

SKILLS TECHNOLOGY FORESIGHT GUIDE

SKOLKOVO Education Development Centre (SEDeC)
June, 2016

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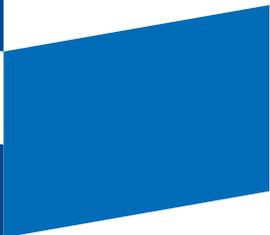
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First published (2016)

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ILO Cataloguing in Publication Data

Sudakov, Dmitry; Luksha, Pavel; Strietska-Ilina, Olga; Gregg, Con; Hofmann, Christine; Khachatryan, Liana

Skills technology foresight guide/Dmitry Sudakov, Pavel Luksha, Olga Strietska-Ilina, Con Gregg, Christine Hofmann, Liana Khachatryan; International Labour Office. — Geneva: ILO, 2016

ISBN: 9789221310600 (print); 9789221310617 (web pdf)

International Labour Office

skill requirements/training policy/technological change

13.01.2

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Printed in Russia.

Acknowledgements

SKOLKOVO Education Development Centre would like to thank the International Labour Organization for its partnership and support during planning and development of this global research endeavour.

SEDeC would also like to extend our sincere gratitude to the participants of the Global Workshop *Using Technology Foresights for Identifying Future Skills Needs*, Global Seminar *Development of the Skills Technology Foresight Tool for Future Skills Needs Identification* and contributors to the Skills Technology Foresight Guide:

Martin Bakule, Gregg Cornelius, Nijhawan Dinesh, Bernd Dworschak, Anastasia Fetsi, Mihaela Ghişa, Hwang Gyu-hee, Ernst Hartmann, Christine Hofmann, Liana Khachatryan, Pavel Luksha, Dionisio Joao Parise, Vinh Ngo Quang, Mu Rongping, Valeria Sakharova, Karina Simonyan, Marilia de Souza, Olga Strietska-Ilina, Dmitry Sudakov, Zinaida Vorobyeva, Tomoaki Wada.

Our special thanks are extended to Pavel Luksha, and Olga Strietska-Ilina for their valuable guidance and support.



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Foreword

In June 2010 at the G20 Summit in Toronto, the International Labour Organization (ILO) presented the G20 Training Strategy *A Skilled Workforce for Strong, Sustainable and Balanced Growth*. The strategy drew on the Conclusions on skills for improved productivity, employment growth and development adopted by the International Labour Conference in June 2008 and ILO's own practice. In 2012 in Seoul, G20 leaders confirmed their aspiration to support developing countries in implementing national strategies for skills development, building on the G20 Training Strategy.

The Russian Federation's interest in working with the ILO on the use of the G20 Training Strategy in a range of countries resulted in the project *Applying the G20 Training Strategy, implemented in accordance with the Russia's Development Cooperation Strategy*. The project has devised a comprehensive skills development programme including the implementation of essential building blocks for improving the quality of vocational education and training relevant to the labour market needs of today and tomorrow.

The G20 Training Strategy's focus on skills anticipation for future market opportunities is understood in the context of the global driver of change—innovation and technological change. In the framework of the project *Applying the G20 Training Strategy*, the ILO and Moscow School of Management SKOLKOVO developed the Skills Technology Foresight approach. This guide represents a new tool for skills needs anticipation based on the best international practices and foresight approaches.

The current methodology is based on the results of the international workshop *Using technology foresights for identifying future skills needs* held back in July 2013, which united foresight experts from all over the world. The workshop participants discussed various national skills foresight methods. This has led to the prospective development of the technology foresight method. This guidance tool was prepared to steer experts and practitioners in defining future technological change and related changes in work organisation, job tasks and skills needs.

The method was piloted in two countries—Armenia and Vietnam—in selected sectors (food processing, information and communication technologies, precision engineering, and metal processing). Special attention was devoted to the direct interaction between government and training providers on the one hand and the private sector (employers' associations, trade unions and business) on the other hand, leading to concrete policy recommendations and measures applicable to emerging economies and developing countries.

We would like to thank the authors of this guide—Dmitry Sudakov and Pavel Luksha from the Moscow School of Management SKOLKOVO. We would like to thank Valeria Sakharova from the Moscow School of Management SKOLKOVO for project coordination and guidance. We also wish to thank Olga Strietska-Ilina from the ILO for the technical supervision of the foresight and technical editing of the guide, the ILO reviewers Cornelius Gregg and Christine Hofmann and all experts who contributed to development of the method. Special thanks to our project partners in Armenia and Vietnam for their excellent collaboration in foresight implementation.

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Introduction¹

‘It is no longer sufficient to train workers to meet their specific current needs; we should ensure access to training programmes that support lifelong skills development and focus on future market needs.’

The G20 Pittsburgh Summit
Leaders’ Statement

¹ This introduction is based on materials of the SKOLKOVO-ILO Global Workshop Proceedings Using Technology Foresights for Identifying Future Skills Needs (2014)

Promoting sustainable employment, economic growth and social development is the focus of collaboration of the International Labour Organization (ILO) with its constituents. The same priorities are the focus of the G20 Training Strategy designed to build an employment-oriented framework of skills development for future economic growth² by closing the gap between labour market development and the capacity of the education and training systems.

As the best practices of education policy-making contribute to the improvement in all areas of economic development, design of future-oriented education policies becomes a priority of research. In this context, skills needs anticipation becomes the practice that harmonises the labour market via insights into educational policies: in the mid- and long-term horizon, the labour market obtains professionals with competencies relevant for market needs, thus closing skills gaps, because educational institutions had enough time and information to adjust.

The problem of identifying future skills needs is becoming more and more acute in the current dynamics of the global economy. The speed of change is increasing, while global competition is becoming tighter, with former leaders leaving and new players joining the game. To smooth the transition caused by the pace of economic globalisation and environmental degradation, and strengthen their position in the new digital world, governments need to envisage the long-term development of critical sectors of the national economy, or consider shifting to new ones. Of particular interest are the technology-driven industries, as the focal points concentrating research and development, foreign direct investment, talent and cutting-edge technology. At the same time, emerging technologies also influence more traditional sectors, such as agriculture, and this influences skills needs. Skill-intensive technologies contribute to the increase in labour

productivity and economic competitiveness and potentially fuel growth with a positive impact on employment. Technology can also partially substitute for labour and thus influence the structure of demand: skill-intensive jobs increase in number, while jobs with routine tasks can be replaced by technology. Middle-skill jobs also face a skills set change caused by changing technologies. Skills are required for R&D and innovation, but also for adopting and adapting technologies (business skills, management skills) and for operating and maintaining technologies.

Technological context

Introduction of new technologies can have a positive impact on the competitiveness of economic agents. This can happen directly, as introduction of a new technology helps to increase productivity and quality. It may also happen indirectly via spillovers: for instance, introduction of IT in a developing country can lead to improved competitiveness of SMEs³ through informed decision-making by reducing information asymmetry. The development of ICT allows SMEs to take advantage of opportunities in a global market that is increasingly intertwined and also facilitates the generation of local and global business opportunities by lowering the entrance effort.

Technology-driven sectors are often associated with rapid change and therefore uncertainty, yet they usually offer better quality jobs and a higher income. While investors wander across global industrial hubs searching for the next big market, national governments strive to apply relevant strategies to provide the right skills for the next generation of workers through the technical and vocational education and training (TVET) and higher education (HE) systems.

Developing countries strive to move up the value chain, increase value added production,

² A Skilled Workforce for Strong, Sustainable and Balanced Growth: A G20 Training Strategy. International Labour Office. — Geneva, 2010. ISBN 978-92-2-124278-9

³ Growth and Jobs in a Hyperconnected World. The Global Information Technology Report 2013. World Economic Forum and INSEAD. ISBN-13: 978-92-95044-77-7

improve competitiveness in global markets, and build a knowledge economy with technological innovations. This can lead to sustainable economic growth if TVET and HE are closely aligned with the anticipated labour market demand.

With the strong connection between skills and technologies (Fig. 1), new tools are required to assess future skills needs which will accurately consider the specifics of technology-driven sectors.

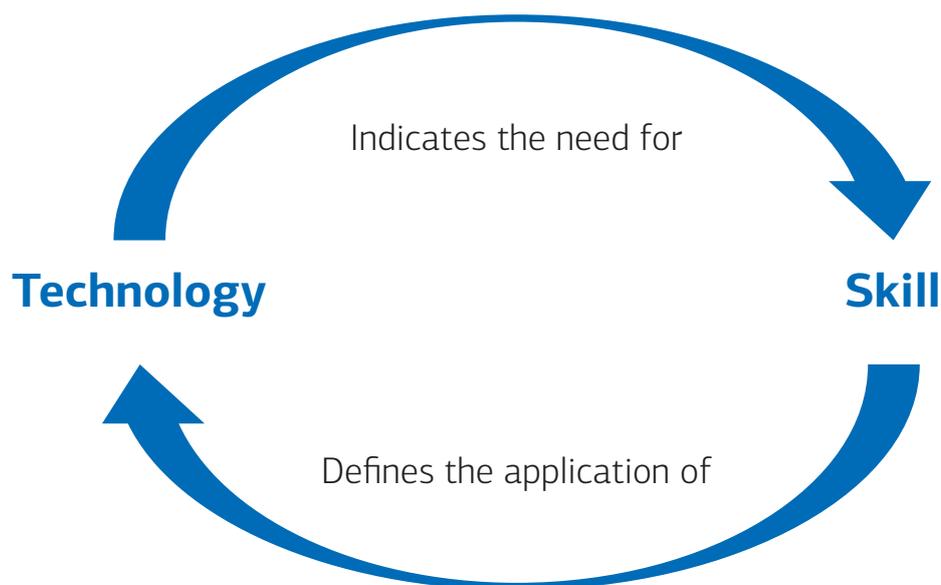
Even though technological changes have always been addressed as one of the major drivers of skills changes, skills needs anticipation and technology foresights have existed as independent disciplines. With the launch of the skills foresight project under the auspices of the G20 Training Strategy, an attempt was made to bridge the two areas of research and planning to introduce a technology foresight-based method of skills anticipation built around international best practices in skills anticipation methods.

One of the key landmarks of the project was the global workshop *Using Technology Foresights for Identifying Future Skills Needs*, which featured leading skills anticipation and technology foresight experts from around the globe. The workshop resulted in a set of requirements for the new method for technology-foresight based skills anticipation.

In July 2013, leading international experts and national technology foresight programme architects from Brazil, China, the Czech Republic, Germany, India, Japan, the Republic of Korea, Romania, Russia, and Switzerland gathered at SKOLKOVO to discuss the convergence of skills anticipation and technology foresight.

During Day 1 of the workshop, a comprehensive review of national and international foresight cases was conducted, featuring discussions of studies on various methods for identifying skills needs and changing and emerging occupations in key sectors in the context of a changing technological landscape.

Figure 1. Technology—Skills Impact Cycle.



Source: SKOLKOVO-ILO Global Workshop Proceedings, *Using Technology Foresights for Identifying Future Skills Needs*, 11-12 July, 2013

During Day 2, participants jointly developed the basic parameters of the new international techniques to anticipate future skills through technological foresight.

The objective of the session was to formulate requirements for an international methodology for skills technology foresight, while identifying best practices, most appropriate methods and solutions to address some of these requirements.

The new method was piloted in two countries – Armenia (food processing and precision engineering/ICT) and Vietnam (metal processing industry), with particular attention to building policy recommendations applicable to the contexts of developing countries. In both countries, the results were considered to be of substantial value for governments, industry bodies, employers and labour organisations in their efforts to bridge the gap between the skills demand and supply which results from technological change, among other driving factors.

It was noted that skills technology foresight can complement existing country practices dealing with skills anticipation, such as the Future Profiles method used by SENAI (Brazil) or Fraunhofer Technology Radar used in Germany.

This guide presents a step-by-step implementation of the Skills Technology Foresight (STF) process, its methodology and the main tools for preparing, conducting and applying the results of STF. All necessary materials are included in the Appendix.

Chapter 1 presents the main objectives and key features of the method, together with the basic assumptions identifying the STF framework. Chapter 2 describes the key activities preceding the skills technology foresight session. Chapter 3 examines the STF process step by step. Basic post-session activities are discussed in Chapter 4.



Chapter 1. Skills Technology Foresight: Main Objectives and Features

Foresight methods can be applied to a vast array of situations and needs. While skills foresight is a group of foresight methods for skills anticipation based on qualitative identification of future skills needs of the economy or a particular sector or industry, *skills technology foresight* (STF) is a new method that combines skills anticipation approaches and technology foresight methodology. It therefore allows identification of future skills needs in the context of technological change and innovation. The method takes a sector-based approach and focuses on sector transformations driven by new technologies.

The problem of identifying future skills needs is becoming more and more acute in the current dynamics of the global economy. Today, the speed of change is increasing, while global competition is becoming tighter, with former global leaders leaving and new players joining the game.

The question of the choice of sectors is crucial for skills technology foresight. The use of the method should primarily focus on industries having high potential for change due to the new technologies. This is due to the fact that these sectors not only become the focal points concentrating research and development, foreign direct investment, talent and cutting-edge technology. The other aspect is that technology can significantly alter the employment structure in a sector, positively influencing jobs that require specialised and unique skills, while often having an adverse impact on jobs dominated by routine tasks. New technologies change the requirements for workforce skills and knowledge, thus leading to growing demand for new competencies. This makes the use of skills anticipation instruments crucial for such sectors of the economy.

However, it should be noted that STF should not be confined to high technology sectors. More traditional sectors such as agricul-

The type of country should be taken into consideration when applying STF. Obviously, it is a practice more suitable for emerging economies, although less developed economies may also have sectors suitable for STF. The STF approach is less effective for countries which have efficient systems in place to identify science and technology priorities linked to training systems leading to bridging skill gaps, while for growing countries dependent on technology transfer and lacking these systems the STF methodology can be very useful.

ture or tourism can envisage significant gains in productivity due to the use of modern production technologies and management methods. The main focus is therefore on sectors that can increase their competitiveness by applying new technologies, either developed domestically, or transferred from international markets.

The sector selection for STF should be guided by the following requirements:

- The sector should have a **substantial impact on the country's economic growth**.
- **Technological change shapes production or service approaches** for the sector.
- The sector has the potential to **increase country's global competitiveness due to new technologies**.
- The sector occupies a significant share in national employment and/or has the potential to positively impact employment (either directly or indirectly through the supply chain or through induced employment effects, i.e., as the result of income spending), or the sector may experience negative direct employment effects in the short to medium term.

It is essential that technological change can be harnessed not only through long and expensive research and development, but also through technology transfer. This means that skills for adaptation, operation and maintenance of technologies will be needed.

Basic assumptions underlying the Skills Technology Foresight framework

Core features of STF methodology design and implementation.

Qualitative approach

Skills Technology Foresight is a collaborative qualitative methodology engaging stakeholders' participation in the knowledge production process. The main argument for using a qualitative approach instead of a quantitative one is the changing environment of the chosen sector, causing discontinuity in the process and thus making quantitative methodologies less effective.

Matching skills supply and demand

STF aims to develop policy recommendations and, consequently, propose amendments to curricula. This requires identifying demand for skills in the future, taking account of the existing skills supply, and finding ways to close the gap.

Skills provision is classified into three types of education and training programmes:

- formal technical and vocational education and training (TVET);
- higher education (HE); and
- industry-based training: apprenticeship training, on-the-job training, short professional advancement courses, internships, etc.

Skills Technology Foresight focuses on anticipating the demand for skills in the short-term, mid-term and long-term perspectives. Comparing the existing situation with future skills needs, the participants of the foresight process are seeking to identify existing and emerging gaps, clarifying what should be done about them, and defining the key actors, namely the industrial sector stakeholders (for example, employers, trade unions, etc.), the education institutions, and the government, to work together to close these gaps between labour market needs and the education and training systems.

The process is as important as the content

With regard to the key results of skills foresight, one should note that the *process of the foresight session is very valuable and productive in itself*: capacity building is part of the result. Stakeholders' participation in sessions brings shared values, the core of which is the value of communication for the long-term strategic development agenda between policy makers, education and training institutions and the private sector.

Skills Technology Foresight framework

STF serves as a tool for change management, raising awareness of the problems and gaps in the strategic policy-making (Fig. 2). In this context, the value of dialogue is very high, as in response to change, all relevant actors need opportunities to sit at the same table translating the strategic dialogue into enhanced government-to-government, government-to-business, and government-to-citizen cooperation. Building capacity among stakeholders who do not sufficiently collaborate with each other to 'sit together and develop a vision' is an invaluable asset in itself.

The question of choosing sectors is crucial for skills technology foresight. The use of the method should primarily focus on industries having high potential for change due to the new technologies. These sectors concentrate research and development, foreign direct investment, talent and cutting-edge technology. The other aspect is that technology can significantly alter the employment structure in a sector, positively influencing jobs that require specialised and unique skills, while often having an adverse impact on jobs dominated by routine tasks. New technologies change the requirements for workforce skills and knowledge, thus leading to growing demand for new competencies. This makes the application of skills anticipation instruments crucial for such sectors of the economy.

Although the implementation phase is not a part of the STF process itself, it is important

for the scheme in order to show the whole framework.

Skills Technology Foresight seeks to identify the future skills gap in an industry, primarily in the context of a rapidly changing technological landscape, and recommend necessary changes in the curriculum and formats of technical vocational education, training, and the higher education system that may help to close the gap.

To achieve this goal, the participants of the process

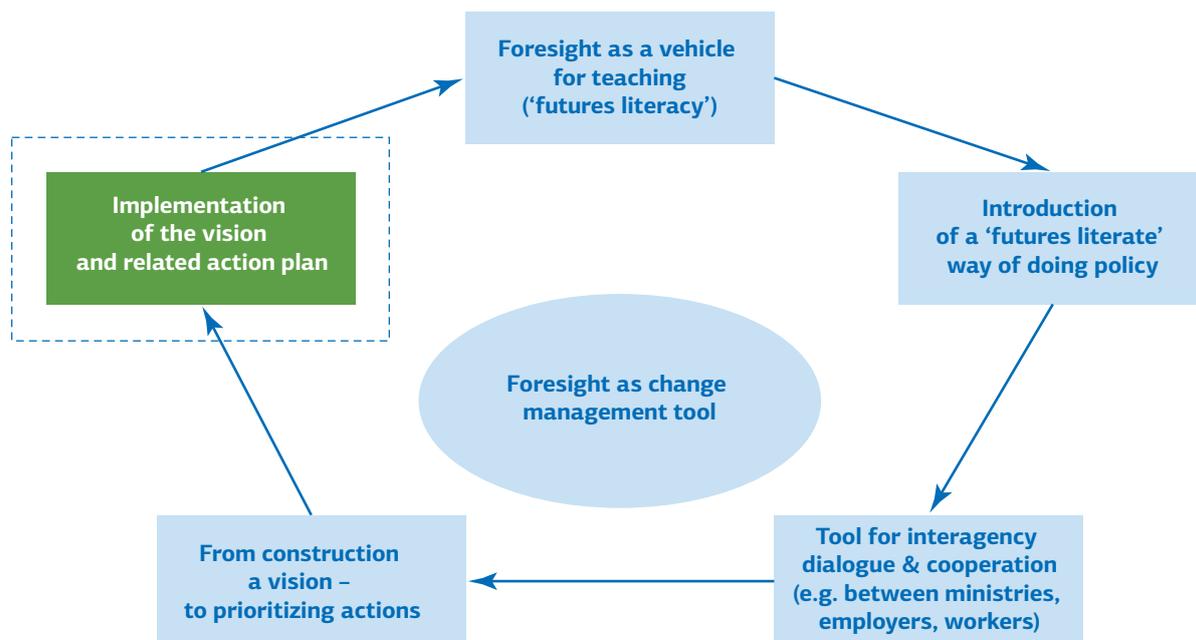
- design their shared vision of the future of the sector and the professionals working in the sector or review the existing vision (for example, government sectoral strategy). Group participants discuss:
 - vision for sector;
 - technical implications;
 - skills implications;

- design or review projects aimed at development of the sector by skills improvement;
- propose applicable structures of shared governance, like Sector Skills Councils or Development Centres to deliver an industry-led skills plan and promote a sustainable skill development ecosystem; and
- formulate the requirements for changes in the legal environment if needed (for example, poor intellectual property law can be a bottleneck for technology implementation and skills improvement).

The general framework scheme of STF is presented in Figure 3.

The main working field of STF is the so-called map of the future, which is a common space (usually a large poster or a whiteboard) that sets the background for all the elements

Figure 2. STF as change management tool.

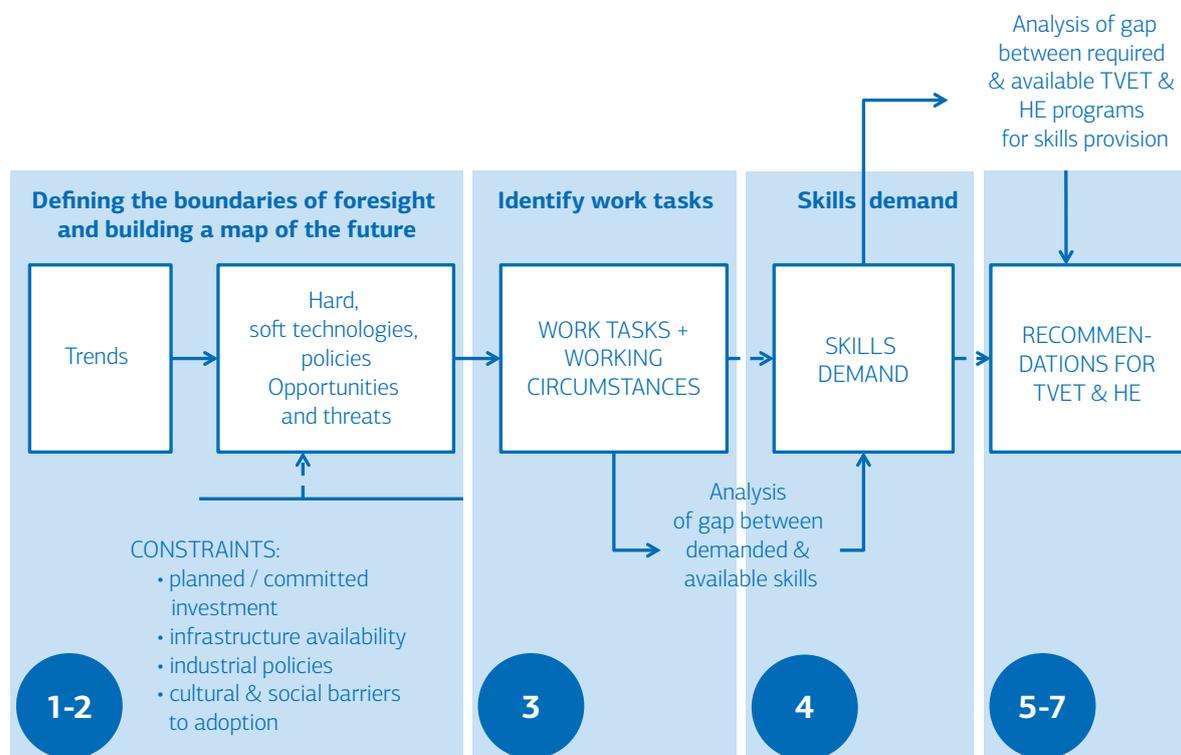


of the foresight. It is also becoming one of final products of the collaborative stakeholders' work in the end of the session. Stages 1 and 2 are the steps of forming the map of the future, including trends, hard and soft technologies plus derivative technologies (a thorough description of these stages will be provided hereinafter), thus making the full-scale prognosis. Stages 3 and 4 consist of transforming the map of the future into a set of requirements for transforming training systems and responses to risks associated with future threats. Stage 5 is a concluding step based on all preliminary steps—specific practical recommendations for TVET and higher education systems are made here.

To conduct an STF session, one should pass through STF lifecycle as described below. This lifecycle includes:

- pre-session activities,
- foresight session, and
- post-session activities.

Figure 3. STF as change management tool.





Chapter 2. Pre-Foresight Session Activities

Pre-session activities are very important for the success of STF implementation; thus, special attention should be paid to them. The pre-session activities should focus on:

- determining the key partner,
- conducting desk research, and
- identifying sector experts.

Determining the key partner

The first and the most important issue which arises before the foresight session is determining the key partner of the project in the country/region. The government, an industry skills council or an employers' association or a trade union needs to play the key role of an agent of change, since they serve as initiators of foresight activities. Experience from various countries suggests that commitment to implementation of foresight results may be stronger where driven by the private sector; at the same time, the sustainable approach is that foresight should be demanded from within the country/region rather than induced from an outside entity.

The key sponsor of the project is responsible for defining the scope of the project, sector (or sectors) selection, etc. It is also responsible for embedding the foresight activities into a policy agenda (for example, national qualifications framework, curriculum and standards development, national development plans, industrial policies, etc.).

Desk research

The desk research aims to prepare a report with several essential focuses.

The first focus of the report is analysis of a country's existing socioeconomic priorities and how the chosen sector(s) corresponds to the governmental strategy. It helps, first of all, to understand the country's political agenda which influences the sector development in the long term.

Secondly, it is aimed at describing the context and the prospects of the sector, such as its size and dynamics, describing key sector players, time series for labour market information on the sector, size of firms, occupational distri-

bution of the workforce, and past and current interventions. Requirements for the report are described in greater detail in Appendix 1, with sample Terms of Reference.

The third focus of the report is horizon scanning for future skills features, scanning global technology trends (through country applicability, technology gap, technology development checks—whether global technologies can be applied to the sector). Please see Appendix 1 for tentative Terms of Reference for the desk research and report.

The report must be available to people participating in the foresight sessions, and people should be encouraged to read it before these sessions. This is a highly important step, since the overall results of STF implementation depend on the expertise and knowledge of participating experts.

Foresight Session

Identifying participants in the foresight session

Relevant and engaged participants are key to the success of every participatory method, including STF.

STF methodology allows organizing a productive dialogue among various stakeholders in the framework of the foresight session. Special attention should be paid to the selection of the participants of the foresight group.

The ideal list of participants should consist of representatives from the following entities:

- representatives of leading employers in the industry;
- small innovative businesses (start-ups or the like);
- employers' organisations and trade unions;
- relevant governmental and regulatory bodies (policy makers);
- educational sector representatives:
 - higher educational institutions;
 - TVET institutions;
 - other providers of education and training;
 - informal/nonformal education providers;

- human resources management and skills development experts;
- representatives of leading sectoral suppliers and other value-chain industries;
- research and development institutions, analytical entities, business strategy consultants;
- futurists; and
- prospective labour market participants, for example, students.

However, the foresight session is considered to have a sufficient pool of repre-

sentatives if there is the following tentative composition:

- industry representatives—40–50%;
- representatives of the related industries and industry suppliers—20–30%;
- education and training experts—20–30%; and
- other participants (including policy makers)—10–20%.

The variety of expertise required to complete each step is described below in Table 1.

Table 1. Expertise required for each step of the foresight session

Step of the STF	Key expertise required	Key experts to provide this expertise
Trend identification	<p>Knowledge of domestic and global market trends and their implication for business strategies</p> <p>Ability to spot trends and derive market requirements</p>	<ul style="list-style-type: none"> • business owners and strategy/planning officers • marketing experts/trend watchers • business consultants • industry regulators
Hard and soft technologies required	<p>Knowledge of existing and potentially available hard technologies in domestic and global markets</p> <p>Knowledge of best domestic and global managerial practices</p> <p>Ability to derive technological requirements from market requirements</p>	<ul style="list-style-type: none"> • strategy/planning officers • technology and production officers • R&D specialists • international equipment suppliers • business consultants and technology transfer experts
Working tasks/working conditions	<p>Knowledge of existing workforce structure and specific tasks assigned to various jobs in the industry</p> <p>Ability to derive workforce requirements from technologies applied</p>	<ul style="list-style-type: none"> • HR officers • strategy and production officers • trade union representatives • business consultants
Skill demand	<p>Knowledge of existing skill structure of various jobs in the industry</p> <p>Ability to derive skill requirements from working tasks assigned</p>	<ul style="list-style-type: none"> • HR officers • education specialists (TVET and HE) • business owners • business consultants • trade unions
Demand for change of TVET and HE practices	<p>Knowledge of existing curriculum and formats of education in the industry's TVET and HE system</p> <p>Ability to derive curriculum change requirements from skills required</p>	<ul style="list-style-type: none"> • HR officers • education specialists (TVET and HE): methodology and planning



Chapter 3. Foresight Session Process

As the core of the STF methodology, a foresight session is divided into three stages:

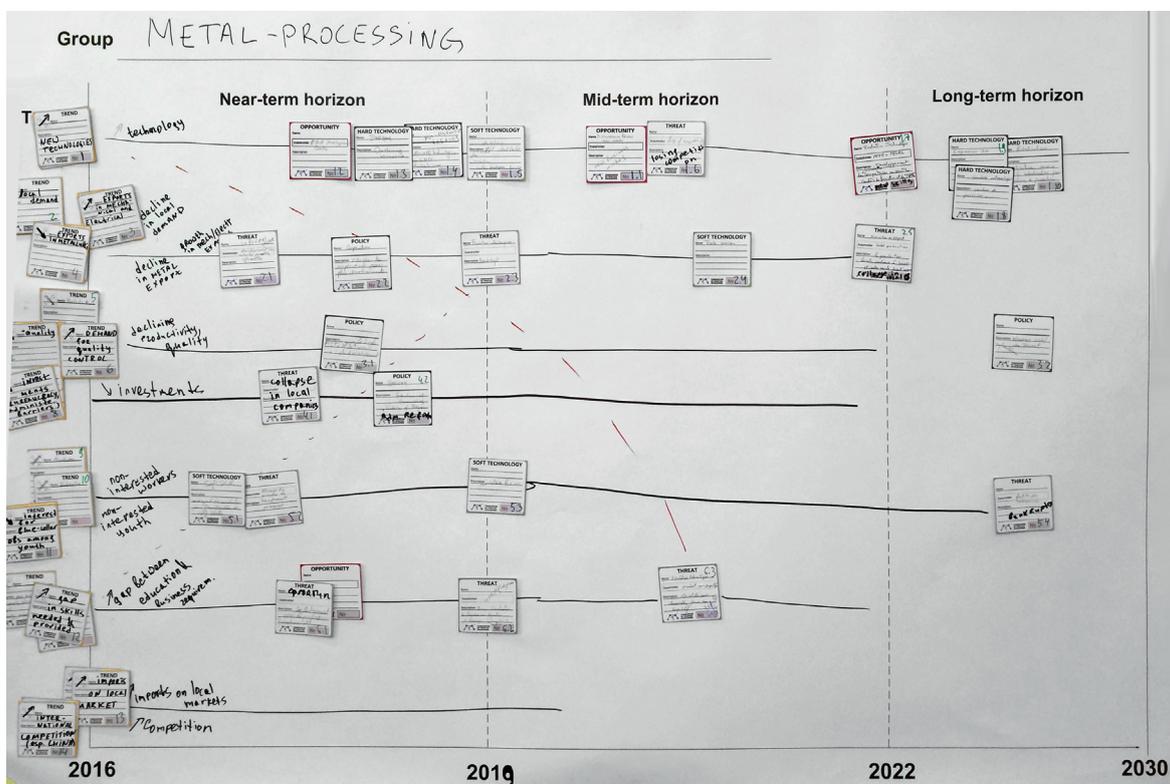
- **technology foresight** aimed at constructing the vision of the future of the industry and the professionals working in it or reviewing the existing vision;
- **skills anticipation** based on the technology foresight; and
- **recommendations** to the educational system, policy makers and labour market stakeholders aiming to close the gaps between future skills demand and supply.

The design of session should follow the three stages described above. Please see Appendix 2 for a sample foresight session agenda.

Work in groups

With the moderator's aid, experts who represent the industry or the subject of the foresight session work to create an integrated map of the future via collective discussion of each card propounded by participants, either accepting or amending, or completely rejecting it. This work occurs in several steps, during each of which the group(s) works with a specific type of cards. Steps can succeed each other without a coffee break, thus accentuating and maintaining the group dynamics, at the discretion of the moderator. In most cases, such work is carried out in several groups formed by the presenter.

Example of a map of the future



Organising Group Work

The main tool and activity field for the foresight session participants is the map of the future, which is a large paper sheet (or just any space) where the horizontal axis represents *time* and the vertical axis *trends*.

The size of the map depends on the size of the group. A group of 15–20 persons requires a map size of at least 1 m high and 2.5–4 m wide.

Participants (15–20 people) take places far enough from the map to be able to see its overall landscape and the location of cards and trends, and have the opportunity to approach it closer for study. Each group should have a moderator. The venue for the session must be spacious enough to enable participants to comfortably work in sub-groups of several individuals, which implies mobile workplaces like chairs, tables, cushions, etc.

With the moderator's aid, participants fill in the map with different objects represented by cards stuck to the map. There are 6 basic types of cards: trend, hard technology, soft technology, policy, threat, and opportunity. The cards have different colours for clarity.

Placing Objects on the Time Axis

The card's content and its time axis location on the map are coordinated with the group. If possible, each card should contain the estimated year of its 'beginning'. Cards are placed in one of the following three time horizons indicated on the horizontal axis.

- **Short-term horizon** (for example, 2016–2018). This time horizon includes trends, technologies and threats expected by experts to appear in the near future. In fact, the variety of content on this horizon is determined by the measure of participants' and the group's competence and awareness of actual processes in their own subject areas.
- **Mid-term horizon** (for example, 2018–2022). This horizon tends to include cards which experts themselves consider important, and cutting-edge ones already existing at present. However, the experts should be well aware of ambiguity in the

conditions in which these phenomena are emerging. Due to this, the experts should both trust and, at the same time, somehow mistrust them, thus 'shifting' these phenomena into the future. For example, a certain social trend will be on the rise, or parent technologies for the proposed card are already entering mass production. (for example, the Internet in its present state could only appear after the widespread adoption of personal computers. An innovative medical technology cannot enter mainstream use before it has been tested and obtained regulatory approval.)

- **Long-term horizon** (for example, 2022–2030). Objects on this horizon belong to either of the two categories: 1. Objects whose appearance on the map is dictated by the development of a certain technological trend: for example, neuro-sockets for direct plugging of computers into the human brain may appear as a result of the ongoing trend of interpenetration of the human and the artificial; 2. Familiar products being developed to a new technological level (for example, gadgets in the remote future, continuing the line of TV evolution still further from the CRT (cathode-ray tube) to the present-day LED and plasma monitors plugged into IP-TV, and yet further on). Participants place those objects which appear at the intersection of several trends or technological lines (for example, personalised medicines, which in the future will require emergence of both personal biochemical models and home synthesis) on this horizon.
- **'Black swans'**—the fourth, specific horizon including phenomena which, as estimated by the group majority, will never happen. For such a card to appear on the map, one of participants must propose it, but the majority would reject. As a rule, cards, which happen to be placed here belong to one of two types. The first type are superficial fantasies, not systematically

connected with the map of events, and unable to pass the group-expertise level (for example, extraterrestrial attack or creation of a perpetual motion engine). The second type are 'wild cards', which are considered by the group to be ones with an extremely low probability, though they have good reasoning (for example, disappearance of banks as institutions).

Filling in cards on the map is organised in a series of steps, as described below.

- Participants split into micro-groups of 2–3 people each.
- The facilitator distributes cards to each group (trends, technologies, threats, etc.).
- The facilitator asks a question.
- One by one, each micro-group proposes a card.
- Other participants respond to the proposal.
- Micro-group participants respond, explain and, if necessary, reformulate a card.
- Participants vote for the card.
- If the vast majority approves of the card, the moderator places it on the map of the future. If not, it goes to black swans.

Based on the discussion results, the card is placed on the map with an indication of the particular year and, accordingly, in the particular time horizon. The card is placed on the map by the moderator.

The group should strive to fill in all three time horizons. In practice, on the majority of maps the long-term horizon is not filled as densely as the short-term horizon. Occasionally, the mid-term and even the long-term horizons may be filled more densely. These

Recommendations on filling in cards

- Cards must be filled in clearly and be legible (with clear handwriting or printing).
- Cards must be understandable, with minimal assistance, to an outside participant.
- The formulation must be understandable to each participant of the foresight session, including those from other groups.
- The map should not contain too many objects: during work, the moderator assesses the map's 'legibility' because it is not only the result of collective work, but also its main tool during the entire foresight session.

features of the group work are diagnostically valuable.

Proposals for cards which are similar in content should be located close to one another on the map. Proposals which are inclusive of one another, are closely interconnected, or are special instances of one another should be grouped in one card (pile), with the reference card representing the group proposal in the most complete/precise form on top.

The final product of the group work is the resulting map of the future, which is modified from each step to the next. If necessary, at the beginning of each step the moderator conducts an 'intermediate synthesis and packing' of the whole map, voicing the connections between cards, the revealed 'topics', and also the connection with the overall foresight session goal.

Work with poorly-formulated cards is conducted at the moderator's discretion: here there are several intermediate variants, starting with 'poorly-formulated cards are to be eliminated' to 'assist in getting the poorly-formulated (but potentially interesting) cards into proper form'. The choice between these options is made by the moderator, depending on group work dynamics, the remaining time available, etc.

Typically, the map will contain from 50 to

150 objects of all types. In this respect, the principal function of the moderator is to lead the group discussion so as to place only noteworthy, significant, and interesting proposals on the map.

Foresight elements to consider

There are three elements used during the foresight process, when working on the map of the future:

1. trends;
2. phenomena with life cycle;
 - 1.1. hard technology;
 - 1.2. soft technology;
3. phenomena-events;
 - 1.1. policy;
 - 1.2. threat;
13. opportunity.

Steps in the foresight session

The foresight session consists of the following steps:

Step 1. Set the boundaries of the foresight.

Step 2. Build the map of the future.

Step 3. Identify work tasks, i.e., define what changes in work tasks and workplace organisation will occur in the short-term, mid-term and long-term horizons, with regard to the discussed changes in the life cycle of the components of these tasks.

Step 4. Discuss, i.e., correlate the map of new work tasks with the existing practices in the industry. The main goal of this step is to estimate which work tasks can be implemented with the existing skills of the workforce and which ones are clearly new.

Step 5. Estimate demand for new learning/training programmes, i.e., correlate the map of new skills demand with the existing learning/training programmes.

Step 6. Define project initiatives, i.e., cards with a project description based on format, technology, response to a threat or realisation opportunities. A project can be 'distributed' over the map, thus linking several cards located there.

Step 7. Group presentation of work results by a presenter appointed by the group; general conclusion of the presenter is that groups report to each other on their results, and the presenter summarises the results of the work of various groups verbally and using diagrams.

The steps are described in detail.

Step 1. Set the boundaries of the foresight

The first step of work directly in groups consists of **identification of the work subject** and its boundaries. This is the key stage, guaranteeing that the group discussion of the subject, and each in-group proposal in particular, will be related directly to the subject matter of the discussion, and not to any adjacent subjects or subjects located a few levels higher/lower (for example, if the discussion subject is 'taxi for people', then 'cargo transportation system under WTO' is not relevant).

The work format in the step includes moderated discussion using a blackboard/white-board or a flip chart for reconstruction of the subject scheme and visualisation, thus speeding up synthesis of the information. As a rule, it is the moderator who draws, and the group participants make informative amendments to the scheme.

To determine subject boundaries, the group (aided by its moderator) identifies the 'super-systems' of a higher level which include, as components, the discussion subject (for example, 'education in general'—'education in transport'—'education of operatives in transport'), and the 'sub-systems', which are elements of the discussion subject. The group discusses and formulates levels limiting the discussion subject from 'above' or from 'below'. It must be noted that trends are the type of cards that always belong to the higher level, because they make the objective context in which the subject develops. For example, 'growth of production automation' is a trend for any particular industry.

Step 2. Build the map of the future

The **second step** starts with placing **trend cards (Trends)** on the map. These are placed in the left field of the map (Short-Term Horizon), except for those few cases when these trends are expected to appear in future, where the trend's starting point can be located on any time horizon on the map.



The Trend is the basic and formative card of the foresight. 'Initial' trends fix the starting point of the foresight, and development of these trends (and their derivative phenomena) on the time map determines the orientation of the foresight-filling process. Other objects are placed on the map only with reference to the trends – as the meaningful point of development, as the trend's culmination, or as 'an answer to the challenge' set by the trend. The map should only contain cards linked to trends (except for the black swans field).

A Trend:

- Is an objectively observable and measurable process of gradual qualitative and quantitative change developing within at least one time horizon on the 'time map';
- occurs in a 'larger system', a super-sys-

tem for the foresight subject (for example, in transport and education as related to the subject 'education in transport', or in the country as a whole if the discussion subject is 'region', etc.); and

- has a measurable (yet not necessarily already measured) indicator, changing in time in a certain direction. For example, 'replacement of humans in routine activities by automation' can be measured every year, and this trend can be recorded.

The formulation of a trend card includes the following three parts:

- indication of the dynamic (increase, decrease, acceleration, expansion, etc.);
- indication of the phenomenon which undergoes changes (number of traffic jams, terms of a claim consideration, degree of device interconnectivity, etc.); and
- indication of the sphere in which the trend operates (all over the world, in a city, in education, etc.)

Examples of trends are: 'increase in the proportion of the population over 65 years old', 'increasing share of small firms', 'miniaturisation of devices around the world'. Trends must be directly connected with the foresight subject, and occur in a super-system as related to the subject.

The set of trends is identified, firstly, by information analysis on the given subject area and discussions with experts. Whatever occurs on the time map, occurs in the trends, generates the trends and is connected with them. If a group has trouble formulating the trend, the moderator may help by suggesting, as the discussion issue within the subject, the trends he/she knows about from the adjacent areas.

Objects disconnected from all trends must not appear on the map. If participants identify an important object unconnected with any of the trends during later stages, this is a signal for them to add some new trend to link it. Consequently, only meaningful trends stimulating creation of new subjects can be added onto the map. Emergence, change and disappearance of

trends must be substantiated and formulated on the map, influenced by either other trends and/or products, technologies, events or legal provisions. So, trend-breaking points are to be marked with explanatory cards.

The process begins with the analysis of the processes of change that drive the industry/sector's development. These processes are reflected in trends that shape the industry's future, including, but not limited to, the following types of processes:

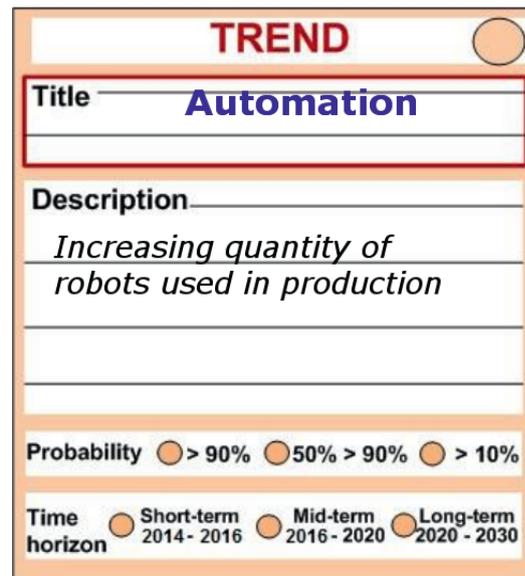
- changes in consumer demand due to changing consumer expectations and preferences (for example, growing demand for healthy and organic food in the food processing industry);
- changes caused by policies and regulations affecting a sector's development;
- changes in domestic and global industrial production standards (for example, the increasing use of environmentally friendly operations);
- changes in the industry resource base that may constrain the development of the industry (for example, increasing average workforce age);
- changes in technological development; and
- general changes in the economy that induce new working practices (for example, the intensified use of digital technologies that leads to the wide use of remote workforce).

These trends present opportunities for new market niches and threats to existing business models dominating the industry and will require response from it. *The work format in this step is: the moderator introduces the idea of a trend and gives examples. Then, each participant receives several blank trend cards and, either individually or in a micro-group (up to 3-4 people), fills them in. After the majority of participants fill in at least one trend card (which takes from two to seven minutes), the moderator asks each participant to express his/her view in the following format:*

- The trend's proponent reads the formulated trend's name and indicates the year of its beginning.

- If the audience misunderstands the matter (which is revealed by the moderator's direct question), the proponent reads the description of the card.
- If understanding is still not achieved, the proponent is asked additional questions.
- If necessary, the card is reformulated by the proponent and approved/rejected by group voting.
- The rejected card is placed in the black swans field.

Example of a filled card:



The image shows a sample trend card with an orange border. At the top, the word "TREND" is written in red. Below it, the "Title" field contains "Automation" in blue. The "Description" field contains "Increasing quantity of robots used in production" in black. At the bottom, there are two rows of radio button options. The first row is for "Probability" with options "> 90%", "50% > 90%", and "> 10%". The second row is for "Time horizon" with options "Short-term 2014 - 2016", "Mid-term 2016 - 2020", and "Long-term 2020 - 2030".

The trends which were rejected by the group as a whole and which are hardly probable but yet interesting are placed in the black swans field. This field is located in the right part of the map, beyond the long-term horizon. It can contain not only trend cards, but any cards not supported by the group's majority.

On the map, trends are indicated by straight lines stretching out of the trend cards (normally, on the left side, at the very start of the time-line, in 'the present'). As a rule, trends rarely start in the future, though sometimes they do. For example, the trend 'growing influence of artificial intelligence

on science' can start only after implementation of this technology and its apparent influence on science.

When a group has generated a sufficient number of trends (or, simultaneously, depending on participants' capabilities), the moderator suggests clustering the trends, i.e., combining them into logical groups. The maximum number of trends for effective work is ten. A larger number needs to be grouped content-wise.

There are some specific issues when choosing time horizons during the foresight session. Please refer to Appendix 4 for further details.

Next, the hard technology cards are placed on the map. Hard technologies include inventions and technical innovations which, unlike soft technologies, do not disappear when they are not human-operated.

HARD TECHNOLOGY	
Title _____	
Description _____ _____ _____	
Probability <input type="radio"/> > 90% <input type="radio"/> 50% > 90% <input type="radio"/> > 10%	
Time horizon <input type="radio"/> Short-term 2014 - 2016 <input type="radio"/> Mid-term 2016 - 2020 <input type="radio"/> Long-term 2020 - 2030	
Relevant TREND	<input type="text" value="No"/>
Author _____	

The industry responds to opportunities and threats by adopting new hard technologies (for example, new equipment, new product technologies or a new production process, etc.) and 'soft technologies', or social practices or patterns (for example, new business models, or new management processes, etc.). The appli-

cability of these technologies is constrained or enabled by factors such as:

- *planned investment* of key business players or the government in the development or transfer of the technology;
- *availability of infrastructure* that enables the technology: for example, the modern software sector requires both a reliable supply of electricity and sufficiently well-developed telecommunications infrastructure for Internet communication;
- *available skills*, i.e. properly trained specialists capable of using these technologies;
- *industrial policies*, for example, environmental tax liabilities that allow introduction of alternative energy sources; and
- *cultural and social barriers to adoption of technologies*: for example, religious considerations can constrain the use of computers, or highly authoritarian corporate cultures can constrain the use of participatory leadership formats.

Since adoption of technologies is a response to challenges posed by trends, the response time should be taken into account. This is an important consideration even in case of technology transfer (as technologies have to be identified, licensed, and adapted through industry learning), and much more for technological innovation—the time lapse between the research, prototype, and product development, early adoption and wide-scale use phases can be significant. Technology-driven demand for skills often becomes apparent to education and training systems only when the technologies become widespread (for example, used by at least 10–20% of industry enterprises).

Adoption of specific technologies in a sector may require the adoption of derivative or complementary technologies in related sectors (for example, suppliers or infrastructure providers). For instance, adoption of tractors and other heavy agricultural machinery requires vehicle service and filling stations (i.e. the re-

sponse from complementary sectors enabling technology use).

The work format in this step is: the moderator introduces the idea of hard technology and gives examples of it. After that, each participant receives several blank hard technology cards and, either individually or in a micro-group (up to 3-4 people), fills them in. After the majority of participants have filled in at least one card, the moderator asks each participant to express his/her view in the same format as for trends.

Example of a filled card:

HARD TECHNOLOGY	
Title	3D-laser measurement technologies
Description	<i>Application of such technologies allows perform high precision 3D-measurement, imaging and comparison of parts within production</i>
Probability	<input checked="" type="radio"/> > 90% <input type="radio"/> 50% > 90% <input type="radio"/> > 10%
Time horizon	<input type="radio"/> Short-term 2014 - 2016 <input checked="" type="radio"/> Mid-term 2016 - 2020 <input type="radio"/> Long-term 2020 - 2030
Relevant TREND	<input type="text" value="No"/>
Author	

Then the group generates and places on the map the **soft technology cards**, which are, as mentioned above, forms of social interaction, the 'soft' social technologies, such as 'university', 'car-sharing system', 'P2P banking', etc.

Soft technology can be a social/institutional response to a challenge or an opportunity, which, in fact, means realisation of social practices. For example, 'network schools' as a format of the trend 'network self-organization'.

SOFT TECHNOLOGY	
institutional, organizational & managerial methods & solutions	
Title	
Description	
Probability	<input type="radio"/> > 90% <input checked="" type="radio"/> 50% > 90% <input type="radio"/> > 10%
Time horizon	<input type="radio"/> Short-term 2014 - 2016 <input checked="" type="radio"/> Mid-term 2016 - 2020 <input type="radio"/> Long-term 2020 - 2030
Relevant TREND	<input type="text" value="No"/>
Author	

Soft technology

- is always based on the trend (which is either a challenge to it or an opportunity for it); and
- can launch a new trend.

The work format in this step is similar to the one with technologies.

Example of a filled card:

SOFT TECHNOLOGY	
institutional, organizational & managerial methods & solutions	
Title	Flat organizational structures
Description	<i>Growing complexity and transparency with increasing digitalization and internet penetration allows creation of flat structures - more effective and fast</i>
Probability	<input type="radio"/> > 90% <input checked="" type="radio"/> 50% > 90% <input type="radio"/> > 10%
Time horizon	<input type="radio"/> Short-term 2014 - 2016 <input checked="" type="radio"/> Mid-term 2016 - 2020 <input type="radio"/> Long-term 2020 - 2030
Relevant TREND	<input type="text" value="No"/>
Author	

The next step in building a map of the future is working with **policies**. Policies are introduced as a separate card in a separate step. The work format here is that for technology cards and format cards.

POLICY	
Title	_____
Description	_____ _____ _____
Probability	<input type="radio"/> > 90% <input type="radio"/> 50% > 90% <input type="radio"/> > 10%
Time horizon	<input type="radio"/> Short-term 2014 - 2016 <input type="radio"/> Mid-term 2016 - 2020 <input type="radio"/> Long-term 2020 - 2030
Comments	_____

Policy is an institutional and/or regulatory response to an identified need or challenge, a momentary act of a political will embodied in a regulatory or strategy document, a law or a regulation.

A policy –

- is partly stipulated by trends (setting the ‘challenge’);
- is also stipulated by its own logic of ‘institutional development’ (i.e., the goals of the subject managing a ‘big system’, for example, federal/regional government, industry regulator, etc.); and
- works to launch/break/decelerate the trend or to change its direction.

For example: ‘permission for foreign pilots to pilot aircraft of local airlines’; ‘order on financing a separate budget line for subscription to SCOPUS trade magazines for all higher education institutions in the Russian Federation’.

Example of a filled card:

POLICY	
Title	<u>Amendments to the Air Law</u>
Description	<i>permission for foreign pilots to drive aircraft of local airlines</i>
Probability	<input checked="" type="radio"/> > 90% <input type="radio"/> 50% > 90% <input type="radio"/> > 10%
Time horizon	<input checked="" type="radio"/> Short-term 2014 - 2016 <input type="radio"/> Mid-term 2016 - 2020 <input type="radio"/> Long-term 2020 - 2030
Comments	_____

Often, the policy step is implemented closer to the end of the session, as it supports the soft technologies and the project initiatives. Sometimes, the policy step is not determined, but when participants propound a distinct regulation (amendments to a law, new code, regulations, etc.) in course of a soft technologies step, the idea is introduced and the propounded content is carried on to the new type of card.

The last substep of step 2 includes working with **threats and opportunities** and differs from the previous ones. Threats and opportunities necessarily imply the answer to the question ‘for whom?’ It means that every threat or opportunity implies the stakeholder, for whom a certain phenomenon, hard or soft technology, event or just trend development may prove to be a threat or an opportunity. Frequently, one and the same phenomenon can be a threat for one stakeholder, but an opportunity for another.

Threat or opportunity is a consequence of trend development, a meaningful consequence of technology, which can negatively or positively influence any particular subject. While filling in the card ‘threat’ or ‘opportunity’, one must identify the stakeholder affected by it.

THREAT

Title _____

Description _____

Probability > 90% 50% > 90% > 10%

Time horizon Short-term 2014 - 2016 Mid-term 2016 - 2020 Long-term 2020 - 2030

Relevant item

Author _____

OPPORTUNITY

Title _____

Description _____

Probability > 90% 50% > 90% > 10%

Time horizon Short-term 2014 - 2016 Mid-term 2016 - 2020 Long-term 2020 - 2030

Comments _____

For example, ‘increasing automation’ is a threat for employees, as they can lose their jobs, but is an opportunity for producers, as this can lead to productivity growth.

Generation of threats and opportunities is stimulated by work with the list of stakeholders and cards placed on the map. In reference to every trend and every other card on the map, a participant must ask ‘How can it damage or support the given subject? What is the loss or profit of the given phenomena or the trend development for the given subject?’

The work format in this step is similar to working with other cards.

At this stage, the map becomes sufficiently filled with cards, and for participants to be able to comprehend it as a whole, the moderator conducts ‘mini-assemblages’, drawing their attention to links between objects within the same time horizon (along the vertical axis) and notable parallels between trend developments (along the horizontal axis).

In some cases, the moderator also assists participants in revealing and determining causative or thematic links between cards placed on different trends, for example, ‘cognitive education’ connecting the cards ‘distributed university’, ‘adaptive textbook’, ‘game reputation

system’, etc. Some particularly important connections are marked as lines on the map.

The key output of step 2 is the map of the future, which can be used in several ways. Please see specific cases in Appendix 3 as a map of the future sample. Steps 3 through 6 are specific to skills foresight and illustrate how the map of the future can be used.

Step 3. Identify work tasks

The map of the future compiled gives an opportunity to get an idea of the ‘future image’ of the industry. Then it is overlapped onto the product life span in the industry, which for the majority of industries appears as follows: ‘research and development’—‘production’—‘marketing and sales’—‘follow-up service’. In this step, participants are asked what changes will happen in the work tasks and workplace organisation on the short-term, mid-term and long-term horizons with regard to the changes discussed in the given components of the life-cycle.

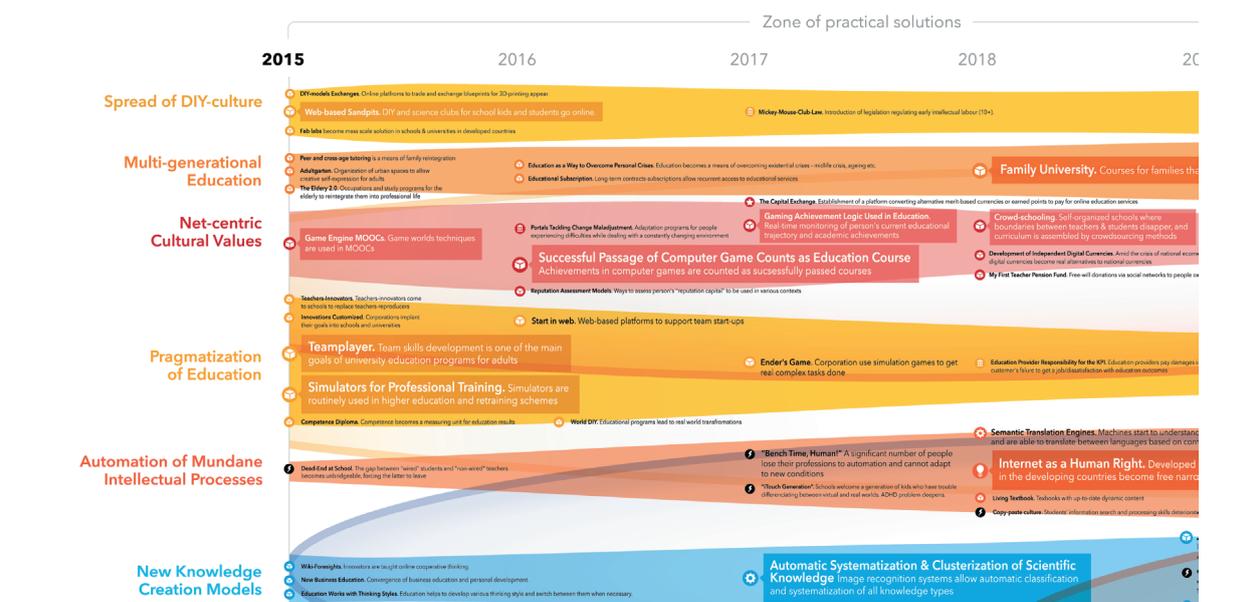
This step reveals the map of key changes in an industry’s work processes.

Based on the list of technologies that industry seeks to apply, it is possible to define the list of necessary work tasks to be performed

Example of a mini-assembled map during STF session



Example of a final presentation



by employees. Some of these work tasks will be shaped as new occupations (for example, the wider use of domestic robotics will require workers specialised in developing or operating these robots), while the majority of them will address the existing workforce, redefining the scope of their responsibility (for example, the use of genetically modified crops does not necessarily imply new occupations in the agricultural sector, but it may require existing workers to use new knowledge and different procedures to grow these crops).

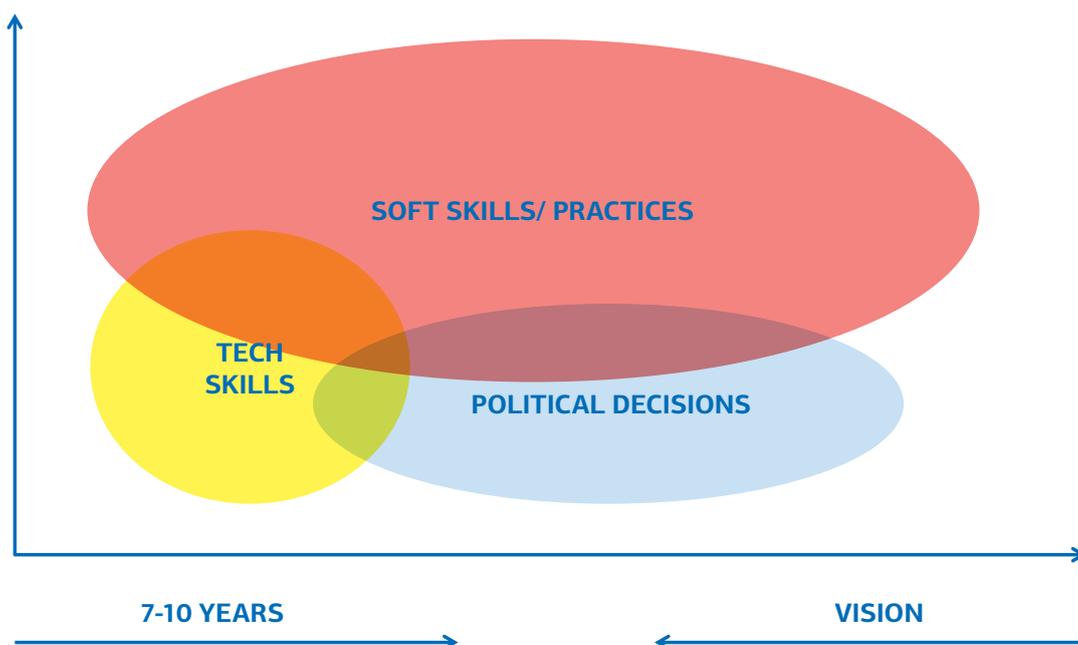
In addition, some technologies may redefine not only the individual work tasks, but affect working environment characteristics. For instance, the wider use of computers may enable electronic document management, which will require all workers to track their operations with using digital equipment, and it may also enable some workforce to work remotely.

Moreover, in some cases, working environment scenarios can redefine the individual work tasks: for example, the implementation of robotic production (cyber-physical) systems in developed industrialised countries can imply working environments that will lead to either simplification or complication of work tasks (depending on the extent to which employees will be required to control, maintain and reprogram robotic production lines).

Step 4. Discuss demand for new skills

Step 4 is focusing on discussing demand for new skills and correlating the map of new work tasks with the industry practices. The main task of this step is to estimate which work tasks can be realised via competences of the existing workers and which ones are undoubtedly new.

Figure 4. Time-horizons for a skills demand estimations.



The additional task is to estimate which competences are already present in the industry, yet obviously insufficient (for example, there may be specialists in ergonomics, but, as in the future the machine tools will require more attention to ergonomics, these specialists' competence will have to be enhanced).

Actually, at this point the industry formulates its demand for new staff, with regard to its understanding of current and future work tasks.

During this step, the group works on two horizons: up to the mid-term horizon (when we can quite reliably estimate hard technologies) to identify demand for essential technical skills; and long-term horizon, the vision about what the situation develops towards.

Making a long-term estimate of the demand for technical skills is hindered by several factors. Firstly, the growing speed of technological changes does not allow us to make reliable forecasts; secondly, political decisions have great impact on the long-term situation in the sector. At the same time, culture and organisational practices influence the long-term horizon significantly.

This leads us to the conclusion that when speaking of technical skills, groups can focus on the short- to mid-term horizon, while soft skills and practices including marketing, managerial skills, etc., would be applicable not only for short-term, but also for mid- and long-term horizons.

Step 5. Estimate of demand for new learning/training programmes

Step 5 includes estimation of demand for new training programmes and correlating of the new skills demand map with the existing training programmes.

Based on the changing work tasks and working environments, it is possible to define the skills needed for the sector. The existing skill base in the industry should be compared to the skills that are required, and the following types of skills should be identified:

- *new skills* defined by work tasks that cannot be performed with the existing skill base (for example, the use of neural implants in the medical industry requires special training of neurosurgeons and supporting specialists such as nurses);
- *obsolete tasks and related skills*: some skills in the sector can be rendered obsolete by the use of new technologies, for example, the wide use of tractors and trucks in rural Southeast Asia has made elephant transportation (and, consequently, elephant breeding) almost nonexistent. Worth saying, the phasing out of obsolete technologies occurs gradually, so the time should be taken into consideration while related skills are still necessary because older technologies are still applied. In addition, skills can be usually reused in other tasks and work areas: the fact that certain tasks become obsolete does not necessarily mean that the related skills cannot be utilised elsewhere; and
- *skills with changing scope of use*: some technologies, either hard or soft ones, may change the scope of use of certain skills, for instance, turning them from specialised into general sectoral skills (for example, the wider use of recycling and reuse practices in the industry may require that every worker in the industry is aware of, and uses, resource-conserving practices).

The main task is to determine to what extent the existing specialist training programmes are able to provide industry with newly required skills. Then, based on that, to determine what changes in the training programmes may be needed from the content viewpoint and the training formats.

Step 6. Define project initiatives

Step 6 (formulation of projects) presupposes, at its minimum, working of the group on the selected projects. The work format is a moderated discussion. Depending on the time available,

the group can be split into several subgroups to work in parallel on several project solutions. The manner, sequence, and responsible parties for change implementation is an essential part of the discussion.

Quite often, the group manages to identify knowledge and format transformation responsibility and areas of their involvement, such as state regulatory support to create a favourable environment for academic transformation and the role of business in participative learning (quality apprenticeship and relevant qualification system, clear and motivating learning path both in HE and TVET, etc.). The heterogeneous group composition mentioned above with its diverse outputs results in better outcomes, at least setting up new insightful and thought-provoking communication, creating change-targeting networks, and stimulating pilots and their future leaders.

As far as possible, depending on group capacity and work dynamics, the project is specified by determining particular implementation agents and roles to be accomplished, the project group staff and/or allies, the vision of the result of change, understanding of future preconditions, and annual, half-year and monthly action plan drafts.

Step 7. Group presentation of work results

Step 7 includes presentation of the groups and summary presentation of the organisers. An important issue is to allocate groups with necessary time to prepare sufficient but concise presentations and select a presenter among themselves. Organisers must be able to see all the presentations beforehand to prepare a summary including all the findings made by present groups. The organisers' presentation should include recommendations made as following.

Based on the identification of skills demanded, a set of recommendations can be developed for different stakeholders that can influence the provision of these skills. The most important are those for TVET and HE systems. Recommendations can be based on the analysis of gaps between skills required by the sector and educational and training programmes available among TVET and HE providers. Once the gaps are identified, it is possible to develop the programme of changes required in the curriculum design and training offer to serve the future skills needs better.

The most critical role in timely skill provision is recognised to be that of sector employ-

Table 2. Key questions for project initiatives description.

Goal of the initiative

Exact steps

- Step description
- Terms (when?)
- Leader of the step

Resources needed estimate

- Money
- Other (equipment, expertise, legislative support, etc.)

Who will provide resources?

Partners

Final result and its expected impact (includes how we monitor and evaluate the success of the project)

ers. They have the most up-to-date, practical and applicable knowledge and are the primary beneficiaries of TVET and HE systems. Leading employers can act as Knowledge Centres themselves, and also collaborate to develop joint training work-based programmes for the sector. These opportunities should be addressed during the STF session.

Policy makers can also support with less systematic, but practical support, for example, at times when skills gap cannot be closed by local providers due to lack in the education and training system itself, and the government can help train education providers internationally, or otherwise encourage the international exchange of skills.

So in cases when projects come across hindering regulatory provisions, commitment of group representatives of those bodies should be achieved.



Chapter 4. Post-Foresight Activities

Although it was mentioned above that the process of the foresight session is a significant product in itself, it is important to ensure follow-up and implementation of the results.

Verification of results

In order to validate the quality of the results of the foresight session, thorough verification of the results is needed. This verification can be made using one or more of the following:

- additional panel studies with industry experts;
- questionnaire surveys based on the foresight session results; and
- verification interviews with international experts.

Prepare a summary report of the Foresight Workshop results

Apart from the sponsor's requirement for reporting back, a summary report of key findings should be considered for participants. Even if there was not any promise to report back, many participants would like to know what happens as a result of STF, otherwise it can feel that their information disappears into a black hole.

This is also important, as the group composition envisages some professional stakeholder participants, too. Another benefit of a summary report is that it serves as a reminder and may set minds of readers in the right direction to support in any way a pilot project if it has been initiated as a result of STF.

Dissemination of the results

During the workshop, the participants emphasised the significance of the dissemination stage, which is to support adoption of new policies and new approaches by the general public. In case of an STF-based pilot project, the group members are encouraged to tap into existing networks that can influence decision makers and target users and the general audience through their credibility, expertise, and power of their distribution capacity.



Conclusion

Anticipation of future skills needs using technology foresight has high potential as an emerging policy making tool for improving labour market policy, facilitating economic modernisation and industrial development, producing quality long-term sectoral planning, promoting informed strategic social policy decisions, and tackling emerging social problems at the early stage.

The requirements suggested here result from collaboration between the Moscow School of Management SKOLKOVO and the ILO and were piloted in Armenia and Vietnam in 2014–2015 with the view of further implementation in several developing countries.

In September 24–25, 2015 in Armenia, the Moscow School of Management SKOLKOVO and the ILO gathered experts in skills anticipation from Armenia, Brazil, Germany, South Korea, and Vietnam to validate the proposed and piloted method at a workshop. The STF approach received appreciation from international experts as well as a number of comments and suggestions which were included in this version of the Skills Technology Foresight Guide.

During the workshop, experts also discussed questions regarding implementation of the STF results, dissemination of key findings made during the STF process, and monitoring and evaluation of the projects implemented.

Implementation of the STF results

Changes based on the STF results have so far developed in two logical dimensions:

- systemic level, for example, policy changes and institutions' operations change; and
- education and training programmes/projects, stemming from STF results and promoted by either an institution or a group of individuals.

It was noted that key success factors for the quality of results and their implementation include committed stakeholders interested in making changes and having the capacity; high level of participant expertise; participation of

strong sector companies having deep knowledge about the sector; sector skills council; right sector choice with potential for knowledge generation; sectoral development strategy. Nevertheless, this situation is rarely observed, and best efforts must be made to achieve it, including:

- paying attention to desk research preparation in order to obtain the best objective information before starting the process for selection of the right sector and partner;
- providing access to sustainable funding, through government or other channels;
- timely identifying and early involving stakeholders, as well as social partners. The latter should be there from the very beginning, before sessions;
- advocacy work—gathering evidence of success stories to generate interest;
- identifying the leader in the group. It must be the strongest and influential player in the sector (depending on the sector—government or employer representative); and
- taking into account a government structure as well.

Participants of the workshop agreed that there are two crucial factors for results implementation: sustainable funding and the leader role. It was discussed that STF can become not only an instrument for identifying future skills needs, but also an instrument of agile prototyping and piloting of change projects, which can then be scaled up. In this case, some funding for these projects and prototypes can be a part of the STF process.

Requirements for a potential project leader include:

- motivation—understanding why the project is important (personal cause);
- translation instruments—possess several success stories to show the benefits of the project implementation; and
- competencies to run the project and 'sell' the project's product.

The leader must understand who is the main stakeholder/customer of the change

project product, for example, a training provider, or a national human resource development authority. The proposal from the leader must leverage existing resources and attract them to follow and implement the project. Existing resources, like community or student exchange programmes, can support the programme with the required but missing knowledge and competences. At the same time, the product itself may not necessarily focus on direct changes in the system, but cause activities that affect it indirectly, improve the context, or initiate change processes.

Monitoring and evaluation

Although M&E phase is not a part of STF itself, it has crucial role in planning correct processes - a checklist for implementation of future projects. Thus, participants validating the workshop identified three main parts of the framework of monitoring and evaluation (M&E):

- object of monitoring (what is to be monitored);
- M&E implementer (who does what and why); and
- M&E approach (how it has been monitored).

When these M&E basic outlines are understood, specific and appropriate activities and indicators can then be developed to monitor key moments of change and evaluate success in effecting it.

There was a suggestion that STF can go beyond its diagnostic function and be implemented in several options, as given below:

1. STF as mere tool of Analysis and Diagnostics of new skills linked to technology;
2. STF as Diagnostics with specific recommendations and drafted pilot projects; and
3. STF as the full cycle of Diagnostics, Recommendations and Pilot Implementation.

Workshop participants discussed and agreed that in order to monitor and evaluate

the effectiveness of Skills Technology Foresight, the results of the process must be more than just diagnostics or knowledge generation with elements of capacity development. One of the results of the STF process must be specific recommendations in the form of proposed drafts or even initiated pilots with a clear resource mobilisation strategy or evidence of resources available. So, Option 2 (STF with specific recommendations and drafted pilot projects) was chosen as being a feasible and more than diagnostic tool. The results of these piloted initiatives and the change they are to bring must be realistic and measurable, like having list of demanded skills and/or real education/training programmes.

Participants agreed that it is reasonable to apply the M&E phase following the STF session in two phases:

- The first one covers evaluation of the Diagnostics phase helping to engage the right processes (addressing the right institution and right participants of the sector, identifying the role of the leader, etc.) in order to produce valid results while applying qualitative indicators. This phase is evaluated against a checklist of anticipated activities following the STF session and is relatively easy to realise, as it is embedded in the structure of the project itself. Thus, STF is finalised with drafting of a roadmap and a checklist. The roadmap itself is an outcome, but it is not a critical indicator of successful outcome—introducing a change—the goal of STF activity. The critical indicator of outcome can be the percentage of educational programmes actually realised (new skill owners with high employability), stemming from the production technology implemented (improved productivity, creation of new products or even start of innovative activities) foreseen by STF result-based researches.
- The second phase of STF M&E is more of a long-term nature and focuses on monitoring of outcomes (change realisation) and gathering evidence of the aforemen-

tioned impact to understand whether the foresight results were implemented.

In this respect, the participants discussed and outlined what is considered to be evidence of the STF Project, its impact, outcomes and results.

STF PROJECT = FORESIGHT + ACTION PLAN

RESULTS (output):

- recommendations developed;
- capacity delivered ('future' skills); and
- pilot project(s) proposed + resources mobilised.

OUTCOME: for example, skills delivered meet the technological changes.

IMPACT: for example, improved sectoral performance (production, innovation) + (unintended results beyond the sector/positive externalities).

Participants concluded that the role of the STF monitoring and evaluation can be fulfilled by different sector 'actors'. In different cases, it can be private business, or employee organisations like SENAI in Brazil, that has the capacity to monitor project impact, as it is involved in STF results implementation. Government usually has the greatest capacity for the M&E process due to its network; it can act either itself or fund capable agencies for realisation. There was also a suggestion to consider setting M&E steering committees if the sector skill councils that are generally the best fitting ones are missing.

Another point of M&E discussion was the necessity to keep inputs and outputs in a reasonable framework to avoid making M&E realisation more expensive than the whole process itself. It was emphasised that there is always data available in the market, but resources to process it or analysis are limited.

Dissemination of key findings

The group also covered the requirement on engaging a broader set of stakeholders, including the general public. To achieve greater impact

and stakeholders' acceptance, non-participating stakeholders have to be a part of the big picture, and there are existing approaches to accomplishing it.

One of them is the experience of SENAI—the National Service for Industrial Training of Brazil. The organisation represents a network of vocational training providers under the auspices of the Confederation of Industry. Using this beneficial position, SENAI applies a system of regular meetings of businesses with TVET providers, as well as various seminars to keep the results alive and articulated. An Articulation Committee is formed to support the process of changes and the responsible staff (1–2 employees) keeps the discussion alive through blogging, bulletin dissemination and other means of public outreach.

The Moscow School of Management SKOLKOVO strategy has one of its outreach systems focusing on parents, i.e., those forming the ultimate demand and making the decision on training programmes. Through the online and hard copy 'Atlas of Emerging Jobs' (<http://atlas100.ru/en>), families are kept informed about upcoming and obsolete jobs, so they can direct young people to get jobs that are more beneficial or seek advantages in pioneering a new emerging sector. This approach also helps in convincing TVET and other educational institutions that are reluctant to change in some cases to receive signals of discontent from different directions, including their customers. Thus, the general public generates a push for future skills, which results in creation of new educational programmes.

Examples of different solutions for enabling public participation are available. There is a special student website that publishes 10 jobs of the future every year in South Korea. Canada also has similar website with 100 future jobs (<http://careers2030.cst.org/>), nicely and comprehensively presented and detailed up to the required skills.

Another strategy for creating a public push is dealing with people's fear of new technology, as the one that makes their world of customary things obsolete. Germany applies serious

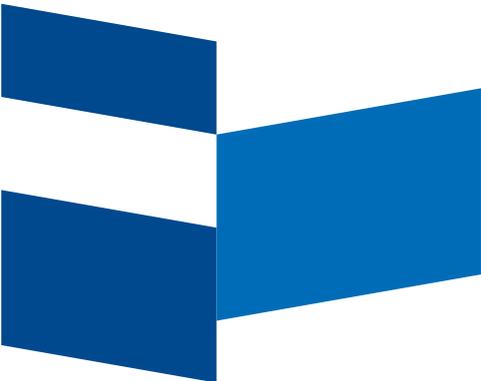
efforts in combating this fear by various public outreach activities contrasting the fears with opportunities. The Ministry of Labour and Social Affairs promotes public discussions on TV channels or live talk shows after an orientation film in cinemas with the participation of representatives of employers, trade unions and relevant agencies and media coverage.

STF is a relatively new interdisciplinary approach at the confluence of technology foresight and skills anticipation studies. The method represents a change management tool, being a vehicle for teaching (futures literacy building) and government-to-government, government-to-private sector and government-to-citizen co-operation and professional communication.

References

1. G20Pittsburgh2010SummitStatement. URL: <http://www.g20.utoronto.ca/2009/2009communique0925.html>
2. *A Skilled Workforce for Strong, Sustainable and Balanced Growth: A G20 Training Strategy*. International Labour Office. — Geneva, 2010. ISBN 978-92-2-124278-9
3. *Growth and Jobs in a Hyperconnected World. The Global Information Technology Report 2013*. World Economic Forum and INSEAD. ISBN-13: 978-92-95044-77-7
4. *G20 St. Petersburg 2013 Summit Leaders' Declaration*. URL: <http://www.g2orussia.ru/load/782795034>
5. International Labour Office (ILO). *Skills for improved productivity, employment growth and development, Report V, International Labour Conference, 97th Session, Geneva, 2008* (Geneva)
6. Loveridge Denis. 2008. *Foresight: The Art and Science of Anticipating the Future*. Routledge Miemis Venessa, Smart John and Brigis Alvis. 2012. *Open Foresight*. *Journal of Futures Studies*, September 2012, 17(1): 91–98
Waehrens Brian Vejrum, Riis Jens Ove. 2010. *Failures to enact the future—A social practice perspective*. *Futures*, 42(4): 328–336

Appendix 1. Sample Terms of Reference



Terms of reference for the analytical work ‘Review of the sector [NAME OF SECTOR] in [COUNTRY]’

1. General Provisions

Description: analytical report ‘Review of the sector [NAME OF SECTOR] in [COUNTRY]’.

- 1.1. The main purpose of the review is to provide comprehensive information about the structure, major markets, training system, R&D and innovation infrastructure for [NAME OF SECTOR] in [COUNTRY]. Analytical review will be used in the preparation of foresight sessions in [DATES], as well as one of the deliverables of foresight sessions results.

2. General Requirements

2.1. Structure, methodology and data requirements:

2.1.1. The analytical report will represent the review of [NAME OF SECTOR] in [COUNTRY].

2.1.2. The analytical review should include the following sections:

- basic information about the sector;
- the structure of the sector;
- major markets;
- related sectors;
- workforce profile;
- training system;
- public policy; and
- innovation infrastructure.

2.1.3. The methodology is selected by the contractor and agreed upon with the customer during the signing of the agreement.

2.1.4. Requirements for the data provided in the report:

- The study can be done on the basis of open public sources, analytical and research papers, and interviews with industry experts and other data.
- The sources of all information must be indicated.
- In case any information described in §2.2 cannot be provided, the contractor must provide the most recent and relevant information available.

2.2. Content requirements:

2.2.1. The section ‘Basic information about the sector’ should include analysis based on the following information:

- major trends, developments and challenges in the sector in the past ten to twenty years;
- a brief description of the major segments within the sector;
- a brief description of the major products for each segment, and an assessment of their international competitiveness (including examples of international acknowledgement such as international partnerships, awards at international fairs, etc.); and
- a description of the new (innovative) products with high market potential (assessed by sector experts).

2.2.2. The section ‘Sector structure’ should include analysis based on the following information:

- the number of companies, the most recent year available;
- market shares by type of companies (large, small and medium enterprises; public/private), the most recent year available;
- market share and volume of production (in USD) of the major players, the most recent year available;
- a brief description of the major sector players, including their product specialisation, production volume and trends;

- exports volume (in USD), the most recent year available;
 - changes in the market over the last five years (mergers and acquisitions, entry of new players, etc.);
 - the participation of foreign players and the role of FDIs in the sector—trends in last five to ten years (examples: cooperation, joint ventures, etc.); and
 - strategic development plans for the major players for the next five to ten years.
- 2.2.3. The section ‘Major markets’ should include analysis based on the following information:
- the volume of exports for the sector and segments, in USD, 1990–2012 time period;
 - the share of exports in total production, 1990–2012 time period;
 - volumes and shares of the major markets (countries), 2013; and
 - volumes and shares of the main competitors on the major markets, 2012.
- 2.2.4. The section ‘Related sectors’ should include analysis based on the following information:
- major equipment and technology suppliers of the sector (both national and international); and
 - major client companies (both national and international), including those which export the sector’s production as a part of complex products (where applicable).
- 2.2.5. The section ‘Workforce profile’ should include analysis based on the following information:
- number of people employed in the sector and its segments, 1990 — present
 - the share of sector workforce in the total working population and compared to other sectors, 1990 — present;
 - employed workforce by occupation in the sector, 1990 — present. Compare with the composition of employment by occupation in other sectors;
 - employed workforce by level of education in the sector, 1990 — present. Compare with the composition of employment by the level of educational in other sectors;
 - employed workforce by age group in the sector, 1990 — present;
 - employed workforce by gender in the sector, 1990 — present;
 - the level of real wage compared with other sectors and the national average wage, USD, trend in past five to ten years; and
 - average labour productivity (real GDP per worker) in comparison with the major competitors in export markets, 2000 — present.
- 2.2.6. The section ‘Training system’ should include analysis based on the following information:
- the number of enrolments and number of graduates in related education and training programmes by level of education (higher education, vocational, and retraining programmes), 1990 — present;
 - job placement of the graduates by level of education;
 - a brief description of educational institutions and training programmes with the highest reputation;
 - the number of graduates for educational institutions and training programmes with the highest reputation, 2000–2012 time period; and
 - major skill demand/supply/mismatch challenges in the sector.
- 2.2.7. The section ‘State policy’ should include analysis based on the following information:
- major laws, acts and regulatory bodies related to sector development; and
 - description of the state strategy and major milestones for 2012–2020 with specific emphasis on the sector.
- 2.2.8. The section ‘Innovative infrastructure’ should include analysis based on the following information:
- the total number of R&D centres, the most recent available year;
 - a brief description of the major R&D centres;

- patent registrations;
- description of existing technology parks and incubators; and
- a brief description of the key actions by the state to support innovation.

3. Deliverables

The result of the analytical review:

- A comprehensive analysis following the structure of the sector, as well as of the training system.

Requirements for the final report:

- The analytical review should conform to the structure described in the paragraph "General requirements".
- The final report should be delivered in English.

4. Timeline

Expected duration of analytical work is three weeks, but the report should be delivered no later than [DATE].



Appendix 2. Sample Agenda of STF Session

Day 1.

- 9:00 – 10:00 Opening and keynote address. Welcome by organisers and key sector representatives. Description of the goals and main stages of the foresight process
- 10:00 – 10:45 Scanning of key problems of the sector labour market
- 10:45 – 11:00 Coffee break
- 11:00 – 13:30 Skills technology foresight. Mapping of the key trends, soft and hard technologies
- 13:30 – 14:30 Lunch
- 14:30 – 15:30 Identifying top-priority routes for development of the sector
- 15:30 – 17:30 Mapping of changes in work tasks and working conditions
- 17:30 – 18:30 Group reports. Discussion of the day's results

Day 2.

- 9:00 – 9:30 Discussion of Day 1 results. Description of Day 2 tasks
- 9:30 – 10:45 Finalization of work tasks map
- 10:45 – 11:00 Coffee break
- 11:00 – 12:30 Identification of the skills demand. Mapping of the new skills, obsolete skills and skills with changing scope of use
- 12:30 – 13:30 Identification of gaps between labour market needs and the capacity of the education and training systems
- 13:30 – 14:30 Lunch
- 14:30 – 16:00 Development of recommendations for stakeholders that can influence the provision of skills needed
- 16:00 – 17:00 Closing statements. Debriefing

Day 3.

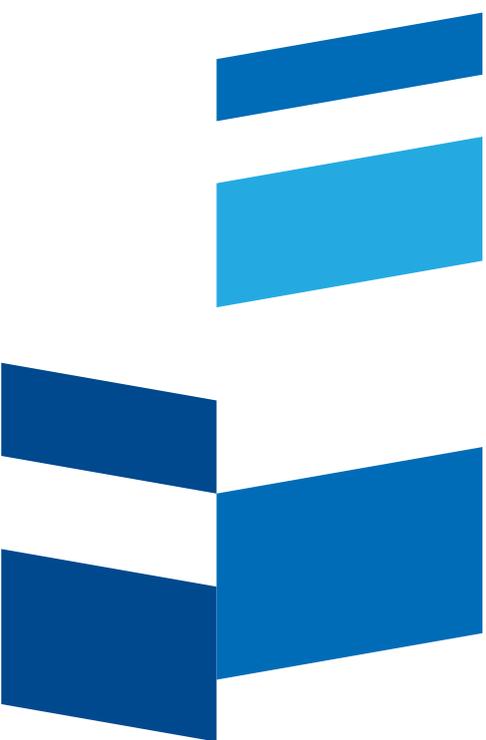
- 15:00 – 18:00 Verification session. Verification of the results of Days 1 and 2 with heads of leading sector companies and formulation of the development projects

Day 4.

- 15:00 – 18:00 Presentation to stakeholders. Discussion of the next steps and support for the development projects



Appendix 3. Sample Map of the Future



Appendix 4. Choosing Time Horizons during STF Session

Time horizons

Horizon	Short-term (approx. 2–3 yrs)	Mid-term (approx. next 3–5 yrs)	Long-term (approx. next 7–10 yrs)
Industrial planning focus	Projects and plans that are currently being executed	Strategic objectives set by industry's businesses	Long-term vision of the industry
Technological focus	Short term technology improvements (technologies entering the market through innovation or transfer)	Technologies that allow substantial gains in productivity/competitiveness (currently developed or potentially transferred)	Disruptive technologies (currently researched) that can potentially change the industry's technological base
Focus of TVET and HE changes	On-the-job training, short professional advancement courses, minor changes in TVET programmes	Main potential for improvement through changes in curriculum of HE and TVET programmes	'Direction for transformation': curriculum elements that can sustain in longer term

The skills technology foresight considers changes that may occur some time into the industry future. As we discussed above, the industry requires a certain time to respond to changing consumer and stakeholder needs through adoption of new technologies. Apart from that, the TVET and HE system requires a certain time to respond to changing skill demand, even if this demand is presented immediately. For instance, taking into account the time required to revise educational programmes, and the education cycle itself, the earliest when new technological specialists can be brought into the industry from the higher education system is between three and five years. This cycle is shorter for workers trained in TVET system (but still would be at least between two and three years). Training for specific skills, however, can be introduced on shorter time frames (for example, courses can be created even within the annual cycle if the need is pressing).

The discussion of industrial trends (and projects/plans to be implemented by key industry players), technologies that can be adopted by the industry, and changes that can be made in the TVET and HE sector to accommodate the demand for new skills, can be made across three time horizons (please see Chapter 1 for RF methodology details). Some specific attention should be paid to the long-term horizon (typically, between 7–8 and 20 years from now) where a long-term 'vision of the sector' is formed, and where certain technologies can substantially disrupt the existing industry's practices. While this horizon is too far for the TVET and HE system to be taken into consideration for specific education and training programmes, it can be used to identify the 'direction for transformation' (for example, if the sector expects to actively use digital technologies or robotics in the long term, the applicable training for engineers can be embedded into educational programmes). Table 1 lists content requirements for these three horizons in more detail.



The Moscow School of Management SKOLKOVO, one of the leading private business schools in Russia and the CIS, was founded in 2006 by members of the business community. Since then the School has educated almost 10 000 professional from Russia and abroad in its programs of MBA, EMBA, Business Practicum, Start-Up Academy and corporate programs.

The School serves as a major Russian hub of expertise in business and economy with focus on the studies of the global emerging markets. The business school operates five research centers and has five chairs, conducting research into separate business sectors.

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