Regionalised manufacturing baseline scenarios for Finland 2035:
Constructing a measuring point for scientific and societal intervention

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Manufacturing 4.0 – strategies for technological, economic education, and social policy adoption

strategic RESEARCH
research-based knowledge to support society

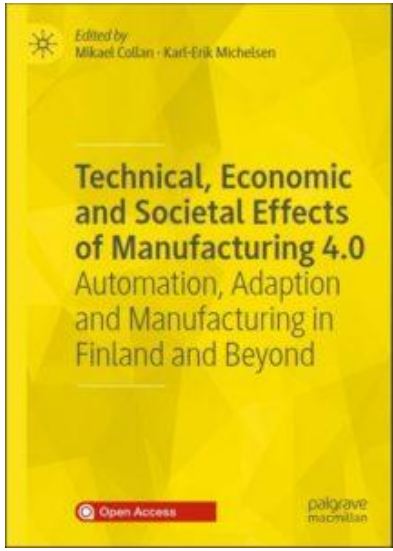
MFG 4.0

Funded by The Strategic Research Council of the Academy of Finland for the call of Adaptation and Resilience for Sustainable Growth for the period of 2018-2020.

The consortium includes **seven research groups**, **five work packages** and **four universities**.

*WP1: Future Research (**FFRC, UTU**)*
WP2: Automation and Distributed Manufacturing
WP3: Decision-making, potential, and business models
WP4: Education
WP5: Reshaping Social policies

Website: http://mfg40.fi/
Milestone book freely available: https://mfg40.fi/technical-economic-and-societal-effects-of-manufacturing-4-0-automation-adaption-and-manufacturing-in-finland-and-beyond/



LUT Lappeenranta University of Technology

HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

JYVÄSKYLÄN YLIOPISTO
UNIVERSITY OF JYVÄSKYLÄ

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Manufacturing 4.0 - MFG4.0 – Some background articles and studies in 2018-2020

Aho, Samuli & Kaivo-oja, Jari (2019) Suomen väestöllisen- ja taloudellisen huoltosuhteen kehitys suuralueilla ja maakunnissa vuosina 1990-2017. [Development of Finland's population and economic dependency ratio in metropolitan areas and provinces in 1990-2017]. *Kansantaloudellinen aikakauskirja*. Vsk 115, No. 2, pp. 270-288.

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Kaivo-oja, J. & Lauraeus, T. (2018) The VUCA Approach as a Solution Concept to Corporate Foresight Challenges and Global Technological Disruption, *Foresight*, Vol. 20 Issue: 1, pp. 27-49, https://doi.org/10.1108/FS-06-2017-0022

Kaivo-oja, J., Knudsen, M.S. & Lauraeus, T. (2020) Coping with Technological Changes – Regional and National Preparedness in Face of Technical Change. In Collan, M. & Michelsen, K.-E. (eds.) *Technical, Economic, and Societal Effects of Manufacturing 4.0 – Automation, Adaption, and Manufacturing in Finland and Beyond*. Palgrave-MacMillan: London.

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Kaivo-oja, Jari, Kuusi Osmo, Knudsen, Mikkel Stein & Lauraeus, Theresa (2020) Digital Twin: Current Shifts and Their Future Implications in the Condition of Technological Disruption, I*nternational Journal of Web Engineering and Technology*, Vol. 15, No. 2, in press. ©Inderscience Publishers.

Kaivo-oja, Jari, Lauraeus, Theresa & Knudsen, Mikkel Stein (2020) Picking The ICT Technology Winners – Longitudinal Analysis of 21st Century Technologies on The Basis of The Gartner Hype Cycle 2008–2017: Trends, Tendencies and Weak Signals. *International Journal of Web Engineering and Technology,* Forthcoming. In print. ©Inderscience Publishers.

Kaivo-oja, J., Knudsen, M.S. & Lauraeus, T. (2018). Reimagining Finland as a Manufacturing Base: The Nearshoring Potential of Finland in an Industry 4.0 Perspective. *Business, Management and Education*, 16(1): 65-80 https://doi.org/10.3846/bme.2018.2480

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Manufacturing 4.0 - MFG4.0 – Some background articles and studies in 2018-2020

Karppinen, Ari, Aho, Samuli, Haukioja, Teemu, Kaivo-oja, Jari & Vähäsantanen, Saku (2019) Alueiden älykäs erikoistuminen Suomessa. Aluekehittämisen indikaattorianalyysi. *Tutu e-Julkaisuja* 4/2019. Tulevaisuuden tutkimuskeskus, Turun yliopisto, s. 167.

Knudsen, M., Kaivo-oja, J., and Lauraeus, T. (2019) Enabling Technologies of Industry 4.0 and Their Global Forerunners: An Empirical Study of the Web of Science Database. *International Conference on Knowledge Management in Organizations, KMO 2019: Knowledge Management in Organizations*, pp 3-13 Ed. L. Uden et al. (Eds.): KMO 2019, CCIS 1027. Springer Nature Switzerland AG, pp. 1–11 https://doi.org/10.1007/978-3-030-21451-7_1

Ogbeibu, Samuel, Emelifeonwu, Jude, Senadjki, Abdelhak, Gaskin, James & Kaivo-oja, Jari (2019) Technological Turbulence and Greening of Team Creativity, Product Innovation, and Human Resource Management: Implications for Sustainability. *Journal of Cleaner Production*. In press

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Four typical purposes of scenario work (Wright, Bradfield & Cairns 2013)

- **Sense-making:** a one-off ‘exploratory question-raising scenario project’;
- **Developing strategy:** a one-off ‘decision-making scenario project’;
- **Anticipation:** an ‘on-going exploratory scenario activity’; and
- **Action-based organizational learning:** an ‘on-going decision-making activity’.

- New emphasis on current scientific discussion: **Sense-making, Sense-giving and Sense-breaking**

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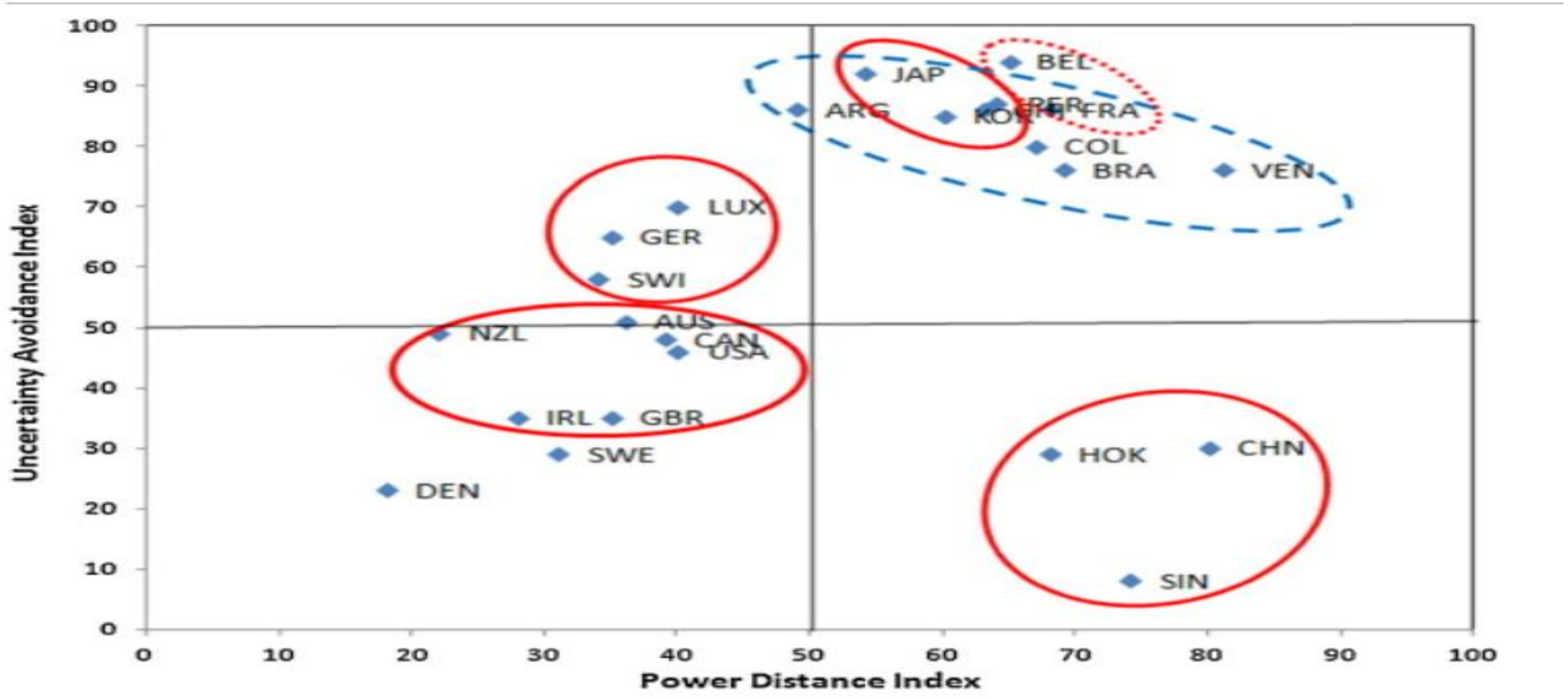
Multi aspects of scenario analysis (Van Asselt 2000)

- There is not one problem, but a tangled web of problems (**multi-problem**)
- The issue of concern transcends numerous disciplines (**multi-dimensional**)
- The processes that underlie the issue interact on various scale levels (**multi-scale**)

The impacts of cultural setting on foresight, scenario analysis and scenario learning process: Case example of the Power Distance Index and the Uncertainty Avoidance Index (Hofstede 1980, 1984)



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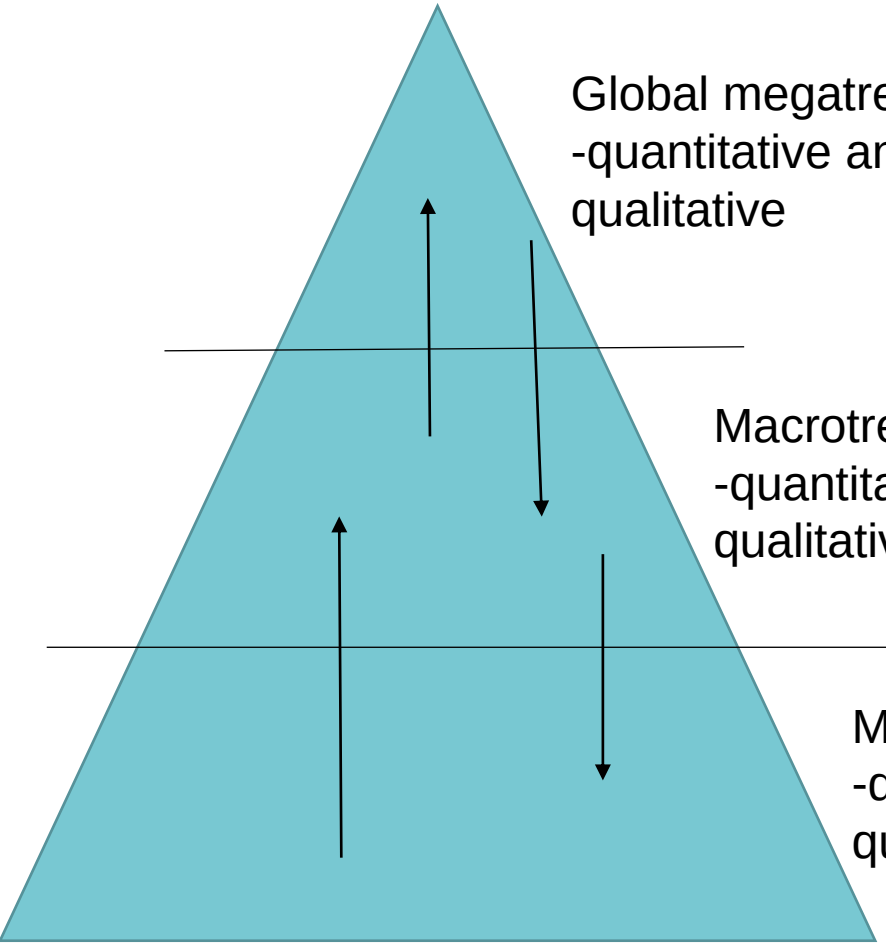
Data-driven trend analysis integrated to Frank W. Geel´s MLP heuristic transition model (Kaivo-oja et al 2020)



Global megatrends
-quantitative and qualitative

Macrotrends
-quantitative and qualitative

Microtrends
-quantitative and qualitative

Global landscape
Global driver-driven analysis (Global scenarios)

EU S3 Strategy – Industry 4.0

National S3

Socio-technical regimes
Macro-level driver-driven analysis (National scenarios)

Regional S3

Niche-level innovation and development processes
Micro-level driver-driven analysis (Regional scenarios)

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Why do we need to start with a baseline?

- ”*Ungrounded speculation may pass for knowledge in (some quarters of) the futures field but* ***the world is, correctly, not fooled****. The only future views worth taking seriously are those that account for the mechanisms of their emergence. Core to such account is* ***situating a forward view in the field of its antecedent forces****, explaining how we get from here to there.”* (Adam V. Gordon, 2020)
- ***Data-driven scenarios*** *are “hard cash” for business and political decision -makers*

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Why downscale global trends to regional contexts?

Starting from research question:

- How can Finland thrive faced with the global, technical changes provided by the Fourth Industrial Revolution and Industry 4.0?

Combined with the dominant regional development paradigm **Smart Specialization Strategy (S3);** ; strong place-based tenets,stressing needs to underpin regional development at more fine-grained levels than the national level.

We **need to focus on the regional levels**, because:

- The location and importance of industrial, export and import activities are different in different regions of national economies.
- The key elements of the S3 approach, industrial comparative advantages, regional resilience levels, and innovation activities are different in different regions.
- The industrial scale and scope factors are different in different regions.
- The nature of regional collaboration and actor-network network patterns are different in different regions inside national economies.

See further arguments in Kaivo-oja, Knudsen & Lauraéus, 2020

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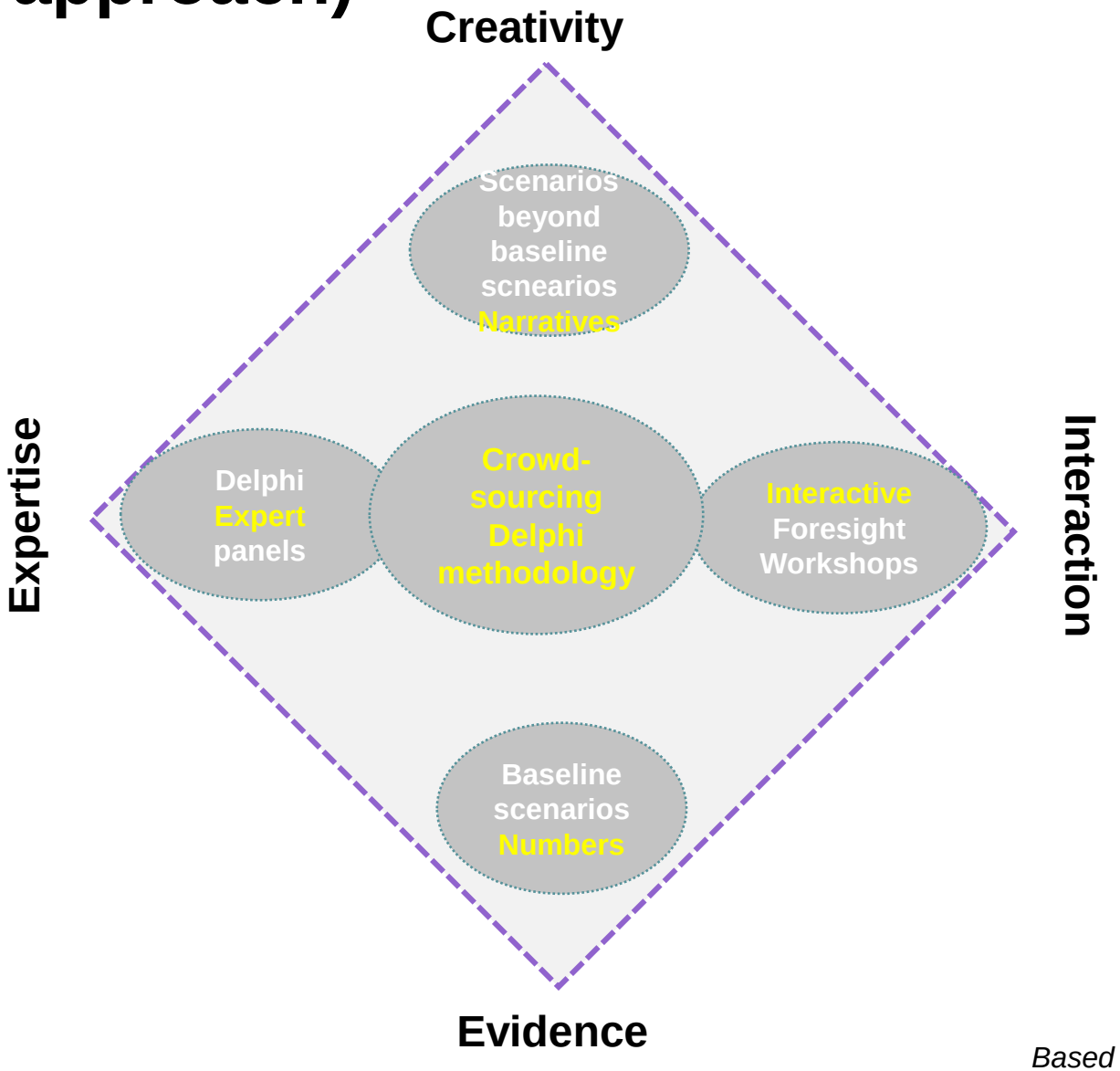
Future Diamond: Baselines a starting point for hybrid foresight approach (Manufacturing 4.0: A methodological foresight approach)



Baseline scenarios:

- Evidence-based starting point; a measuring point for proposed interventions.
- We have tried to do methodological refinements to attempt novel approaches (=> scientific value) and provide as relevant results as possible

MFG4.0 uses a hybrid foresight approach:

- The regional baseline scenarios are just one element in the MFG4.0-project.
- Application in regional contexts (smart specialization) and design of functioning interventions requires use of supplementary methods accounting for expertise, creativity and interaction.
- Examples within project: Delphi, expert panels, interviews, bibliometric analyses, stakeholder workshops, regional workshops etc.

Based on Popper, 2008

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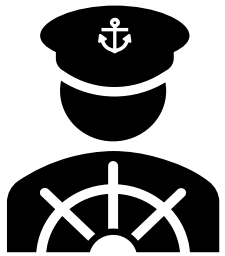
Creating a Baseline Opportunities Forecast in the MFG4.0 project

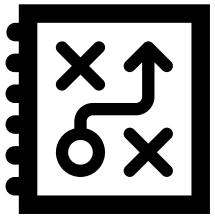
We synthesize three large sets of data – global, national and regional.

- Past, (inter)national: *Input-output tables from the World Input-Output Database (WIOD)*
- Future, global: *Long-term GDO growth forecasts from the OECD*
- Present, regional: *Regional employment statistics from Statistics Finland*



Key result:

A novel model of baseline regional development based on global projections



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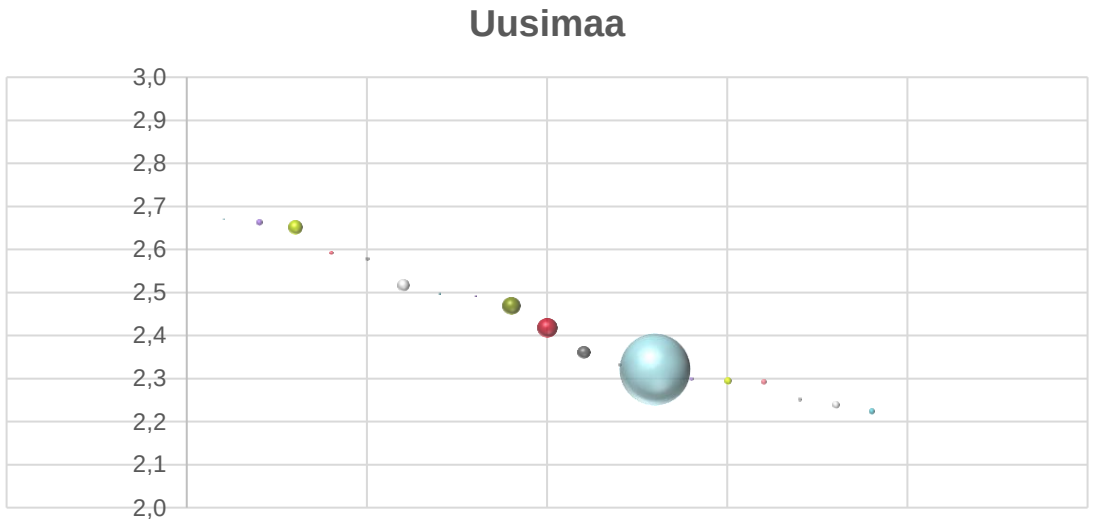
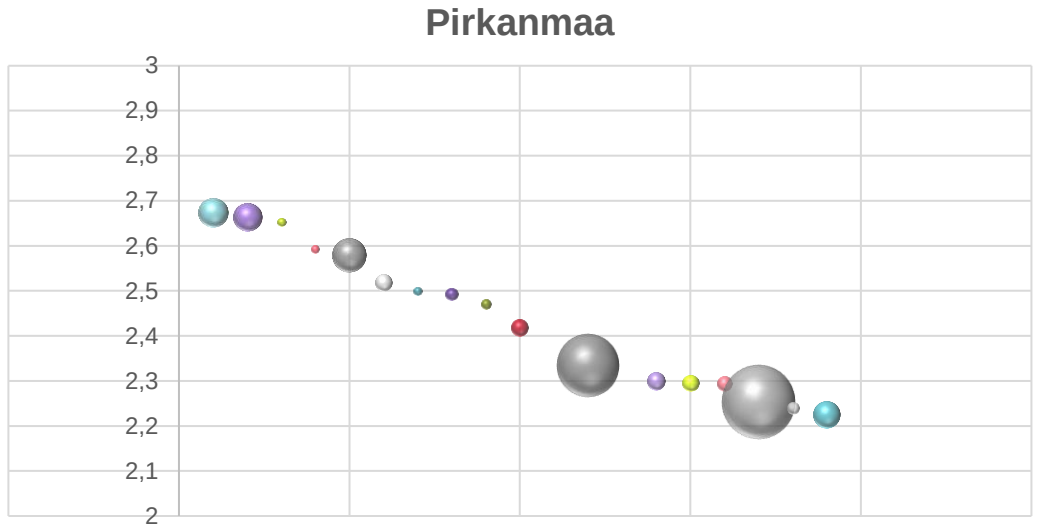
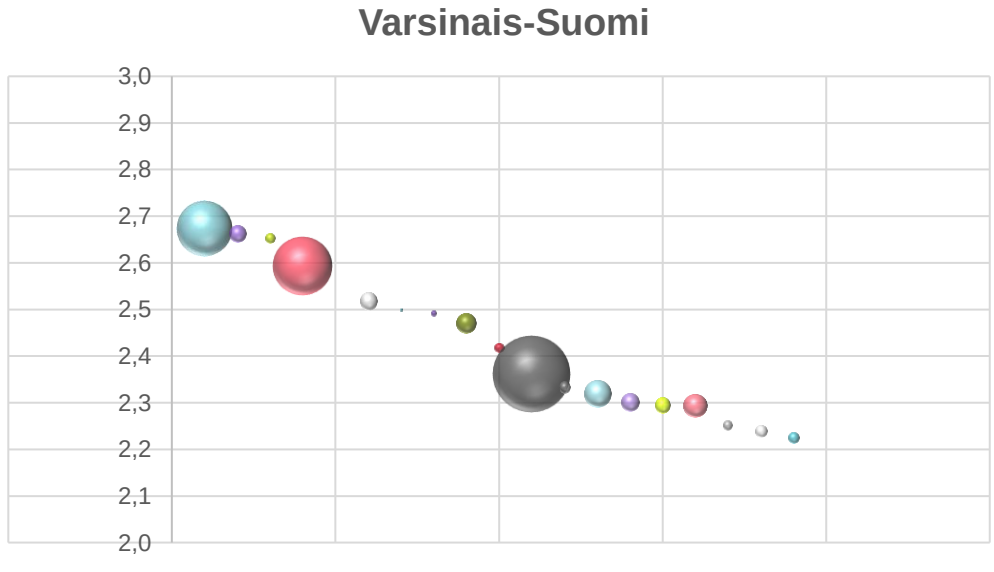
We might visualize regional variations







Key:

Good outlook = Large bubbles in high-growth sectors

Worse oulook= Large bubbles in low-growth sectors

Note: BHI is relative. Large circles might not represent that large share of the local economy, e.g. the case of coke refining in Uusimaa

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Next steps

Preliminary results included in Kaivo-oja, Knudsen & Lauraéus (2020) Coping with Technological Changes: Regional and National Preparedness in Face of Technical Change in Collan & Michelsen (eds.): *Technical, Economic and Social Effects of Manufacturing 4.0: Automation, Adaption and Manufacturing in Finland and Beyond.* Palgrave MacMillan.

- Finalising baseline scenario model, analysis and results
- Publication of detailed results in a Finland Futures Research Centre E-Book (2021)
- Submission of article with methodological focus (2021)

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Thank you!

See more!: https://mfg40.fi/