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An overview of skills foresight methods

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Abstract. *With structural shifts in the labor market, future skills research is a topic of interest. Skills foresight is an approach for anticipating future skills. Methods and tools are required to identify future skills needs. This study aims to understand the use of methods and tools in skills foresight.*
The literature review identified 26 methods and tools, and their objectives applied in skills foresight studies. Identified methods and tools were classified according to the stages of a foresight study and to the frequency of appearances. To present relationships between methods and tools, a combinations matrix was created. Comparing methods and tools in skills foresight to methods and tools in foresight revealed that the use of methods and tools in skills foresight studies is similar to the use of methods and tools in general.

Keywords. Skills foresight, methods and tools

1 Introduction

Technology is changing how we live, communicate, work, as well as transforming our jobs, creating new or substituting current jobs. Ten or even five years ago, the most in-demand occupations did not exist (World economic forum, 2016). The labor market demands new skills and knowledge, but the educational system is unable to keep up with these changes. Therefore, in order to keep up with these changes we have to peer into the future. Foresight is an approach for anticipating the future. According to For-Learn project, foresight is „a systematic, participatory, future intelligence gathering and medium to long term vision building process aimed at enabling present-day decision and mobilizing joint actions“ (*FOR-LEARN Online Foresight Guide*, 2013). Foresight is founded on two premises, there are many possible futures, and future developments can be influenced (Andersen & Rasmussen, 2014). The foresight aims to explore and shape the future. Foresight is applied in diverse fields, like environment, business, health, military, education, labor market.

Skills foresight is an approach for identifying future skills needs in the labor market. Skills foresight provides information to labor market stakeholders about potential future skills needs, so they can make decisions and take actions. Education and training providers need to know which curricula to update, the government uses this information for immigration policy, employers to design human resources development strategies, individuals to make decisions about their career (ILO, 2015). To identify future skills needs we need methods (Lassnigg, 2006).

Methods applied in foresight studies are derived from social and technical science, and often modified (Halicka, 2016). The list of methods that can be used in foresight studies is extensive and open. According to Aaltonen and Sanders (2006) starting point for a successful foresight study is knowledge about research methods, in-depth understanding of methods. The exhaustive collection of methods is presented by Glenn and Gordon (2009) with history and description of the methods, how to use methods, and strengths and weaknesses of the methods. More information about foresight methods is provided in Unido Technology Foresight Manual and For-Learn project webpage (Unido, 2005; FOR-LEARN Online Foresight Guide, 2013). Aaltonen and Sanders (2006) emphasize the use of different methods in a foresight study. The quality of the results of a foresight study depends on the use of a set of methods. Using only one method, or in an inexpert combination, reduces the quality of the results (Magruk, 2011). The question is how to select methods for foresight study. Classifying methods is helpful for the selection of methods (Halicka, 2016).

Different authors presented classes of methods according to criteria like type of data, kind of cooperation, orientation, stage of research, reference to time, the essence of research, and way of thinking. Glenn and Gordon (2009) presented 38 methods and tools classified as qualitative and quantitative, and normative and explorative. With the normative approach we determine, create a future. The starting point is desired future, and then one works backwards to the present to determine choices for realizing the vision. With the explorative approach, we analyze how the future can evolve, and prepare and adapt to a possible future. Many methods can be used for both normative and explorative approach. Saritas (Elena-

Perez et al., 2008) made a classification of 31 methods based on five stages of foresight study: understanding, synthesis and models, analysis and selection, transformation, and actions. Another classification according to two perspectives, nature and capabilities, was proposed by Popper (2008). By nature, methods are classified as qualitative, quantitative, and semi-quantitative. Semi-quantitative methods apply mathematical principles to measure opinions and viewpoints of experts and stakeholders. By capabilities, i.e. the ability to gather or process information, methods are distinguished based on creativity, evidence, interaction, and expertise. These four perspectives form the foresight diamond, a framework that is widely used in foresight studies. The original paper was cited more than 500 times. Based on the review of 866 foresight studies, Popper (2008) argues that methods should be selected from all perspectives of the foresight diamond. More detailed reviews of the classification of methods are provided by Halicka and Magruk (Halicka, 2016; Magruk, 2011, 2015).

In addition to understanding the main features and classifications of methods, it is important to consider factors that determine methods selection like resources, level of participation, suitability for combination with other methods, desired outputs of a foresight study, quantitative and qualitative data requirements, and methodological competences (Unido, 2005). Saritas and Burmaoglu (2015) concluded the list with four more factors: proof of concept-learning from other sites of application, urgency-time constraint, type of engagement, and prior experience and familiarity.

Analyzing the use of methods through time revealed that the number of methods employed has increased. Some of the traditional methods, such as scenario, Delphi and roadmapping remain as key methods, while other new methods are becoming more popular. These are other well-known methods, such as system dynamics, bibliometric analysis, simulation, patent analysis, network analysis. The increasing use of these methods reflects the focus on quantitative methods. Traditional methods have remained as dependable tools for foresight, but the way they are practiced has changed. They are being used with new tools and technologies, such as electronic surveys and advanced simulation-based scenarios. The available digital data and the increased processing capacity bring up a new world of analysis and decision making in complex environments. To analyze and process massive data foresight incorporates big data and machine learning. The COVID-19 pandemic has disrupted our economies and societies, generating high uncertainty. The health, economic, political, environmental, and social consequences of this disease are still unknown. OECD suggests strategic foresight as an approach for making decisions in the face of uncertainty. In the same vein, the recently published report of the UN Secretary General (UN, 2021) lays down a plan to establish a Futures Laboratory within the UN system, aiming to "strengthen strategic foresight, preparedness for catastrophic risks, and anticipatory decision-making…".

While the referenced methodological reviews provided overview of methods used in foresight in general, in this paper we aim to identify and classify methods and tools in skills foresight, as well as their objectives, and to compare the use of methods and tools in skills foresight and foresight in general. Research questions are related to methods and tools: which methods and tools are applied in skills foresight studies, and what are the objectives of methods and tools. The structure of the paper is as follows. Section 2 presents the methodology applied in this research. Section 3 provides results of the review of methods and tools in skills foresight. Section 4 is the discussion. Section 5 is the conclusion.

2 Methodology

In order to identify methods and tools, and their objectives we performed a targeted literature review. We searched Web of Science Core Collection, Scopus, ScienceDirect, EBSCO host, IEEE Xplore, Emerald Insight, and Google Scholar. The second source of studies were surveys and reports from government agencies and international institutions, like Expert group on future skills needs, UK Commission for Employment and Skills, International Labor Organization, and European Training Foundation. Only studies with research questions related to qualitative aspects of skills were analyzed, e.g. what skills will be required in the future. Combinations of keywords were used in the search: anticipation, future, foresight, skills, jobs, occupations, demand, needs, and requirements. After the selection, 19 studies were included in the analysis. The selected studies regarded different jobs from different industries. Methods and tools used in the studies as well as their objectives were recorded in an Excel spreadsheet. Identified methods and tools, and their objectives were classified according to the stages of a foresight study in the following way: understanding, generation, and transformation (Adapted from Elena-Perez et al., 2008). Understanding is the first stage, creates a common understanding of a topic, clarifies the goals, and provides input for later stages. Understanding aims to identify and classify trends and drivers of change, identify stakeholders, scan occupations and skills, and current policies. The next stage is generation. The input from the understanding stage is combined to create conceptual models. Based on anticipation, possible, probable, and desirable future models are developed. Alternative models of the future are analyzed, and through negotiations among stakeholders, the most desirable one is selected. Transformation is the third stage. This stage aims to connect the future with the present, defining a

relationship between future and present with a focus on the change of the existing system. In this stage plans, strategies, and policies are proposed to achieve the desired state. Changes in the organizational structures and behavior patterns are required to move from the current system to the intended future system.

The frequency of appearance of methods and tools was recorded as the total number of appearances and the percentage of appearances. Methods and tools were classified according to the percentage of appearances in three groups: the very frequently used methods and tools (more than 31%), commonly used methods and tools (11-30%), and less frequently used methods and tools (1-10%) (Adapted from Popper, 2008). To present relationships between methods and tools, a combinations matrix was created. Methods that have appeared less than four were excluded from the matrix. Each cell shows the proportion in which two methods and tools are combined with respect to the number of times the method and tool was used. To present results in a more "digestible" way, the following categories have replaced the percentage. The percentage is coded as L for low (0-19%), M for moderate (20-39%), H for high (40-59%), and VH for very high frequency of combinations (more than 60%) (Adapted from Popper, 2008).

3 Results

The literature review identified 26 methods and tools, and their objectives applied in skills foresight studies. Methods and tools, their objectives, and classifications according to the stages of a foresight study and the frequency of appearances are presented in Table 1. Literature review, interview, survey, and scenario are the most frequent methods. Fig. 1 shows the distribution of the number of methods and tools used in an individual skills foresight study. Table 2 presents the methods and tools combination matrix. The diagonal shows the total number of times the method and tools were used. Methods and tools are presented in rows and compared to the columns. E.g. literature review and scenario were combined 4 times. Literature review was used 11 times, 4/11=36%, and percentage is replaced by M. Scenario was used 8 times, 4/8=50%, and percentage is replaced by H.

4 Discussion

For the purpose of this article, methods and tools were classified by the stage of a foresight study, and the frequency of appearance. First, classification by the frequency of appearance, the number of methods and tools used in skills foresight, and methods and tools combination matrix are discussed.

Based on the frequency of appearance, methods and tools were divided into three groups: the very frequently used methods and tools, commonly used methods and tools, and less frequently used methods and tools. Literature review, interview, scenario, and survey were the most frequently used methods and tools. The literature review is a research of secondary data from sources such as academic journals, reports, conferences, newspapers, internet. It is commonly done in the first stage of the foresight study for identifying trends and drivers of change, analyzing the current policies, identifying changes in occupations and skills, and serves as input into later stages. The second group included commonly used methods and tools such as workshop, focus group, horizon scanning, Delphi, STEEP analysis and SWOT analysis. The group of the least frequently used methods and tools included consistency analysis, cross impact analysis, expert elicitation, expert panel, grounded Delphi, machine learning, patent analysis, road mapping, stakeholder analysis, system thinking, text mining, thematic analysis, uncertainty impact analysis, visioning, wind tunneling, and world cafe workshop. Qualitative methods and tools were more frequently used, with less emphasis on quantitative methods and tools. Popper (2008), who analyzed 866 foresight studies, found similar results, e.g. the most frequently used methods were literature review, expert panel, and scenario. Comparison of our results to those of Popper's (2008), and Saritas and Burmaoglu's (2015) showed that focus group is a method specific for skills foresight, while grounded Delphi and world cafe workshop are new methods that have recently emerged.

As previously mentioned, quality of a foresight study results depends on use of a range of methods. Fig. 1 shows that number of methods and tools per study ranged between one and eight, with an average of four methods and tools. To understand relationships between methods and tools, a combinations matrix was created. Table 2 presents which methods and tools are frequently combined in skills foresight studies. Only a few findings are discussed. As expected, most methods and tools are highly used with interview and literature review. Interviews and focus groups are highly used with surveys, complementing and validating results from surveys. Frequency of use of workshop, horizon scanning, STEEP analysis and SWOT analysis in combination with scenario was high. Workshop is used for ranking trends and drivers of change, for developing projections of alternative future developments, and for analysis of an impact of a scenario. Horizon scanning is used for identifying trends and drivers of change, STEEP analysis to classify trends and drivers of change into categories, and SWOT analysis for identifying strengths, weaknesses, opportunities and threats.

In the second classification, methods and tools, and their objectives were classified according to the stages of a foresight study: understanding, generation, and transformation. Most methods were used in only one type of stage, however, interview, survey, focus

Table 1. Methods and tools, objectives and stage

Methods and tools (number of cases/%)	Objectives	Stage
Literature review (11/58%)	Identifying trends and drivers of change [1]; Analysing the current policies [14]; Identifying changes in occupations and skills [21]; To define future skills and roles as input for Delphi [18];	U
Horizon scanning (4/21%)	Identifying trends and drivers of change [5].	U
STEEP analysis (2/11%)	Classifying trends and drivers of change into categories [1].	U
SWOT analysis (2/11%)	To identify strength, weakness, opportunities and threats of the sector [14].	U
Expert panel (1/5%)	Validating list of skills for an interview [11].	U
Stakeholder analysis (1/5%)	Identifying and selecting stakeholders from whom data will be collected [10]; To identify stakeholders directly affected and responsible for skill needs [10].	U
Text mining (1/5%)	To identify drivers of change and technologies [15].	U
Interview(11/58%)	Collecting data about future skills for input for scenarios [9]; Collecting trends and drivers of change [7]; Identifying areas for further scanning and analysis [6]; Validating results from a literature review [1]; Collecting data about future skills [11].	U/G
Survey (8/42%)	Collecting data about future skills and knowledge [16]; Gathering opinions and generating ideas from which the research could construct themes to develop in the interview and in the workshop [9]; Expert survey to define the content of the skills model, employers' survey to collect data about skills and verify results from an expert survey [17].	U/G
Workshop (6/32%)	Developing projections of alternative future developments for each key factor [1]; Developing implications of trends and drivers of change for future employment and skill requirements [6]; To review and expand the impact of scenario on employment and skills [6]; To validate results from survey and interview [7]; Analysis of the possible trajectories of development of the ICT sector [14]; Clustering and ranking trends and driver of change in terms of the degree of importance [19].	U/G
Focus group (4/21%)	Collecting data about future skills and roles [18]; To review and update questionnaire [16]; In the first round of Delphi to collect data [2].	U/G
Scenario (8/42%)	To construct and explore alternative images of the future of jobs and skills [1].	G
Delphi (3/16%)	To narrow down the drivers of change into a final set of three [13]; To identify future skills and roles [18].	G
Consistency Analysis (1/5%)	To define a list of all possible and plausible combinations of projections [1].	G
Cross impact analysis (1/5%)	For selecting the most important factors for the development of alternative scenario [1].	G
Grounded Delphi (1/5%)	Identifying skills and data analysis [2].	G
Machine learning (1/5%)	To predict future occupation [4].	G
Patent analysis (1/5%)	To identify future skill needs [12].	G
System thinking (1/5%)	To determine what drives the future evolution of the workforce system [5].	G
Thematic analysis (1/5%)	To analyze the ranking of each skill across the areas of inquiry [11].	G
Uncertainty impact analysis (1/5%)	For selecting the most important factors for the development of alternative scenario [1].	G
Visioning (1/5%)	To develop a shared picture of a preferred future for skills development [19].	G
Gap analysis (1/5%)	To relate the shortfall between the current situation in terms of skills policies and the desired state [19].	T
Road mapping (1/5%)	To define steps needed to achieve the desired vision [19].	T
Wind tunneling (1/5%)	To convert the findings from each of scenarios into a single assessment of current and future policy [6].	T
World cafe workshop (1/5%)	To refine the skills scenarios and develop potential responses [9].	T

* Numbers in brackets refer to references in the Appendix.

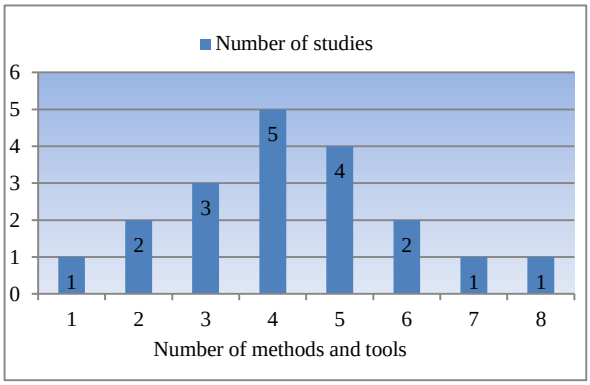

Figure 1. Number of methods and tools in studies

and workshop were used in both understanding and generation stages. Various methods are used in understanding stage: literature review, horizon scanning, interview, workshop, survey, focus group, stakeholder analysis, SWOT analysis, and STEEP analysis. From the viewpoint of the foresight diamond, these methods are included in three perspectives of the diamond: evidence (facts and data), interaction (discussion and knowledge exchange), and expertise (experience). Methods used in the generation stage are interview, survey, focus group, workshop, expert panel, Delphi, grounded Delphi, scenario, uncertainty impact analysis, cross impact analysis, machine learning, patent analysis, system thinking, and visioning. This stage involves creativity and innovative thinking. Considering the foresight diamond, these methods are included in three perspectives of the diamond: creativity (imagination), interaction (discussion and knowledge exchange), and expertise (experience). Wind tunneling, world cafe workshop, gap analysis, and road mapping are methods used in the transformation stage. Considering the foresight diamond, these methods are included in two perspectives of the diamond: interaction (discussion and knowledge exchange) and expertise (experience).

5 Conclusion

Methods and tools are means for conducting foresight studies. For a successful foresight study, it is important to have knowledge about research methods and tools. The aim of this study was to understand use of methods and tools in skills foresight. The literature review identified methods and tools, and their objectives in skills foresight studies. Classifications of identified methods and tools provided a foundation for discussing use of methods and tools in skills foresight. The findings have revealed that use of methods and tools in skills foresight studies is similar to use of methods and tools in foresight studies in general, with some methods specific for skills foresight. However, it should be noted that analysis was performed on a relatively small number of studies.

Table 2. Methods and tools combinations matrix

	Interview	Literature review	Scenario	Survey	Workshop	Focus group	Horizon scanning
Interview	11	VH	H	H	M	L	L
Literature r.	VH	11	M	H	M	M	L
Scenario	VH	H	8	M	H	L	M
Survey	VH	VH	M	8	L	M	L
Workshop	VH	VH	VH	L	6	L	M
Focus group	H	VH	L	H	L	4	L
Horizon s.	M	L	VH	M	H	L	4

Key: very high (VH); high (H); moderate (M); low (L).

This study provides a starting point for skills foresight research, and can be used in a planning phase of research. The discussion on methods and tools should continue, with exploring more factors that influence selection of methods and tools, like desired outputs of a foresight study, time constraints, and level of participation. Furthermore, different foresight frameworks should be analyzed and applicability of frameworks in skills foresight research should be explored.

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