation

The presented dissimilarities can be explained with the different applicability of the industry 4.0 segments by different industry segments. The applicability of the industry 4.0 segments is various within the different fields of industry, that is also discoverable in figure 8.

5) Geographical arrangement: during the research it become obvious, that the geographical arrangement of the enterprises impacts the industry 4.0 segment, this is presented in figure 9. By the analysis of these results, it is important to consider, that the GINOP project did not allowed to participate enterprises from Budapest and the region West-Transdanubia was also limited. The GINOP project had an additional education factor, which was the SME had to be innovative.

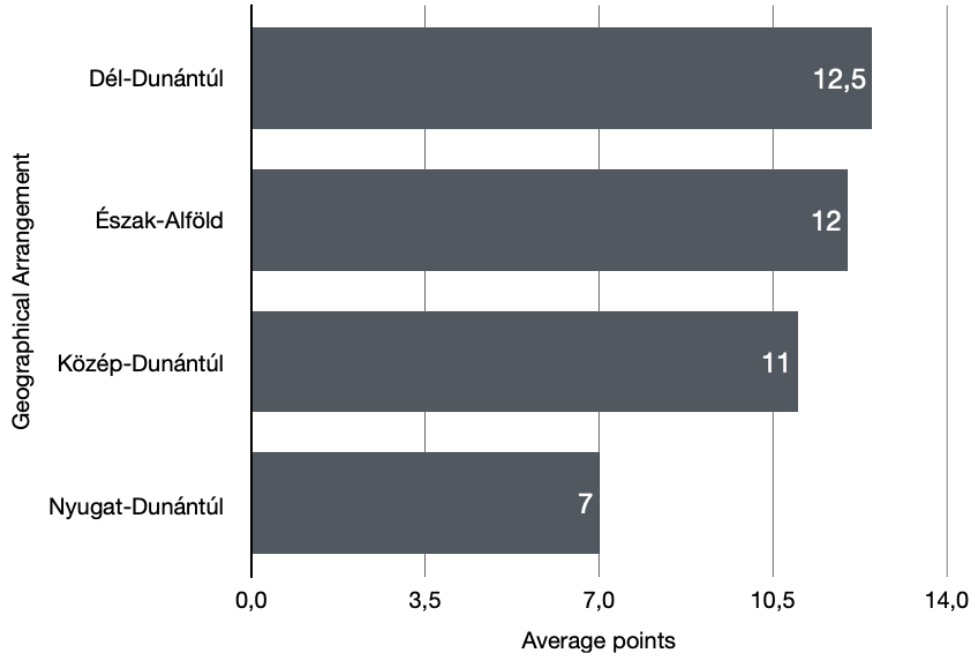


Figure 9: Comparison by regions within Hungary

6) Degree of organization: as figure 10 presents with moving average trend lines, that there is a relation between the industry 4.0 implementation progress and the degree of organization. Usually, higher organization degree enables higher Industry 4.0 implementation.

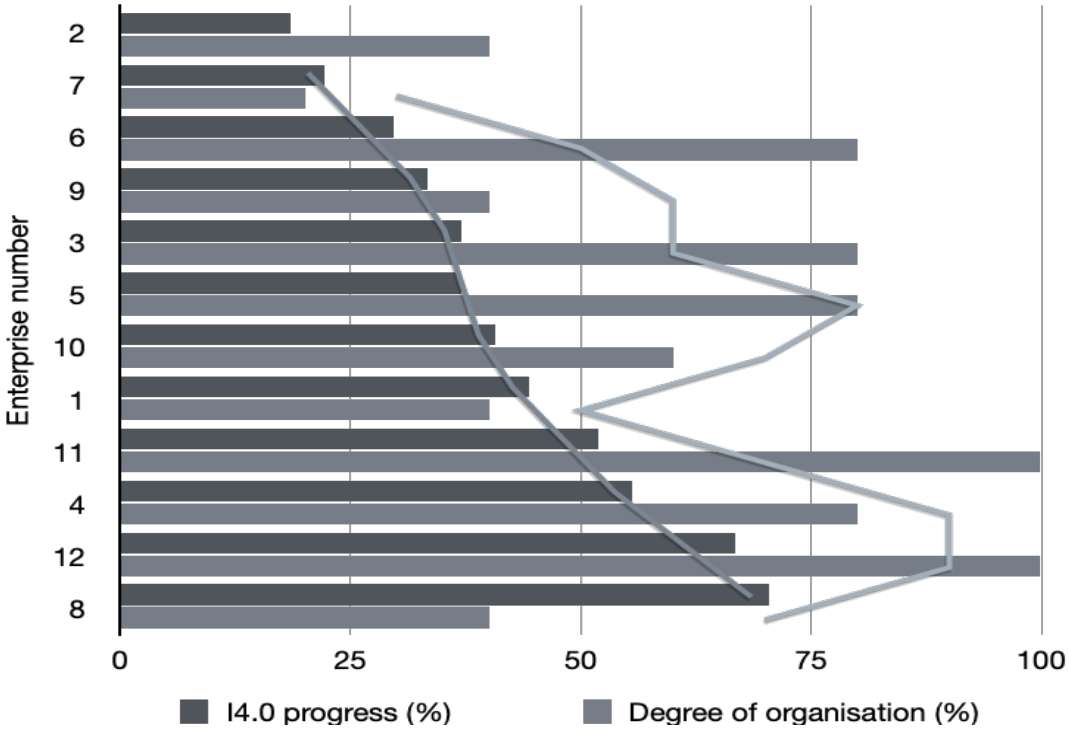


Figure 10: I4.0 related to the degree of organisation

Summary

In the beginning of the research there were four hypotheses created. In this summary we confirm these hypotheses:

- Table 1 and figure 4 which summarize the industry 4.0 trends by the surveyed enterprises, validated that the industry 4.0 implementation progress is relatively low by the Hungarian SMEs, but it is in a fast-growing phase
- Figure 7 presented that, there are preferred industry 4.0 segments by the Hungarian SMEs. Also showed, that this preferation is related to the field of industry where the enterprises are active.
- In the previous section all the founded Industry 4.0 implementation progress influencing factors were presented with their impacts: net revenue, employee number, industry segment, geographical arrangement, degree of organization.
- The degree of organization effect research confirmed that the aim of the paper section's last hypothesis: enterprise size increase (employee number) comes with the increase of the degree of organization. These are the causing the biggest impact by the industry 4.0 implementation progress.

Figure 11 was created to provide an overview about the previously mentioned results.

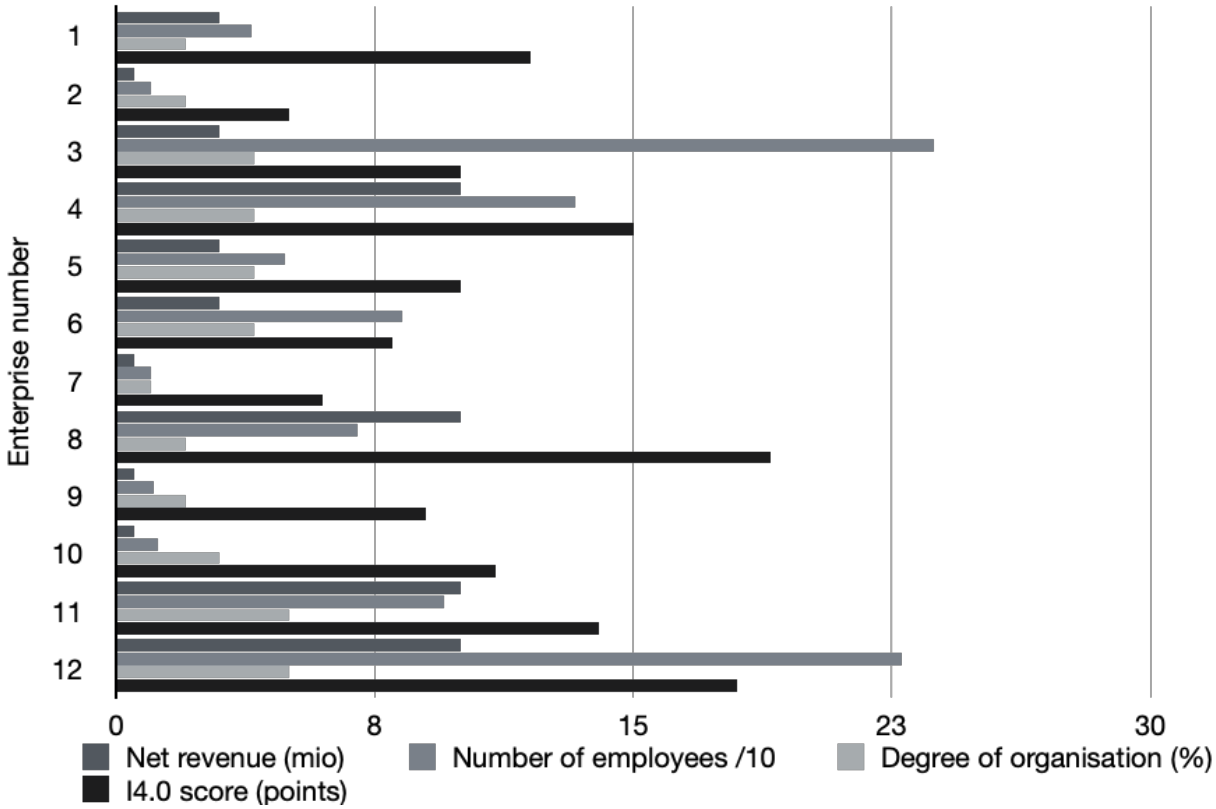


Figure 11. Conclusions by the surveyed enterprises

As a summary we can declare that there are many industry 4.0 implementation progress influencing factors and the capabilities of the enterprises are also crucial by these processes.

The research did not mention all the possible effecting factors e.g.: company missions, leadership style, corporate culture etc., that is why we are suggesting further analysis with these topics.

However, it became clear that, the tendency toward the industry 4.0 solutions by the Hungarian SMEs is worthy of attention and quantifiable.

Acknowledgement

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